CES Medline search with abstracts

(May 2006)

By Konstantine Balakatounis, PT

1) Cranial OR transcranial OR transcerebral AND electrotherapy

2) AND electric* AND stimulation –intsead of electrotherapy

3) Electrosleep

4) Electroanesthesia

Cranial OR transcranial OR transcerebral AND electrotherapy

1: J Neuropsychiatry Clin Neurosci. 2005 Fall;17(4):548-51.

Cranial electrotherapy stimulation reduces aggression in a violent retarded population: a preliminary report.

Childs A.

North Texas State Hospital-Vernon Campus, 4730 College Drive, Vernon, TX 76384, USA. allen.childs@dshs.state.tx.us

Nine aggressive, retarded patients refractory to conventional care at a maximum security hospital were given a 3-month course of cranial electrotherapy stimulation. Aggressive episodes declined 59% from baseline; seclusions were down 72%; restraints were down 58%; and use of prescribed-as-needed sedative medications decreased 53%. The most dramatic change was that of a disorganized, schizophrenic patient whose aggressive episodes declined from 62 to 9, seclusions from 53 to 8, restraints from 9 to 1 and PRNs from 25 to 1. No patients discontinued cranial electrotherapy stimulation (CES) because of side effects. This preliminary report indicates that CES appears to be an efficacious, safe, and cost-effective addition to the treatment regimen in this patient population.

Publication Types:

Clinical Trial

PMID: 16387997 [PubMed - indexed for MEDLINE]

2: South Med J. 2004 Dec;97(12):1269-70.

Cranial electrotherapy stimulation: a safe neuromedical treatment for anxiety, depression, or insomnia.

Gilula MF, Barach PR.

Publication Types:

Letter

PMID: 15646771 [PubMed - indexed for MEDLINE]

3: Can J Neurol Sci. 2004 Nov;31(4):576-84.

Giovanni Aldini: from animal electricity to human brain stimulation.

Parent A.

Centre de Recherche Universite Laval Robert-Giffard, Beauport, Quebec, Canada.

Two hundred years ago, Giovanni Aldini published a highly influential book that reported experiments in which the principles of Luigi Galvani (animal electricity) and Alessandro Volta (bimetallic electricity) were used together for the first time. Aldini was born in Bologna in 1762 and graduated in physics at the University of his native town in 1782. As nephew and assistant of Galvani, he actively participated in a series of crucial experiments with frog's muscles that led to the idea that electricity was the long-sought vital force coursing from brain to muscles. Aldini became professor of experimental physics at the University of Bologna in 1798. He traveled extensively throughout Europe, spending much time defending the concept of his discreet uncle against the incessant attacks of Volta, who did not believe in animal electricity. Aldini used Volta's bimetallic pile to apply electric current to dismembered bodies of animals and humans; these spectacular galvanic reanimation experiments made a strong and enduring impression on his contemporaries. Aldini also treated patients with personality disorders and reported complete rehabilitation following transcranial administration of electric current. Aldini's work laid the ground for the development of various forms of electrotherapy that were heavily used later in the 19th century. Even today, deep brain stimulation, a procedure currently employed to relieve patients with motor or behavioral disorders, owes much to Aldini and galvanism. In recognition of his merits, Aldini was made a knight of the Iron Crown and a councillor of state at Milan, where he died in 1834.

Publication Types:

Biography

Historical Article

Personal Name as Subject:

Aldini G

PMID: 15595271 [PubMed - indexed for MEDLINE]

4: Cochrane Database Syst Rev. 2004;(3):CD001878.

Non-invasive physical treatments for chronic/recurrent headache.

Bronfort G, Nilsson N, Haas M, Evans R, Goldsmith CH, Assendelft WJ, Bouter LM.

Wolfe-Harris Center for Clinical Studies, Northwestern Health Sciences University, 2501 W 84th St, Bloomington, MN 55431, USA. gbronfort@nwhealth.edu

BACKGROUND: Non-invasive physical treatments are often used to treat common types of chronic/recurrent headache. OBJECTIVES: To quantify and compare the magnitude of short- and long-term effects of non-invasive physical treatments for chronic/recurrent headaches. SEARCH STRATEGY: We searched the following databases from their inception to November 2002: MEDLINE, EMBASE, BIOSIS, CINAHL, Science Citation Index, Dissertation Abstracts, CENTRAL, and the Specialised Register of the Cochrane Pain, Palliative Care and Supportive Care review group. Selected complementary medicine reference systems were searched as well. We also performed citation tracking and hand searching of potentially relevant journals. SELECTION CRITERIA: We included randomized and quasi-randomized controlled trials comparing non-invasive physical treatments for chronic/recurrent headaches to any type of control. DATA COLLECTION AND ANALYSIS: Two independent reviewers abstracted trial information and scored trials for methodological quality. Outcomes data were standardized into percentage point and effect size scores wherever possible. The strength of the evidence of effectiveness was assessed using pre-specified rules. MAIN RESULTS:

Twenty-two studies with a total of 2628 patients (age 12 to 78 years) met the inclusion criteria. Five types of headache were studied: migraine, tension-type, cervicogenic, a mix of migraine and tension-type, and post-traumatic headache. Ten studies had methodological quality scores of 50 or more (out of a possible 100 points), but many limitations were identified. We were unable to pool data because of study heterogeneity.For the prophylactic treatment of migraine headache, there is evidence that spinal manipulation may be an effective treatment option with a short-term effect similar to that of a commonly used, effective drug (amitriptyline). Other possible treatment options with weaker evidence of effectiveness are pulsating electromagnetic fields and a combination of transcutaneous electrical nerve stimulation [TENS] and electrical neurotransmitter modulation.For the prophylactic treatment of chronic tension-type headache, amitriptyline is more effective than spinal manipulation during treatment. However, spinal manipulation is superior in the short term after cessation of both treatments. Other possible treatment options with weaker evidence of effectiveness are therapeutic touch; cranial electrotherapy; a combination of TENS and electrical neurotransmitter modulation; and a regimen of auto-massage, TENS, and stretching. For episodic tension-type headache, there is evidence that adding spinal manipulation to massage is not effective. For the prophylactic treatment of cervicogenic headache, there is evidence that both neck exercise (low-intensity endurance training) and spinal manipulation are effective in the short and long term when compared to no treatment. There is also evidence that spinal manipulation is effective in the short term when compared to massage or placebo spinal manipulation, and weaker evidence when compared to spinal mobilization.There is weaker evidence that spinal mobilization is more effective in the short term than cold packs in the treatment of post-traumatic headache. REVIEWERS' CONCLUSIONS: A few non-invasive physical treatments may be effective as prophylactic treatments for chronic/recurrent headaches. Based on trial results, these treatments appear to be associated with little risk of serious adverse effects. The clinical effectiveness and cost-effectiveness of non-invasive physical treatments require further research using scientifically rigorous methods. The heterogeneity of the studies included in this review means that the results of a few additional high-quality trials in the future could easily change the conclusions of our review.

Publication Types:

Review

PMID: 15266458 [PubMed - indexed for MEDLINE]

5: Clin Neurophysiol. 2001 Nov;112(11):2075-83.

Quantitative analysis of the electroencephalogram during cranial electrotherapy stimulation.

Schroeder MJ, Barr RE.

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OBJECTIVE: Normal individuals were used to quantitate electroencephalographic (EEG) changes during concurrent administration of 0.5 and 100 Hz cranial electrotherapy stimulation (CES). METHODS: Twelve normal, right-handed males were used in a randomized, double-blind crossover design study. A 3 amplifier system incorporating noise-cancellation was used to collect one channel of EEG (O1-Cz configuration) for 30 min. Either 0.5, 100 Hz, or sham CES treatment was administered for 20 min of each session. Statistical analyses were applied to time- and frequency-domain EEG variables. RESULTS: Relative to sham control, 0.5 and 100 Hz CES caused the alpha band mean frequency to shift downward.

Additionally, 100 Hz CES also caused a decrease of the alpha band median frequency and beta band power fraction. CONCLUSIONS: Both 0.5 and 100 Hz CES provide frequency distribution shifts that suggest beneficial changes in mental state. However, compared to 0.5 Hz CES, 100 Hz CES effected a greater overall change. It is suggested that similar tests be performed on individuals with various behavioral and neurological disorders to determine if comparable EEG changes can be realized and correlated with beneficial effects of CES therapy.

Publication Types:

Clinical Trial

Randomized Controlled Trial

PMID: 11682346 [PubMed - indexed for MEDLINE]

6: NeuroRehabilitation. 2000;14(2):85-94.

The use of cranial electrotherapy stimulation in the management of chronic pain: A review.

Kirsch DL, Smith RB. Chairman.

Cranial Electrotherapy Stimulation (CES) has a growing history of applications in rehabilitation medicine in the United States dating back to early 1970. As a recognized non-drug treatment of anxiety, depression and insomnia, CES gained its first major application in the field of addiction treatment and rehabilitation. By the mid 1980s research was showing additional important uses of CES in the treatment of closed head injured patients, and in paraplegic and quadriplegic patients. The most recent research is showing CES to be highly effective in the management of chronic pain patients. It may be elevating the pain threshold due to its stress reducing effects when anxiety and depression are reduced below clinical levels. Modern theorists of a pain neuromatrix in the cerebral

cortex may provide an additional basis for understanding CES mechanisms in the control of pain related disorders.

PMID: 11455071 [PubMed - as supplied by publisher]

7: Presse Med. 1999 Dec 11;28(39):2197-203. [Electricity in pain management] [Article in French]

Limoge A.

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AVAILABLE TECHNIQUES: For more than thirty years there has been a revival of electrotherapy in the treatment of pain. Analgesia by electrical current is now based on transcutaneous or percutaneous nerve stimulation, deep stimulation, posterior spinal cords stimulation, and transcutaneous cranial stimulation.

EFFICACY: It is now scientifically proven that electrostimulation of certain peripheral fibers and of different structures of the central nervous system plays an undeniable role in filtration and control of painful messages. However, precise indications are a prerequisite. Transcutaneous electrical nerve stimulation is only effective if it acts on neurogenic pain, only if the nerve pathways to be stimulated are superficial, and only if the conduction pathways between the area of stimulation and the superior centers are intact.

Neurosurgical electrostimulation techniques should only be proposed after failure of simple therapies. INDICATIONS: For acute pain, electrostimulation of certain intracerebral structures and transcutaneous cranial electrostimulation may be indicated. Clinicians have a multitude of electrostimulators at their disposal but generally, the parameters recommended for their use have no serious scientific basis. The selected electrical neurostimulator must provide effective nerve stimulation without causing lesions. Electrostimulation could be considered as an adjunct to medicinal treatment for pain relief.

PMID: 10629701 [PubMed - indexed for MEDLINE]

8: Gen Dent. 1999 Jan-Feb;47(1):50-5.

Cranial electrotherapy stimulation (CES): a safe and effective low cost means of anxiety control in a dental practice.

Winick RL. www.info@reiddds.com

A double-blind placebo-controlled study was performed on 33 randomly selected dental patients to evaluate whether cranial electrotherapy stimulation (CES) is a viable procedure for reducing anxiety during routine dental procedures. The active CES treatment group was significantly less anxious than the placebo group at the conclusion of various dental procedures.

Publication Types:

Clinical Trial

Randomized Controlled Trial

PMID: 10321152 [PubMed - indexed for MEDLINE]

9: Vopr Kurortol Fizioter Lech Fiz Kult. 1999 Jan-Feb;(1):15-8.

[The correction of the cardiovascular system changes in patients with the spastic form of infantile cerebral palsy in the chronic residual stage by means of mesodiencephalic modulation]

[Article in Russian]

Epifanov VA, Korableva NN, Zhuravleva NV.

Transcranial electrotherapy--mesodiencephalic modulation on the basis of activation of the central regulatory structures induced by weak impulse current--proved effective in relief of clinical symptoms and mitral prolapse, correction of conduction, automatism, contractility, vegetative unbalance due to normalization of the sympathetic and parasympathetic components of the autonomic nervous system.

PMID: 10224935 [PubMed - indexed for MEDLINE]

10: Vopr Kurortol Fizioter Lech Fiz Kult. 1998 Sep-Oct;(5):27-9.

[The use of transcranial electrotherapy in the rehabilitation of osteoarthrosis patients]

[Article in Russian]

Komarova LA, Kir'ianova VV, Zabolotnykh II, Zabolotnykh VA.

Rehabilitation of 39 patients with osteoarthrosis deformans (OD) consisted of transcranial electrostimulation (TCES) which was performed by means of Transair unit generating impulse current (77 Hz, frontal-retroauricular electrodes position). There was a positive trend in clinical indices, pain intensity, skin temperature. TCES mechanism of action involves stimulation of endorphine brain structures which elevates blood levels of beta-endorphines.

PMID: 9889716 [PubMed - indexed for MEDLINE]

11: Vopr Kurortol Fizioter Lech Fiz Kult. 1997 May-Jun;(3):8-13.

[The effect of transcerebral electrical impulse exposures on regional hemodynamics after the surgical treatment of uterine myoma]

[Article in Russian]

Strugatskii VM, Landekhovskii IuD, Arslanian KN, Omarova MR, Burenko BN, Shekhtman MM, Azabekian AB, Medvedev MB.

After surgical treatment of uterine myoma 28 patients with cardiovascular diseases experienced disturbances of cerebral, upper limb and small pelvis circulation. The course of transcerebral

electrotherapy (short bipolar nonsymmetrical impulses with large amplitude of the negative part) relieved the symptoms as a results of better cerebral and upper limb hemodynamics.

PMID: 9334063 [PubMed - indexed for MEDLINE]

12: IEEE Trans Biomed Eng. 1996 Sep;43(9):939-43.

Potential and current density distributions of cranial electrotherapy stimulation (CES) in a four-concentric-spheres model.

Ferdjallah M, Bostick FX Jr, Barr RE.

Electrical Engineering Department, University of Texas at Austin 78712, USA.

Cranial electrotherapy stimulation (CES) has been successfully used for treatment of many psychiatric diseases. Its noninvasive nature is its major advantage over other forms of treatments such as drugs. It is postulated that the low electric current of CES causes the release of neurotransmitters.

However, the current pathways have not been extensively investigated. In the following paper, analytical and numerical methods are used to determine the distribution of potential and current density in a four zone concentric spheres model of the human head when excited by two electrodes diametrically opposite to each other. Because of the azimuthal symmetry, which is assumed in this study, a two-dimensional (2- D) finite difference approximation is derived in the spherical grid. The current density distribution is projected around the center of the model, where the thalamus is modeled as a concentric sphere. All dimensions and electrical properties of the model are adapted from clinical data. Results of this simulation indicate that, in contrast to previous beliefs, a small fraction of the CES current does reaches the thalamic area and may facilitate the release of neurotransmitters.

PMID: 9214809 [PubMed - indexed for MEDLINE]

13: Brain Inj. 1994 May-Jun;8(4):357-61.

The use of cranial electrotherapy stimulation in the treatment of closed-head-injured patients.

Smith RB, Tiberi A, Marshall J.

Science and Clinical Services, MedTec 2000, Inc, Fort Worth, Texas.

This double-blind study sought to discover if cranial electrotherapy stimulation (CES), which is a known treatment of depression, anxiety and insomnia in non-head-injured patients, could be an effective, drug-free treatment of stress-related symptoms in the closed-head-injured (CHI) patient. In this study 10 CHI patients treated for 45 min daily, 4 days a week for 3 weeks, responded significantly on all negative mood factors of the Profile Of Mood States, while five sham-treated and six placebo controls did not. While the majority of the patients were known seizure cases, no patient suffered a seizure during CES therapy. No placebo effects were found, nor were any negative effects from CES treatment seen.

Publication Types:

Clinical Trial

Randomized Controlled Trial

PMID: 8081350 [PubMed - indexed for MEDLINE]

14: Brain Inj. 1993 Mar-Apr;7(2):179-81.

Fifteen-cycle cranial electrotherapy stimulation for spasticity.

Childs A.

Health Care Rehabilitation Center, Austin, TX 78745.

Severe post-anoxic spasticity in a 25-year-old female was significantly improved during an open trial of 15 cycle per second CES. The bipolar LISS device with suboccipital electrode placement was used for 40 minutes three times a day. A synergism appeared when dantrolene 50 mg twice a day was combined with the CES, these additive effects being greater than either modality used alone.

Publication Types:

Case Reports

PMID: 8453415 [PubMed - indexed for MEDLINE]

15: Acta Belg Med Phys. 1990 Apr-Jun;13(2):45-51.

[Peripheral facial paralysis. Experience of a multidisciplinary approach]

[Article in French]

Lemaitre D, Fondu J, Fonteyn B, Biset E.

Centre de Readaptation Fonctionnelle et de Rhumatologie, Hopital de Jolimont.

The authors report the evolution of 54 patients suffering from complete paralysis of the seventh cranial nerve. They point out the interest of a good diagnose and a multidisciplinary treatment including: drugs, infiltration, kinesitherapy and electrotherapy. A good repair (77%) is obtained if the treatment is early and regular. This therapy will be used according the results of clinical and electrophysiological examinations.

PMID: 2239012 [PubMed - indexed for MEDLINE]

16: Headache. 1989 Jul;29(7):445-50.

Safety and effectiveness of cranial electrotherapy in the treatment of tension headache.

Solomon S, Elkind A, Freitag F, Gallagher RM, Moore K, Swerdlow B, Malkin S.

One hundred patients were enrolled in a multicenter double-blind study to evaluate the safety and effectiveness of the Pain Suppressor Unit, a cranial electrotherapy stimulator for the symptomatic treatment of tension headaches.

Treatment consisted of extremely low level, high frequency current applied transcranially. Pain scores before and after 20 minute treatments of individual headaches as well as patient and physician global evaluations were the primary efficacy variables. Following use of the active unit, patients reported an average reduction in pain intensity of approximately 35%. Placebo patients reported a reduction of approximately 18%. The difference was statistically significant ($p = 0.01$). The active unit was rated as moderately or highly effective in 40% by physicians, and in 36% by patients. Both physicians and patients scored the placebo unit moderately or highly effective for only 16%.

The difference in ordered outcomes was statistically significant ($p = 0.004$).

Approximately 10% of patients in each group reported at least one minor adverse experience. Cranial electrotherapy stimulation is distinct from TENS, and is safe and often effective in ameliorating the pain intensity of tension headaches. It should be considered as an alternative to the chronic usage of analgesics.

Publication Types:

Clinical Trial

Controlled Clinical Trial

Multicenter Study

PMID: 2668227 [PubMed - indexed for MEDLINE]

17: Brain Inj. 1988 Jul-Sep;2(3):243-7.

The use of cranial electrotherapy stimulation in post-traumatic amnesia: a report of two cases.

Childs A, Crismon ML.

College of Pharmacy, University of Texas, Austin 78712.

Publication Types:

Case Reports

PMID: 3262394 [PubMed - indexed for MEDLINE]

18: Alcohol Clin Exp Res. 1986 Mar-Apr;10(2):158-60.

Cranial electrotherapy stimulation as a treatment for anxiety in chemically dependent persons.

Schmitt R, Capo T, Boyd E.

Cranial electrotherapy stimulation (CES) is reported to be an effective treatment for anxiety, a major presenting symptom among chemically dependent patients. In this study, 40 inpatient alcohol and/or polydrug users were given CES or sham CES in a double blind design. An additional 20 patients served as normal hospital routine controls. Dependent measures of anxiety were the Profile of Mood States, the Institute for Personality and Ability Testing Anxiety Scale, and the State/Trait Anxiety Index. CES-treated patients showed significantly greater improvement on all anxiety measures than did either control group. There were no differences in response between older and younger patients, or between the primarily drug or alcohol abusers. No placebo effect was found on any of our measures. It is concluded tht CES is a clinically significant addition to the treatment regimen for this patient population.

Publication Types:

Clinical Trial

Controlled Clinical Trial

PMID: 3521373 [PubMed - indexed for MEDLINE]

19: J Clin Psychiatry. 1984 Feb;45(2):60-1, 62-3.

Cranial electrotherapy stimulation treatment of cognitive brain dysfunction in chemical dependence.

Schmitt R, Capo T, Frazier H, Boren D.

Several studies have shown that cranial electrotherapy stimulation (CES) is useful in treating brain dysfunction associated with alcoholism. A double-blind study replicated the latest of these findings

in 60 inpatients and extended them by treating individuals with alcoholism and other chemical dependencies.

Treatment effects were assessed on three subscales of the WAIS that are clinical indicators of organic brain syndrome. No placebo effect was found. CES appears to be a valuable adjunct to rehabilitation programs for addicted persons and can effect changes in areas not addressed by other treatment modalities.

Publication Types:

Clinical Trial

Randomized Controlled Trial

PMID: 6363398 [PubMed - indexed for MEDLINE]

20: Inf Dent. 1982 Nov 18;64(40):3955-9.

[Significance of transcerebral electrotherapy (Limoge current) in opiate withdrawal of drug addicts]

[Article in French]

Daulouede JP, Daubech JF, Tignol J, Bourgeois M.

PMID: 6984845 [PubMed - indexed for MEDLINE]

21: J Nerv Ment Dis. 1982 May;170(5):275-8.

Confirming evidence of an effective treatment for brain dysfunction in alcoholic patients.

Smith RB.

In earlier studies we found that cranial electrotherapy stimulation (CES) was associated with significant improvement in several areas of brain dysfunction commonly found in alcoholic persons. In this study we compared the effects of CES among treatment and control groups on each of the six subscales of the Revised Beta Examination (Lindner, R. M., and Curvitz, M. Revised Beta Examination, Psychological Corp., New York, 1957) and found CES related to significant improvement on the two subscales which are below the norms in alcoholic patients and which have been correlated with other measures of brain dysfunction. It is concluded that CES can be an important therapeutic strategy in reducing to weeks the time required for recovery of several reversible brain dysfunctions in alcoholic persons which usually require months or years of abstinence.

PMID: 7069414 [PubMed - indexed for MEDLINE]

22: Gastroenterology. 1975 Aug;69(2):359-63.

Inhibition of gastric acid secretion in man by the transcranial application of lwo intensity pulsed current.

Kotter GS, Henschel EO, Hogan WJ, Kalbfleisch JH.

This study was conducted to determine the effectiveness of transcranial electrotherapy (TCE) in reducing gastric secretion in man. TCE has been proposed as a therapeutic modality which induces a relaxed psychological state by the application of low intensity diffuse electrical current and has been purported by Soviet investigators to be beneficial in the treatment of peptic ulcers. Secretion rates were monitored in adult male volunteers by a method of intragastric titration utilizing a pH-sensitive telemetry capsule. In one study 5 subjects had their basal secretion rates monitored before, during, and after the application of TCE at graduated current intensities. A threshold of inhibition was observed for currents of 0.9 ma and greater. In a second study, 12 subjects had histamine-stimulated maximum acid output determined for control and during TCE application. Gastric acid secretion was reduced by an average of 30% when 1-ma TCE was applied, with individual reductions ranging from 5.7% to 53.2%. Since the application of relatively high TCE currents may produce discomfort in some subjects, a third study was conducted to determine whether the inhibition might not merely be the result of nonspecific noxious stimuli. For this study the electrical connections to the TCE electrodes were altered so that the same uncomfortable sensation was produced on the forehead, but no current was actually applied transcranially. This "placebo" TCE produced no reduction in the maximal acid output of 6 volunteers, but when the currents were applied transcranially, the gastric acid secretion was reduced by an average of 27% below control values.

Publication Types:

Clinical Trial

PMID: 1097298 [PubMed - indexed for MEDLINE]

23: Dis Nerv Syst. 1971 Feb;32(2):100-4.

Medical and psychiatric use of electrosleep. Transcerebral electrotherapy.

Koegler RR, Hicks SM, Barger JH.

PMID: 5313321 [PubMed - indexed for MEDLINE]

24: Med Trial Tech Q. 1969 Mar;15(3):63-9.

Transcerebral electrotherapy in cerebral vascular accidents.

Feldman L.

PMID: 5304992 [PubMed - indexed for MEDLINE]

25: Trans Am Neurol Assoc. 1952;56(77th Meeting):245-7.

Transcerebral electrotherapy and pharmacotherapy in the treatment of Little's disease.

MENDEZ M.

PMID: 13038846 [PubMed - OLDMEDLINE for Pre1966]

26: Rass Studi Psichiatr. 1950 Sep-Dec;39(5-6):742-9.

[Transcerebral electrotherapy of low intensity.]

[Article in Undetermined Language]

RIBOLI B.

PMID: 14808637 [PubMed - OLDMEDLINE for Pre1966]

+ Electric* AND stimulation

1: Clin Neurophysiol. 2006 Apr 25; [Epub ahead of print]

Predicted current densities in the brain during transcranial electrical stimulation.

Holdefer RN, Sadleir R, Russell MJ.

Active Diagnostics, Inc. Davis, CA 95616, USA.

OBJECTIVE: We sought an electrical modeling approach to evaluate the potential application of finite element method (FEM) modeling to predict current pathways and intensities in the brain after transcranial electrical stimulation. METHODS: A single coronal MRI section through the head, including motor cortex, was modeled using FEM. White matter compartments with both anatomically realistic anisotropies in resistivity and with a homogeneous resistivity were modeled. Current densities in the brain were predicted for electrode sites on the scalp and after theoretical application of a conductive head restraint device. RESULTS: Localized current densities were predicted for the model with white matter anisotropies. Differences in predicted peak current densities were related to location of stimulation sites relative to deep sulci in the brain and scalp shunting that was predicted to increase with inter-electrode proximity. A conductive head restraint device was predicted to shunt current away from the brain when a constant current source was used. CONCLUSIONS: The complex geometry of different tissue compartments in the head and their contrasting resistivities may jointly determine the strength and location of current densities in thebrain after transcranial stimulation. This might be predictable with FEM incorporating white matter anisotropies. Conductive head restraint devices during surgery may be contraindicated with constant current stimulation. SIGNIFICANCE: Individually optimized tcMEP monitoring and localized transcranial activation in the brain might be possible through FEM modeling.

PMID: 16644273 [PubMed - as supplied by publisher]

2: J Neurosurg Anesthesiol. 2006 Apr;18(2):106-11.

The effects of volatile anesthetics on intraoperative monitoring of myogenic motor-evoked potentials to transcranial electrical stimulation and on partial neuromuscular blockade during propofol/fentanyl/nitrous oxide anesthesia in humans.

Sekimoto K, Nishikawa K, Ishizeki J, Kubo K, Saito S, Goto F.

Department of Anesthesiology, Gunma University Graduate School of Medicine,

3-39-22 Showa-machi, Maebashi City 3718511, Japan.

The aim of the present study was to compare the influence of volatile anesthetics on transcranial motor-evoked potentials (tcMEP) in humans anesthetized with propofol/fentanyl/nitrous oxide and on partial neuromuscular blockade (NMB). The authors studied 35 ASA I and II patients who were undergoing elective craniotomy and brain tumor resection. The patients were randomized to one of three groups to receive halothane (HAL), isoflurane (ISO), or sevoflurane (SEV). Anesthetic depth was initially adjusted using the bispectral index to 40+/-5, and NMB was adjusted to 40%-50% of one twitch of train of four (T1) after recovery from intubation. MEPs with train of five square-wave pulses were elicited using screw electrodes placed in the skull over C3-C4. After craniotomy, the inhalational agent was introduced at 0.5 MAC and then 1.0 MAC (20 minutes each), and the effects on MEPs, NMB, and hemodynamic variables were studied. A decrease in BIS and systolic blood pressure was observed with all agents. Both SEV and ISO at 1.0 MAC significantly decreased train-of-four ratio from 38.4+/-18.1 at control to 19.0+/-9.7 and from 35.3+/-12.4 to 26.1+/-13.7, respectively ($P<0.001$), but not HAL at 1.0 MAC. The amplitudes of tcMEPs were significantly reduced by all agents at 1.0 MAC, with the effect being less in HAL at 0.5 MAC. We have shown that HAL had a lesser

suppressive effect on MEPs than either ISO or SEV at 0.5 MAC, which was partially due to a lesser degree of NMB.

PMID: 16628063 [PubMed - in process]

3: Anesteziol Reanimatol. 2005 Nov-Dec;(6):9-11.

[Transcranial electrical stimulation in the treatment of toxicohypoxic encephalopathy at the early stage of inpatient rehabilitation]

[Article in Russian]

Krasil'nikov AM, Gol'dfarb IuS, Lapshin VP, Shipilov IV, Lezhenina NF, Sukhodolova GN, Epifanova NM, Kukshina AA, Badalian AV.

The authors studied the time course of clinical and neuropsychological changes in the use of transcranial mesodiencephalic modulation in the complex treatment of patients with acute poisoning by neurotropic toxicants, which were complicated by toxicohypoxic encephalopathy. The findings suggest the beneficial impact of this technique on the autonomic functions of the brain stem, on the body's adaptive capacities and the psychoemotional sphere, which makes it possible to recommend the programmed use of this method in such patients.

PMID: 16499097 [PubMed - indexed for MEDLINE]

4: Clin Neurophysiol. 2005 Dec;116(12):2748-56. Epub 2005 Oct 26.

Transcranial magnetic and electrical stimulation compared: does TES activate intracortical neuronal circuits?

Brocke J, Irlbacher K, Hauptmann B, Voss M, Brandt SA.

Department of Neurology, Berlin NeuroImaging Center, Charite, Germany.

OBJECTIVE: To determine whether, and under which conditions, transcranial electrical stimulation (TES) and transcranial magnetic stimulation (TMS) can activate similar neuronal structures of the human motor cortex, as indicated by electromyographic recordings. METHODS: Focal TMS was performed on three subjects inducing a postero-anterior directed current (p-a), TES with postero-anteriorly (p-a) and latero-medially (l-m) oriented electrodes. We analyzed the onset latencies and amplitudes (single-pulse) and intracortical inhibition and excitation (paired-pulse). RESULTS: TMS p-a and TES p-a produced muscle responses with the same onset latency, while TES l- m led to 1.4-1.9 ms shorter latencies. Paired-pulse TMS p-a and TES p-a induced inhibition at short inter-stimulus intervals (ISI) (maximum: 2-3 ms) and facilitation at longer ISIs (maximum: 10 ms). No inhibition but a strong facilitation was obtained from paired-pulse TES l-m (ISIs 1-5 ms). CONCLUSIONS: Our findings support the hypothesis, that current direction is the most relevant factor in determining the mode of activation for both TMS and TES: TMS p-a and TES p-a are likely to activate the corticospinal neurons indirectly. In contrast, TES l-m may preferentially activate the corticospinal fibres directly, distant of the neuronal body. SIGNIFICANCE: TES is a suitable tool to induce intracortical inhibition and excitation.

PMID: 16256428 [PubMed - indexed for MEDLINE]

5: Am J Vet Res. 2005 Aug;66(8):1364-70.

Comparisons of the effects of acupuncture, electroacupuncture, and transcutaneous cranial electrical stimulation on the minimum alveolar concentration of isoflurane in dogs.

Culp LB, Skarda RT, Muir WW 3rd.

Department of Veterinary Clinical Sciences, College of Veterinary Medicine, The Ohio State University, Columbus, OH 43210, USA.

OBJECTIVE: To compare the effects of acupuncture (AP), electroacupuncture (EA), and transcutaneous cranial electrical stimulation (TCES) with high-frequency intermittent currents on the minimum alveolar concentration (MAC) of isoflurane and associated cardiovascular variables in dogs. ANIMALS: 8 healthy adult female Beagles. PROCEDURE: Each dog was anesthetized with isoflurane on 4 occasions, allowing a minimum of 10 days between experiments. Isoflurane MAC values were determined for each dog without treatment (controls) and after treatment with AP and EA (AP points included the Large Intestine 4, Lung 7, Governing Vessel 20, Governing Vessel 14, San Tai, and Baihui) and TCES. Isoflurane MAC values were determined by use of noxious electrical buccal stimulation. Heart rate, mean arterial blood pressure (MAP), arterial blood oxygen saturation (Spo2) measured by use of pulse oximetry, esophageal body temperature, inspired and expired end-tidal isoflurane concentrations, end-tidal carbon dioxide concentration, and bispectral index (BIS) were monitored. Blood samples were collected for determination of plasma cortisol concentration. RESULTS: Mean +/- SD baseline MAC of isoflurane was 1.19 +/- 0.1%. Acupuncture did not significantly change MAC of isoflurane. Treatments with EA and TCES significantly lowered the MAC of isoflurane by 10.1% and 13.4%, respectively. The Spo2, heart rate, MAP, BIS, esophageal body temperature, and plasma cortisol concentration were not significantly different after AP, EA, TCES, and control treatments at any time interval. CONCLUSIONS AND CLINICAL RELEVANCE: Use of EA and TCES decreased MAC of isoflurane in dogs without inducing adverse hemodynamic effects. However, the reduction in isoflurane MAC by EA andTCES treatments was not considered clinically relevant.

Publication Types:

Clinical Trial

Randomized Controlled Trial

PMID: 16173479 [PubMed - indexed for MEDLINE]

6: J Neurosci Methods. 2005 Dec 15;149(2):164-71. Epub 2005 Jul 18.

Mechanomyographic response to transcranial magnetic stimulation from biceps brachii and during transcutaneous electrical nerve stimulation on extensor carpi radialis.

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Transcranial magnetic stimulation (TMS) elicits short latency excitatory responses in the target muscles, termed motor evoked potential (MEP). When TMS is delivered during a voluntary contraction, the MEP is followed by a period of silence called silent period (SP). These MEP parameters are in general recordable by electromyography (EMG). Mechanomyography (MMG) on the other hand is the mechanical counterpart of EMG. Thus, this study has been conducted to observe whether the MEP parameters from MMG signals showed similar trait of EMG recordings. Five normal healthy male subjects were included in this study. The subjects were required to perform right biceps brachii muscles contraction at diverse graded of load level at 5, 10, 20, 30, 40, 60, and 100% maximum voluntary contraction (MVC). MEPs by single pulse TMS on left hemisphere were obtained from both EMG electrode and MMG accelerometer at rest and at different levels of predetermined load level. MEP amplitude and area obtained both from EMG and MMG record were increased with the increase of muscle contraction with a maximum of 60% MVC. With increasing the level of contraction there was a shortening of onset latency and decreasing in the length of silent period in both EMG and MMG signals. We also recorded the EMG- and MMG-MEP from the right extensor carpi radialis muscle during transcutaneous electric nerve stimulation in order to observe neural changes in sensory stimulation from both EMG and MMG responses. The EMG-MEP was not visible in electrical artifact whereas it was obvious in MMG responses. In accordance with other study, this study showed that the voluntary contraction of biceps brachii muscle influenced the MEP parameter which are moreover obtainable by MMG even in electrical noise may provide insight for future study.

PMID: 16026847 [PubMed - indexed for MEDLINE]

7: Clin Neurophysiol. 2005 Sep;116(9):2051-7.

Diagnostic relevance of transcranial magnetic and electric stimulation of the facial nerve in the management of facial palsy.

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OBJECTIVE: Earlier investigations have suggested that isolated conduction block of the facial nerve to transcranial magnetic stimulation early in the disorder represents a very sensitive and potentially specific finding in Bell's palsy differentiating the disease from other etiologies. METHODS: Stimulation of the facial nerve was performed electrically at the stylomastoid foramen and magnetically at the labyrinthine segment of the Fallopian channel within 3 days from symptom onset in 65 patients with Bell's palsy, five patients with Zoster oticus, one patient with neuroborreliosis and one patient with nuclear facial nerve palsy due to multiple sclerosis. RESULTS: Absence or decreased amplitudes of muscle responses to early transcranial magnetic stimulation was not specific for Bell's palsy, but also evident in all cases of Zoster oticus and in the case of neuroborreliosis. Amplitudes of electrically evoked muscle responses were more markedly reduced in Zoster oticus as compared to Bell's palsy, most likely due to a more severe degree of axonal degeneration. The degree of amplitude reduction of the muscle response to electrical stimulation reliably correlated with the severity of facial palsy. CONCLUSIONS: Transcranial magnetic stimulation in the early diagnosis of Bell's palsy is less specific than previously thought. While not specific with respect to the etiology of facial palsy, transcranial magnetic stimulation seems capable of localizing the site of lesion within the Fallopian channel. SIGNIFICANCE: Combined with transcranial magnetic stimulation, early electrical stimulation of the facial nerve at the stylomastoid foramen may help to establish correct diagnosis and prognosis.

Publication Types:

Clinical Trial

PMID: 16024292 [PubMed - indexed for MEDLINE]

8: J Vet Med Sci. 2005 Apr;67(4):433-6.

The effects of transcranial electrical stimulation on anaesthesia and analgesia in rats.

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In this study, we determined the effects of transcranial electrical stimulation (TCES) on the anaesthetic requirements of thiopental and the analgesic requirements of remifentanil, in rats. The experiments were performed on 120 albino male Wistar rats, which were randomly allocated to four groups (n=30). (Thiopental, Thiopental+TCES, Thiopental+Remifentanil, and Thiopental+Remifentanil+TCES). Animals were anaesthetized with thiopental, and 15 min later, remifentanil was injected to rats in the Remifentanil groups. TCES was started in the stimulated groups 20 min after thiopental administration. Rats were stimulated 5 times for this experiment. The times for recovery, herein called Cognition Recovery Time and Motion Recovery Time were measured. Cognition Recovery and Motion Recovery Times were not affected by the stimulation. Analgesia was assessed using the wet tail-flick latency (TFL). In the Thiopental group, the analgesia level returned to control values on the 35th min. In the Thiopental+Remifentanil group, the analgesia level returned to control values on the 50th min. In the Thiopental+ TCES group, the analgesia level reached the peak value on the 65th min. In the Thiopental+Remifentanil+TCES group, the analgesia level reached the peak value on the 35th min and analgesia remained high during the 90 min after cessation of the stimulation. The analgesic potency for the Thiopental+Remifentanil+TCES group was increased by 30-40% when compared with the prior TFL values, 160% when compared with the control group, and 50-75% when compared with Thiopental+TCES group on the 35th min ($P<0.001$). In conclusion, TCES markedly decreases the anaesthetic and analgesic requirements for thiopental and remifentanil in rats.

PMID: 15876795 [PubMed - indexed for MEDLINE]

9: Anesthesiology. 2005 Apr;102(4):733-8.

Tetanic stimulation of the peripheral nerve before transcranial electrical stimulation can enlarge amplitudes of myogenic motor evoked potentials during general anesthesia with neuromuscular blockade.

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BACKGROUND: Neuromuscular blockade can suppress myogenic motor evoked potentials (MEPs). The authors hypothesized that tetanic stimulation (TS) of the peripheral nerve before transcranial stimulation may enhance myogenic MEPs during neuromuscular blockade. In the current study, the

authors evaluated MEP augmentations by TS at different levels of duration, posttetanic interval, neuromuscular blockade, and stimulus intensity. METHODS: Thirty-two patients undergoing propofol-fentanyl-nitrous oxide anesthesia were examined. Train-of-five stimulation was delivered to C3-C4, and MEPs were recorded from the abductor hallucis muscle. In study 1, TS with a duration of 1, 3, or 5 s was delivered at 50 Hz to the tibial nerve 1, 3, or 5 s (interval) before transcranial stimulation, and the effects of TS on MEP amplitude were evaluated. In study 2, TS-induced MEP augmentations were evaluated at the neuromuscular blockade level (%T1) of 50% or 5%. In study 3, MEP augmentations by TS at stimulus intensities of 0, 5, 25, and 50 mA were evaluated. RESULTS: The application of TS significantly enlarged the amplitudes of MEPs at the combinations of duration (3, 5 s) and interval (1, 3, 5 s) compared with those without TS. TS-induced MEP augmentations were similarly observed at %T1 of both 50% and 5%. TS-induced MEP augmentations were observed at stimulus intensities of 25 and 50 mA. CONCLUSIONS: The results indicate that TS of the peripheral nerve before transcranial stimulation can enlarge the amplitude of MEPs during general anesthesia with neuromuscular blockade. TS of the peripheral nerve can be intraoperatively applied as a method to augment myogenic MEP responses.

PMID: 15791101 [PubMed - indexed for MEDLINE]

10: Clin Neurophysiol. 2005 Mar;116(3):588-96.

Intraoperative facial motor evoked potential monitoring with transcranial electrical stimulation during skull base surgery.

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OBJECTIVE: To address the limitations of standard electromyography (EMG) facial nerve monitoring techniques by exploring the novel application of multi-pulse transcranial electrical stimulation (mpTES) to myogenic facial motor evoked potential (MEP) monitoring. METHODS: In 76 patients undergoing skull base surgery, mpTES was delivered through electrodes 1cm anterior to C1 and C2 (M1-M2), C3 and C4 (M3-M4) or C3 or C4 and Cz (M3/M4-Mz), with the anode contralateral to the operative side. Facial MEPs were monitored from the orbicularis oris muscle on the operative side. Distal facial nerve excitation was excluded by the absence of single pulse responses and by onset latency consistent with a central origin. RESULTS: M3/M4-Mz mpTES (n=50) reliably produced facial MEPs while M1-M2 (n=18) or M3-M4 (n=8) stimulation produced 6 technical failures. Facial MEPs could be successfully monitored in 21 of 22 patients whose proximal facial nerves were inaccessible to direct stimulation. Using 50, 35 and 0% of baseline amplitude criteria, significant facial deficits were predicted with a sensitivity/specificity of 1.00/0.88, 0.91/0.97 and 0.64/1.00, respectively. CONCLUSIONS: Facial MEPs can provide an ongoing surgeon-independent assessment of facial nerve function and predict facial nerve outcome with sufficiently useful accuracy. SIGNIFICANCE: This method substantially improves facial nerve monitoring during skull base surgery.

Publication Types:

Clinical Trial

PMID: 15721072 [PubMed - indexed for MEDLINE]

11: Ross Fiziol Zh Im I M Sechenova. 2004 Nov;90(11):1426-9.

[Transcranial electrical stimulation normalizes the blood glucose level in alloxan-induced diabetic rats]

[Article in Russian]

Lebedev VP, Bilichenko SV, Malygin AV, Nechiporenko SP, Kolbasov SE, Melikhova MV.

PMID: 15646211 [PubMed - indexed for MEDLINE]

12: Pain Res Manag. 2004 Winter;9(4):203-6.

The effects of transcranial electrical stimulation on opiate-induced analgesia in rats.

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BACKGROUND AND OBJECTIVES: Recent experiments have shown that transcranial electrical stimulation significantly increases the potency and duration of the analgesic effects of opioids in humans and rats. In the present study, the influence of transcranial electrical stimulation (TCES) on the analgesic effect of remifentanil hydrochloride (HCl) in rats was determined. METHODS: Experiments were performed on 80 albino male Wistar rats. Rats were randomly assigned to four groups: remifentanil HCl, remifentanil HCl and TCES, TCES, and control (n=20/group). Remifentanil HCl was injected on the 55th minute. Analgesia was assessed using the wet tail-flick latency test. RESULTS: In the remifentanil HCl group, analgesia (10.85+/-1.04 s) was reached at the fifth minute, and the analgesia was high for the first 10 min. In the remifentanil HCl and TCES group, the latency time peaked (16.60+/-1.19 s) at the fifth minute. This peak was 150% higher than that for the remifentanil HCl group, and 251% higher than the control or TCES groups. Analgesia in the remifentanil HCl and TCES group was sustained for 20 min at a statistically higher rate than the other treatment groups ($P<0.001$). CONCLUSIONS: TCES markedly increased the duration and analgesic potency of remifentanil HCl in rats. This effect appeared to be related to the release of enkephalins from brain structures, thus enhancing opioid analgesia.

PMID: 15605134 [PubMed - indexed for MEDLINE]

13: Comput Biol Med. 2005 Feb;35(2):133-55.

Transcranial electric stimulation of motor pathways: a theoretical analysis.

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The response to transcranial electrical stimulation of the brain is an important means of assessing motor pathways in the anesthetized patient. The purposes of this study were to elucidate the pattern of axonal excitation produced by transcranial stimulation and to demonstrate how this pattern is affected by changes in the conductivity or geometry of the skull-CSF-brain complex. To this end,

analytic solutions to the problem of electrodes placed on a three shell spherical model were obtained under constant current conditions. The potentials, currents and fields generated were computed and the "activating function" was computed for an idealized set of radially organized axons in order to estimate the degree of membrane depolarization produced by stimulation. The degree to which electromagnetic/radiation effects change these solutions was also estimated. The pattern of stimulation was only slightly dependent on the conductivity and the thickness of the CSF layer. Axons very close to the anode were stimulated with lowest threshold at the brain surface. Axons further away were stimulated with higher thresholds and the point of maximum stimulation moved nearer the center of the sphere. Near the cathode, stimulation was maximal about 5-7 degrees away from the edge of the electrode but the peak magnitude of the activating function was generally 20 times lower than over the anode.

PMID: 15567183 [PubMed - indexed for MEDLINE]

14: Br J Pharmacol. 2004 Nov;143(6):697-704. Epub 2004 Oct 25.

Erratum in: Br J Pharmacol. 2004 Dec;143(8):1074-5.

Inhibitory effect of BIBN4096BS on cephalic vasodilatation induced by CGRP ortranscranial electrical stimulation in the rat.

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Calcitonin gene-related peptide (CGRP) is believed to play a pivotal role in the pathogenesis of migraine via activation of CGRP receptors in the trigeminovascular system. The CGRP receptor antagonist, BIBN4096BS, has proven efficacy in the acute treatment of migraine attacks and represents a new therapeutic principle. We used an improved closed cranial window model to measure changes of the middle meningeal artery (MMA) and cortical pial artery/arteriole diameter (PA) and changes in local cortical cerebral blood flow (LCBF(Flux)) in anaesthetised artificially ventilated rats. The ability of BIBN4096BS (i.v.) to prevent the vasodilatatory actions of rat-alphaCGRP, betaCGRP and endogenously released CGRP following transcranial electrical stimulation (TES) was investigated. BIBN4096BS was per se without vasoactive effect on any of the measured variables and significantly inhibited the hypotension induced by both types of CGRP ($P < 0.001$). The alphaCGRP induced MMA dilatation was reduced from 97.4 +/- 14 to 2.1 +/- 1.3% ($P < 0.001$) and the betaCGRP induced dilatation was fully blocked by BIBN4096BS. ID(50) was 5.4 +/- 1.6 microg kg(-1) for alphaCGRP and 16.3 +/- 1.6 microg kg(-1) for betaCGRP. Transcranial electrical stimulation induced a 119.1 +/- 6.9% increase in MMA diameter. BIBN4096BS (333 microg kg(-1)) attenuated this increase (19.8 +/- 2.1%) ($P < 0.001$). Systemic CGRP and TES induced an increase in PA diameter that was not significantly inhibited by BIBN4096BS. The CGRP induced increase in LCBF(Flux) was similar not prevented by the antagonist. We suggest that systemic BIBN4096BS exerts its inhibitory action mainly on large dural blood vessels (MMA). British Journal of Pharmacology (2004).

PMID: 15504760 [PubMed - indexed for MEDLINE]

15: Spine. 2004 Oct 1;29(19):2153-7.

Transcranial electrical stimulation as predictor of elicitation of intraoperative muscle-evoked potentials.

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STUDY DESIGN: Preoperative electrophysiological and neurologic findings from patients with cervical myelopathy were evaluated statistically to determine their predictive value relative to the success of eliciting intraoperative motor-evoked potentials. OBJECTIVES: To determine which preoperative variables accurately predicted the success of eliciting an intraoperative muscle-evoked potential. SUMMARY OF BACKGROUND DATA: Motor-evoked potential recorded from the muscles after transcranial electrical stimulation is one of the most widely used methods for intraoperative spinal cord monitoring. However, motor-evoked potentials recorded from lower limb muscles are not detectable in patients with severe cervical myelopathy. Therefore, it is helpful to know the probability of the intraoperative transcranial electrical stimulation-motor evoked potential elicitation before the operation. METHODS: There were 38 patients with cervical myelopathy. Before the operation, motor-evoked potentials following transcranial magnetic stimulation were recorded from the flexor hallucis brevis, and central motor conduction times were measured. Neurologic function was evaluated using the Japanese Orthopedic Association score. During the operation, transcranial electrical stimulation-motor evoked potential from the flexor hallucis brevis was recorded. The Japanese Orthopedic Association score, threshold intensity of magnetic stimulation, and central motor conduction times were statistically evaluated for their potential of being predictors. RESULTS: The intraoperative transcranial electrical stimulation-motor evoked potential was detectable in all cases in which the preoperative transcranial magnetic stimulation-motor evoked potential was elicited by a lower intensity than 50% of the maximum output of the stimulator. Therefore, simultaneous use of other methods of monitoring should be considered in such cases that need higher output. However, the Japanese Orthopedic Association score or central motor conduction times were not useful criteria. CONCLUSIONS.: The threshold intensity of the preoperative transcranial magnetic stimulation-motor evoked potential was helpful in predicting elicitation of the intraoperative transcranial electrical stimulation-motor evoked potential.

PMID: 15454708 [PubMed - indexed for MEDLINE]

16: Med Biol Eng Comput. 2004 Jul;42(4):557-61.

Influence of electrode impedance on threshold voltage for transcranial electrical stimulation in motor evoked potential monitoring.

Journee HL, Polak HE, de Kleuver M.

Institute for Spine Surgery & Applied Research, Sint Maartens Kliniek, Nijmegen, The Netherlands. h.l.journee@nchir.azg.nl Motor potentials evoked by transcranial electrical stimulation (TES) are used for monitoring the motor pathways, with emphasis on the spinal cord and brainstem. The stimulus voltage threshold is the voltage below which no motor response can be elicited. It has frequently been used as a monitoring parameter. However, its value can be limited, because it is affected by the impedance of the stimulus electrode. For example, the voltage threshold can change owing to formation of oedema of the scalp. The relationship between the TES voltage threshold and the electrode impedance of different electrode types was studied and discussed in the context of neuromonitoring: 323 impedance and voltage threshold pairs were studied, and TES was performed with disc cup EEG electrodes (six), corkscrew electrodes (type I: seven, type II: eight), multiple EEG needle electrodes (16) and a large needle electrode Cz' (anode) together with a ground strip over the

forehead (cathode) (286). The study found the voltage threshold to be strongly dependent on electrode impedance when the impedance was higher than 460 omega (correlation: R2=0.87; p < 0.001). Below 460 omega, which included 91% of the category with the largest electrode surfaces, 25% of the multiple EEG electrodes and 75% of type II corkscrew electrodes, no significant correlation (R2=0.0064; p=0.15) was found. It was concluded that the correlation between the TES voltage threshold and electrode impedance can be markedly reduced by using TES electrodes with large contact surfaces, resulting in limit values for these parameters. This also may improve the reliability of TES motor evoked potential monitoring.

PMID: 15320467 [PubMed - indexed for MEDLINE]

17: Clin Neurophysiol. 2004 Jul;115(7):1689-96.

Subclinical cranial nerve involvement in hereditary motor and sensory neuropathy: a combined conduction study with electrical and magnetic stimulation.

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OBJECTIVE: To evaluate the electrophysiological findings of clinically unaffected cranial nerves (facial, accessory and hypoglossal nerves) in hereditary motor and sensory neuropathy (HMSN). METHODS: The conduction times of the facial, accessory, and hypoglossal nerves in 10 patients with HMSN type I (HMSN I), 2 patients with HMSN Type II (HMSN II), and 20 normal controls were determined. The extra-and intracranial segments of the cranial nerves were stimulated electrically and magnetically, respectively. The relationships between the conduction parameters of the cranial nerves and limb nerves were analyzed. RESULTS: In patients with HMSN I, the conduction times of the distal and proximal segments were significantly prolonged in all 3 cranial nerves. A positive correlation was found between the conduction parameters of the cranial nerves and the limb nerves. CONCLUSIONS: Electrophysiological involvement of the whole segment of the facial, accessory and hypoglossal nerves is common in patients with HMSN I without clinical signs of alterations. The degree of conduction slowing of the facial, accessory, and hypoglossal nerves paralleled that of limb nerves.

PMID: 15203071 [PubMed - indexed for MEDLINE]

18: Exp Brain Res. 2004 Mar;155(1):48-55. Epub 2003 Nov 22.

Comparison of motor effects following subcortical electrical stimulation through electrodes in the globus pallidus internus and cortical transcranial magnetic stimulation.

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Current concepts of transcranial magnetic stimulation (TMS) over the primary motor cortex are still under debate as to whether inhibitory motor effects are exclusively of cortical origin. To further elucidate a potential subcortical influence on motor effects, we combined TMS and unilateral

subcortical electrical stimulation (SES) of the corticospinal tract. SES was performed through implanted depth electrodes in eight patients treated with deep brain stimulation (DBS) for severe dystonia. Chronaxie, conduction velocity (CV) of the stimulated fibres and poststimulus time histograms of single motor unit recordings were calculated to provide evidence of an activation of large diameter myelinated fibres by SES. Excitatory and inhibitory motor effects recorded bilaterally from the first dorsal interosseus muscle were measured after SES and focal TMS of the motor cortex. This allowed us to compare motor effects of subcortical (direct) and cortical (mainly indirect) activation of corticospinal neurons. SES activated a fast conducting monosynaptic pathway to the alpha motoneuron. Motor responses elicited by SES had significantly shorter onset latency and shorter duration of the contralateral silent period compared to TMS induced motor effects. Spinal excitability as assessed by H-reflex was significantly reduced during the silent period after SES. No ipsilateral motor effects could be elicited by SES while TMS was followed by an ipsilateral inhibition. The results suggest that SES activated the corticospinal neurons at the level of the internal capsule. Comparison of SES and TMS induced motor effects reveals that the first part of the TMS induced contralateral silent period should be of spinal origin while its later part is due to cortical inhibitory mechanisms. Furthermore, the present results suggest that the ipsilateral inhibition is predominantly mediated via transcallosal pathways.

PMID: 15064884 [PubMed - indexed for MEDLINE]

19: Med Biol Eng Comput. 2004 Jan;42(1):110-3.

Improved neuromonitoring during spinal surgery using double-train transcranial electrical stimulation.

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Motor evoked potentials (MEPs) evoked by transcranial electrical stimulation (TES) have become an important technique for monitoring spinal cord function intra-operatively, but can fail in some patients. A new technique of double-train stimulation is described. A multipulse transcranial electrical stimulus is preceded by a preconditioning pulse train that leads to larger MEP responses. An MEP monitoring system was adapted for double-train transcranial stimulation (DTS). MEP responses from 160 anterior tibial muscles obtained by double-train stimulation were analysed. All patients received propofol/remifentanil/O2/N2O anaesthesia. Fifty-two (83%) out of 63 single-train tibial MEPs with response amplitudes below 100 microV were magnified to over 100 microV, with an inter-train (inter-stimulus) interval ITI = 10-35 ms. These 63 amplitudes were magnified by an overall logarithmic mean factor of 15.5. For 97 MEPs with amplitudes above 100 microV, the logarithmic mean facilitation factor was 2.4. It was concluded that double-train TES stimulation can markedly facilitate responses to a single stimulus train (STS). The facilitation appears to be most effective when the responses to STS would otherwise be small or absent. This preconditioning stimulation technique is therefore useful when an STS leads to responses that are too small for effective monitoring.

PMID: 14977231 [PubMed - indexed for MEDLINE]

20: J Neurosurg. 2004 Jan;100(1):155-60.

Comment in: J Neurosurg. 2004 Sep;101(3):563-4; author reply 564.

Transcranial electrical stimulation through screw electrodes for intraoperative monitoring of motor evoked potentials. Technical note.

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The feasibility of high-frequency transcranial electrical stimulation (TES) through screw electrodes placed in the skull was investigated for use in intraoperative monitoring of the motor pathways in patients who are in a state of general anesthesia during cerebral and spinal operations. Motor evoked potentials (MEPs) were elicited by TES with a train of five square-wave pulses (duration 400 microsec, intensity < or = 200 mA, frequency 500 Hz) delivered through metal screw electrodes placed in the outer table of the skull over the primary motor cortex in 42 patients. Myogenic MEPs to anodal stimulation were recorded from the abductor pollicis brevis (APB) and tibialis anterior (TA) muscles. The mean threshold stimulation intensity was 48 +/- 17 mA for the APB muscles, and 112 +/- 35 mA for the TA muscles. The electrodes were firmly fixed at the site and were not dislodged by surgical manipulation throughout the operation. No adverse reactions attributable to the TES were observed. Passing current through the screw electrodes stimulates the motor cortex more effectively than conventional methods of TES. The method is safe and inexpensive, and it is convenient for intraoperative monitoring of motor pathways.

Publication Types:

Clinical Trial

PMID: 14743930 [PubMed - indexed for MEDLINE]

21: Mo Med. 2003 May-Jun;100(3):262-5.

Repetitive vs. single transcranial electrical stimulation for intraoperative monitoring of motor conduction in spine surgery.

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We studied the effectiveness of single and repetitive transcranial electrical stimulation to activate motor tracts under partial neuromuscular blockade and total intravenous anesthesia. During spinal surgery, in 10 patients, the latency and amplitude of the evoked abductor pollicis brevis muscle response after cortical stimulation was calculated and compared. The number of responses evoked by the double (pair) pulse stimulation was significantly higher ($p = 0.0191$) than single pulse stimulation. Repetitive stimulation caused more responses than single ($p = 0.0001$) or double stimulation ($p = 0.0253$). An increase of interstimulus interval from 1-3 msec did not significantly increase the motor response with the double pulse or repetitive stimulations. Varying the number of electrical pulses per train stimulation from 3-9 did not significantly change latency ($P > 0.05$) or amplitude ($P > 0.05$) of the motor response. The findings suggest that use of repetitive stimulation of the motor cortex is an effective method to activate motor pathway during spinal surgery.

PMID: 12847868 [PubMed - indexed for MEDLINE]

22: Spinal Cord. 2003 Feb;41(2):109-17.

The amelioration of the suffering associated with spinal cord injury with subperception transcranial electrical stimulation.

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STUDY DESIGN: Double blind, partial crossover. OBJECTIVES: To evaluate the analgesic activity of a novel cranial electrostimulus in people with spinal cord injury (SCI). SETTING: Hereward College, a residential centre that provides educational facilities for students with disabilities. METHODS: Subjects with SCI experiencing chronic pain were randomly assigned into two groups, one of which received sham and the other transcranial electrostimulation treatment (TCET) on two occasions daily for four successive days. After a 'wash-out' period of 8 weeks all subjects returned and received the identical stimulus that the treated cohort received on the first arm of the study. RESULTS: Pain measurements applied before and after each session indicated that the pain decreased in the treated group to 51% of that reported at the commencement of treatment; reported pain intensity did not decrease significantly in the sham treated subjects. The same (sham) subject group reported experiencing 59% of the pain at the end of the second arm of the study (TCET) as on the first arm (sham). No significant differences were determined between the mood of all subjects estimated before and after each sham or TCET treatment session. The reported analgesic, and combined antidepressant and anxiolytic drug use in subjects receiving TCET on the second arm of the study, was 46% and 53% respectively of the average pre-study drug use. No similar decrease in the use of the drugs was noted in the same subjects after sham treatment on the first arm of the study. Salivary cortisol determinations made prior to and after each sham and treatment session implicated this corticoid in the pain-relieving mode of action of the treatment, but could not be associated with any changes in mood. Subjects receiving TCET had significantly higher urinary 3-methoxy-4-hydroxy-phenylglycol (MHPG) output after the TCET treatment period than sham stimulation, implicating increased central noradrenaline (NA) metabolism in the observed effects. CONCLUSION: The subjects reported less pain during, and immediately after receiving this transcranial treatment, although they were using less medication than when receiving sham treatment.

Publication Types:

Clinical Trial Randomized Controlled Trial

PMID: 12595874 [PubMed - indexed for MEDLINE]

23: J Clin Monit Comput. 2002 Jul;17(5):301-8.

Monitoring of motor evoked potentials with high intensity repetitive transcranial electrical stimulation during spinal surgery.

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OBJECTIVE: Clinical utility of high voltage repetitive transcranial electrical stimulation (TES) was investigated in 46 patients undergoing spine surgery.

METHODS: During spinal surgery, motor evoked potentials (MEPs) were recorded from upper or lower limb muscles following high voltage repetitive TES of motor cortex under propofol and opioid/N2O anesthesia. RESULTS: The number of responses evoked by the double pulse stimulation was significantly higher than the single pulse stimulation. A similar finding was obtained when repetitive and single pulse stimulation was compared. Compound muscle action potentials (CMAPs) were recorded from upper and lower limbs in 4 patients with cervical spine myclopathy. The CMAP was absent on the affected side in 1 patient, which improved slightly after decompression. Radiculopathy was clinically present in 6 patients undergoing posterior lumbar decompression and fusion. No improvement of MEP was noted intraoperatively after spinal decompression and instrumentation. CONCLUSION: The findings suggest that intraoperative MEP monitoring is feasible method, however, its immediate prognostic value for adequacy of neuronal decompression and improvement requires further studies with larger patient population.

Publication Types:

Case Reports

PMID: 12546263 [PubMed - indexed for MEDLINE]

24: Ross Fiziol Zh Im I M Sechenova. 2002 Aug;88(8):977-82.

[Effect of transcranial electric stimulation on the adaptation state]

[Article in Russian]

Markina LD, Kratinova EA.

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The influence of transcranial electrostimulation was studied in medical students considering their adaptation response type (training, activation, stress), reactivity level, psycho-physiological and vegetative status. The transcranial electrostimulation was effective in subjects with the adaptation response involving training and activation, and had no effect when stress was combined with vagotonic prevalence. The transcranial electrostimulation assists to improvement of the students' psycho-physiological indexes and to increase of their reactivity level.

PMID: 12503443 [PubMed - indexed for MEDLINE]

25: J Clin Neurophysiol. 2002 Oct;19(5):416-29.

Safety of intraoperative transcranial electrical stimulation motor evoked potential monitoring.

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This article reviews intraoperative transcranial electrical stimulation (TES) motor evoked potential (MEP) monitoring safety based on comparison with other clinical and experimental brain stimulation methods and clinical experience in more than 15000 cases. Comparative analysis indicates that brain damage and kindling are highly unlikely. There have been remarkably few adverse events. Pulse train TES-induced or coincidental seizures (n = 5) are rare, probably because of very brief (<0.03 second)

stimuli, anesthesia, and the general absence of predisposing cerebral conditions. Soft bite blocks may prevent tongue or lip laceration (n = 29) or mandibular fracture (n = 1). Rare cardiac arrhythmia (n = 5) and intraoperative awareness (n = 1) may be coincidental. Minor scalp burns (n = 2) are rare. Although possible, no spinal epidural recording electrode complications or injuries resulting from TES-induced movement were found. There have been no recognized adverse neuropsychological effects, headaches, or endocrine disturbances. Comprehensive relative contraindications include epilepsy, cortical lesions, convexity skull defects, raised intracranial pressure, cardiac disease, proconvulsant medications or anesthetics, intracranial electrodes, vascular clips or shunts, and cardiac pacemakers or other implanted biomedical devices. Otherwise unexplained intraoperative seizures and possibly arrhythmias are indications to abort TES. With appropriate precautions in expert hands, the well-established benefits of TES MEP monitoring decidedly outweigh the associated risks.

Publication Types:

Review

PMID: 12477987 [PubMed - indexed for MEDLINE]

26: J Comp Neurol. 2002 Dec 16;454(3):350-60.

Glial cell line-derived neurotrophic factor and chronic electrical stimulation prevent VIII cranial nerve degeneration following denervation.

Kanzaki S, Stover T, Kawamoto K, Prieskorn DM, Altschuler RA, Miller JM, Raphael Y.

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As with other cranial nerves and many CNS neurons, primary auditory neurons degenerate as a consequence of loss of input from their target cells, the inner hair cells (IHCs). Electrical stimulation (ES) of spiral ganglion cells (SGCs) has been shown to enhance their survival. Glial cell line-derived neurotrophic factor (GDNF) has also been shown to increase survival of SGCs following IHC loss. In this study, the combined effects of the GDNF transgene delivered by adenoviral vectors (Ad-GDNF) and ES were tested on SGCs after first eliminating the IHCs. Animal groups received Ad-GDNF or ES or both. Ad-GDNF was inoculated into the cochlea of guinea pigs after deafening, to overexpress human GDNF. ES-treated animals were implanted with a cochlear implant electrode and chronically stimulated. A third group of animals received both Ad-GDNF and ES (GDNF/ES). Electrically evoked auditory brainstem responses were recorded from ES-treated animals at the start and end of the stimulation period. Animals were sacrificed 43 days after deafening and their ears prepared for evaluation of IHC survival and SGC counts. Treated ears exhibited significantly greater SGC survival than nontreated ears. The GDNF/ES combination provided significantly better preservation of SGC density than either treatment alone. Insofar as ES parameters were optimized for maximal protection (saturated effect), the further augmentation of the protection by GDNF suggests that the mechanisms of GDNF- and ES-mediated SGC protection are, at least in part, independent. We suggest that GDNF/ES combined treatment in cochlear implant recipients will improve auditory perception. These findings may have implications for the prevention and treatment of other neurodegenerative processes.

PMID: 12442325 [PubMed - indexed for MEDLINE]

27: Spine. 2002 Nov 1;27(21):E454-9.

Intraoperative monitoring of myogenic motor-evoked potentials from the external anal sphincter muscle to transcranial electrical stimulation.

Inoue S, Kawaguchi M, Takashi S, Kakimoto M, Sakamoto T, Kitaguchi K, Furuya H, Morimoto T, Sakaki T.

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STUDY DESIGN: Motor-evoked potentials from the external anal sphincter were analyzed using transcranial electrical stimulation during spinal surgery in patients under general anesthesia. OBJECTIVE: To investigate whether motor-evoked potentials from the external anal sphincter could be elicited by transcranial electrical stimulation under general anesthesia. SUMMARY OF BACKGROUND DATA: Lumbosacral surgery often places nerve rootlets at risk for injury during operative dissection. Specifically, injury for sacral rootlets can result in bowel and bladder dysfunction, but the techniques for monitoring bowel and bladder function are limited. METHODS: Thirty patients who underwent elective spinal surgery were studied. Patients were anesthetized with 50% nitrous oxide in oxygen, fentanyl, and 4 mg/kg/h of propofol (n = 19) or 1 mg/kg/h of ketamine (n = 11). The level of neuromuscular blockade, assessed by recording the —response from the right abductor pollicis brevis muscle, was maintained at an —response amplitude of 40-50% of control. Motor-evoked potentials in response to a multipulse transcranial electrical stimulation at stimulus sites of C3-C4 or Fz-Cz were recorded from the skin over the subcutaneous part of the external anal sphincter using a plug-type electrode probe. The success rate of motor-evoked potentials' recording and peak-to-peak amplitude and the onset latency of motor-evoked potentials were evaluated. RESULTS: Success rates of motor-evoked potentials from the external anal sphincter were 73% and 53% after transcranial stimulation at stimulus sites of C3-C4 and Cz-Fz, respectively. Amplitudes of motor-evoked potentials after C3-C4 stimulation were significantly greater than those after Cz-Fz stimulation. Motor-evoked potential latency from the external anal sphincter was 18.6 +/- 1.5 and 19.0 +/- 2.7 msec after C3-C4 and Cz-Fz stimulation, respectively. CONCLUSIONS: The results suggest that, using a transcranial multipulse stimulation, monitoring of motor-evoked potentials from the external anal sphincter is feasible during ketamine- and propofol-based anesthesia. However, further improvement of techniques would be required for intraoperative elicitation of motor-evoked potentials from the external anal sphincter.

Publication Types:

Clinical Trial

PMID: 12438996 [PubMed - indexed for MEDLINE]

28: Clin Neurophysiol. 2002 Oct;113(10):1532-5.

Comment in: Clin Neurophysiol. 2003 Dec;114(12):2497-8.

Transcranial electrical stimulation: significance of fast versus slow charge delivery for intra-operative monitoring.

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OBJECTIVES: Motor-evoked potentials (MEP) for intra-operative monitoring due to fast charge (fc: 1.0 Coulomb/s) and slow charge (sc: 0.1Coulomb/s) delivery for multipulse transcranial electrical stimulation (TES) were compared.METHODS: MEPs due to fc (n=162) and sc stimulation (n=182) were performed in parallel in a prospective study. The fc stimulation technique is characterized by an increased steepness of charge delivery with consequent reduction of stimulus duration of 50 micros compared to 500 micros in sc stimulation. Stimulation charges ©=Coulomb) and MEP parameters during spine surgery were analyzed.RESULTS: MEPs were successfully recorded in 15/18 patients under total intravenous anesthesia. The mean charge to induce intra-operative MEPs (stimulation threshold) was significantly less in fc (0.195 mC) as compared to sc stimulation (0.298 mC). With both stimulation techniques, in all patients without impairment of motor function, MEPs could be recorded and no technique was superior with respect to successful stimulation. The mean MEP latencies, amplitudes and the extent of intra-individual variation of MEP parameters during surgery (shift of latency less than 10%, variability of amplitude less than 50%) were not different with both stimulation techniques.CONCLUSIONS: TES with either fc or sc stimulation can be used reliably for intraoperative monitoring. Fc and sc stimulation are comparable with respect to feasibility, intra-individual variability and mean parameters of MEP responses. However, fc stimulation provides a higher stimulation efficiency and requires about 35% less total charge for MEP monitoring.

Publication Types:

Clinical Trial

Controlled Clinical Trial

PMID: 12350428 [PubMed - indexed for MEDLINE]

29: Med Biol Eng Comput. 2002 Jul;40(4):395-401.

Modelling the response of scalp sensory receptors to transcranial electrical stimulation.

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Transcranial electrical stimulation of the brain causes considerable discomfort to the patient. The purpose of the study was to find out whether this could be affected by the choice of stimulation parameters. A spherical volume conductor model of the head and active compartmental models of a pyramidal motor nerve and scalp nociceptor were used in combination to simulate the scalp nociception to transcranial electrical stimulation. Scalp nociceptors were excited at distances of several centimetres from the electrodes. The size of the excited scalp area correlated with the length of the stimulation pulse. The area was 12.3, 20.4 and 26.0 cm2, for a 10 micros, 100 micros and 1 ms constant current pulse, respectively. With a 100 micros constant current pulse, the threshold for motor excitation was 205mA and, for nociception, it was 51 mA. There was no significant difference between constant current and capacitor discharge pulses or between electrodes of different sizes. The results imply that the use of very short stimulation pulses can reduce the pain. If a topical anaesthesia is used to reduce the pain, it has to be applied on a large area around the electrodes.

PMID: 12227625 [PubMed - indexed for MEDLINE]

30: J Neurosurg Anesthesiol. 2002 Jul;14(3):213-7.

Amplitudes and intrapatient variability of myogenic motor evoked potentials to transcranial electrical stimulation during ketamine/N2O- and propofol/N2O-based anesthesia.

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The aim of the current study was to investigate whether there are differences in amplitudes and intrapatient variability of motor evoked potentials to five pulses of transcranial electrical stimulation between ketamine/N2O- and propofol/N2O-based anesthesia. Patients in the propofol group (n = 13) and the ketamine group (n = 13) were anesthetized with 50% N2O in oxygen, fentanyl, and 4 mg/kg/hr of propofol or 1 mg/kg/hr of ketamine, respectively. The level of neuromuscular blockade was maintained at an —response amplitude of approximately 50% of control. Motor evoked potentials in response to multipulse transcranial electrical stimulation were recorded from the right adductor pollicis brevis muscle, and peak-to-peak amplitude and onset latency of motor evoked potentials were evaluated. To estimate intrapatient variability, the coefficient of variation (standard deviation/mean x 100%) of 24 consecutive responses was determined. Motor evoked potential amplitudes in the ketamine group were significantly larger than in the propofol group (mean, 10th-90th percentile: 380 microV, 129-953 microV; 135 microV, 38-658 microV, respectively; P <.05). There were no significant differences in motor evoked potential latency (mean +/- standard deviation: 20.9 +/- 2.2 msec and 21.4 +/- 2.2 msec, respectively) and coefficient of variation of amplitudes (median [range]: 32% [22-42%] and 26% [18-41%], respectively) and latencies (mean +/- standard deviation: 2.1 +/- 0.7% and 2.1 +/- 0.7%, respectively) between the ketamine and propofol groups. In conclusion, intrapatient variability of motor evoked potentials to multipulse transcranial stimulation is similar between ketamine/N2O- and propofol/N2O-based anesthesia, although motor evoked potential amplitudes are lower during propofol/N2O-based anesthesia than ketamine/N2O-based anesthesia.

Publication Types:

Clinical Trial

PMID: 12172294 [PubMed - indexed for MEDLINE]

31: J Physiol. 2002 Jun 15;541(Pt 3):949-58.

Interaction of transcranial magnetic stimulation and electrical transmastoid stimulation in human subjects.

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Transcranial magnetic stimulation activates corticospinal neurones directly and transsynaptically and hence, activates motoneurones and results in a response in the muscle. Transmastoid stimulation results in a similar muscle response through activation of axons in the spinal cord. This study was designed to determine whether the two stimuli activate the same descending axons. Responses to transcranial magnetic stimuli paired with electrical transmastoid stimuli were examined in biceps

brachii in human subjects. Twelve interstimulus intervals (ISIs) from -6 ms (magnet before transmastoid) to 5 ms were investigated. When responses to the individual stimuli were set at 10-15 % of the maximal — wave, responses to the paired stimuli were larger than expected at ISIs of -6 and -5 ms but were reduced in size at ISIs of -2 to 1 ms and at 3 to 5 ms. With individual responses of 3-5 % of maximal —wave, facilitation still occurred at ISIs of -6 and -5 ms and depression of the paired response at ISIs of 0, 1, 4 and 5 ms. The interaction of the response to transmastoid stimulation with the multiple descending volleys elicited by magnetic stimulation of the cortex is complex. However, depression of the response to the paired stimuli at short ISIs is consistent with an occlusive interaction in which an antidromic volley evoked by the transmastoid stimulus collides with and annihilates descending action potentials evoked by the transcranial magnetic stimulus. Thus, it is consistent with the two stimuli activating some of the same corticospinal axons.

Publication Types:

Clinical Trial

PMID: 12068053 [PubMed - indexed for MEDLINE]

32: Muscle Nerve. 2002 Feb;25(2):230-5.

Analysis of motor pathway involvement in konzo using transcranial electrical and magnetic stimulation.

Tshala-Katumbay D, Eeg-Olofsson KE, Kazadi-Kayembe T, Tylleskar T, Fallmar P.

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To elucidate the involvement of motor pathways in konzo, 21 konzo subjects (mean age 22 years) underwent transcranial electrical stimulation (TES) in 1998. Fourteen konzo subjects (mean age 21 years) underwent transcranial magnetic stimulation (TMS) in 2000. Three subjects underwent both TES and TMS. Motor evoked potentials (MEPs) were recorded in the abductor pollicis brevis (APB) muscle with TES, and in the abductor digiti minimi (ADM) and tibialis anterior (TA) muscles with TMS. APB-MEPs were normal in 2 of 21 subjects and absent in 9; central conduction time (CCT) was prolonged in 10. Resting ADM-MEPs were absent in 9 of 14 subjects with clinically preserved upper limbs. Among these nine, seven subjects responded after facilitation. Most subjects (13 of 14) failed to show TA-MEPs. Of the subjects who underwent both types of stimulation, one had normal TES-MEP but abnormal ADM-MEP with TMS. These findings suggest involvement of both corticomotoneurons and motor descending pathways in konzo.

PMID: 11870691 [PubMed - indexed for MEDLINE]

33: Clin Neurophysiol. 2002 Feb;113(2):284-91.

Single motor axon conduction velocities of human upper and lower limb motor units. A study with transcranial electrical stimulation.

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OBJECTIVES: To calculate conduction velocities (CV) of single motor axons innervating hand, forearm and leg muscles, weak anodal electrical transcranial stimuli were used and single motor unit potentials were recorded in 17 normal subjects. METHODS: The central motor conduction time and neuromuscular transmission delay were subtracted from the latency of unit response to cortical stimulation and single motor axon CV were calculated. RESULTS: In extensor indicis proprius (EIP) units, CV ranged from 30.3 to 76.1m/s (mean: 51.3 +/- 7.1m/s, 139 units). In first dorsal interosseous (FDI), they ranged from 45.1 to 66.2m/s (mean: 54.6 +/- 2.6m/s, 88 units). In tibialis anterior (TA), velocities ranged from 27.8 to 55.9m/s (mean: 41.3 +/- 7.5m/s, 123 units). In FDI units, velocities were compared with those obtained with the F-wave method (range: 50.3-64.5m/s, mean: 58.1 +/- 2.0m/s). CONCLUSIONS: Compared with previously published values, the present method gives better access to slow-conducting units, first recruited by transcranial stimulation and voluntary effort. The spectrum of individual CV was much broader for EIP and TA than for FDI. A linear decline of maximal CV with age was observed, while minimal CV were not affected, suggesting that aging causes a selective loss of the fastest-conducting units.

PMID: 11856633 [PubMed - indexed for MEDLINE]

34: Zhonghua Wai Ke Za Zhi. 1998 Jul;36(7):417-20.

[The effects of graded spinal cord injuries on transcranial electric stimulation motor evoked potentials in the rat]

[Article in Chinese]

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OBJECTIVE: To study the effects of graded spinal cord injury (SCI) on the motor evoked potentials (MEP) characteristics and the prognostic value of MEP for the motor function. METHOD: Modified Allen's method was used by weight drop force of 30 gcf, 50 gcf, 80 gcf and 100 gcf on the T(8 - 9) spinal cord of 40 SD rats in order to make SCI models. MEP was recorded continuously at L(1 - 2) epidurally and bilateral gastrocnemius muscles before and after the spinal cord lesion was produced (followed up for 1 month). The inclined plane and Tarlov technique were used to assess clinical neurological function. RESULT: The amplitude of rat's MEP changed significantly with graded SCI, the more sever the lesion, the lower the potentials. mMEP was more sensitive than scMEP, though the abolishment of mMEP soon after SCI didn't indicate that the animals could not regain ambulation. Changes in amplitude of scMEP recorded early after SCI were collaborate significantly with inclined plane (gamma = 0.9665, P < 0.01) and Tarlov scale (gamma = 0.8893, P < 0.01) assessed 1 month later, and can be used as a chronic measure parameter of motor function prognosis. scMEP still existed 1 month after SCI in 3 of 11 rats (27.3%) without any voluntary movement in bilateral hindlimbs, suggesting that some parts of conductive function still existed in the spinal cord. So it should be called "discomplete SCI". CONCLUSIONS: scMEP can be used as a reliable parameter for motor function prognosis, because it reflects objectively and sensitively the severity of central motor neurol fiber injury.

PMID: 11825429 [PubMed - indexed for MEDLINE] 35: J Physiol. 2001 Dec 15;537(Pt 3):1047-58.

Descending spinal cord volleys evoked by transcranial magnetic and electrical stimulation of the motor cortex leg area in conscious humans.

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1. Descending corticospinal volleys evoked after transcranial magnetic or electrical stimulation of the leg area of the motor cortex were recorded from an electrode in the spinal epidural space of six conscious patients who had electrodes implanted for treatment of chronic pain, and from one anaesthetised patient undergoing surgery for a spinal tumour. 2. At threshold, the shortest-latency volley (L1 volley) was evoked by stimulation with an anode 2 cm lateral to the vertex. Anodal stimulation at the vertex also elicited a volley at this latency in two patients, but in the other patients the first volley evoked appeared 1-1.3 ms later (L2 volley), at the same latency as the initial volley evoked by magnetic stimulation. High-intensity stimulation of any type could evoke both the L1 and L2 waves as well as later ones (L3, L4, etc.) that had a periodicity of about 1.5 ms. 3. Voluntary contraction increased the amplitude of the L2 and later volleys, but had no effect on the L1 volley. 4. Intracortical inhibition between pairs of magnetic stimuli resulted in clear suppression of the L4 and later waves. The L2 and L3 waves were unaffected. 5. In the anaesthetised patient the L1 volley occurred 1.7 ms later than the volley produced by transmastoid stimulation of the corticospinal pathways in the brainstem. 6. The L1 volley is likely to be a D wave produced by the direct activation of pyramidal axons in the subcortical white matter; the L2 and later volleys are likely to be I waves produced by the trans-synaptic activation of corticospinal neurones. The implication is that electrical stimulation with an anode at the vertex is more likely to evoke I waves preferentially than stimulation over the hand area. A more secure way to ensure D wave activation of corticospinal fibres from the leg area is to place the anode 2 cm lateral to the vertex.

PMID: 11744776 [PubMed - indexed for MEDLINE]

36: J Neurosci Methods. 2001 Dec 15;112(2):193-202.

Reliability of the input-output properties of the cortico-spinal pathway obtained from transcranial magnetic and electrical stimulation.

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The purpose of this experiment was to assess the test-retest reliability of input-output parameters of the cortico-spinal pathway derived from transcranial magnetic (TMS) and electrical (TES) stimulation at rest and during muscle contraction. Motor evoked potentials (MEPs) were recorded from the first dorsal interosseous muscle of eight individuals on three separate days. The intensity of TMS at rest was varied from 5% below threshold to the maximal output of the stimulator. During trials in which the muscle was active, TMS and TES intensities were selected that elicited MEPs of between 150 and 300 microV at rest. MEPs were evoked while the participants exerted torques up to 50% of their maximum capacity. The relationship between MEP size and stimulus intensity at rest was sigmoidal (R2=0.97). Intra-class correlation coefficients (ICC) ranged between 0.47 and 0.81 for the parameters of the sigmoid function. For the active trials, the slope and intercept of regression equations of MEP

size on level of background contraction were obtained more reliably for TES (ICC=0.63 and 0.78, respectively) than for TMS (ICC=0.50 and 0.53, respectively). These results suggest that input-output parameters of the cortico-spinal pathway may be reliably obtained via transcranial stimulation during longitudinal investigations of cortico-spinal plasticity.

PMID: 11716954 [PubMed - indexed for MEDLINE]

37: Otol Neurotol. 2001 Nov;22(6):944-51.

Mapping the VIIIth cranial nerve by electrical stimulation: methods for differentiating auditory from vestibular responses.

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HYPOTHESIS: The goal of this study was to map the VIIIth cranial nerve by electrical stimulation. Specifically, the authors sought to 1) characterize auditory and vestibular evoked responses elicited by electrical stimuli delivered directly to the exposed surface of the VIIIth cranial nerve and 2) compare electrically evoked responses elicited in brainstem nuclei with extracranially recorded far-field potentials. BACKGROUND: Intraoperative monitoring of auditory brainstem responses is useful during cerebellopontine angle surgery. Identification of the vestibular portion of the VIIIth cranial nerve, which traditionally has been performed by physical characteristics and some electrophysiologic properties, is important because the vestibular subdivision in humans is indistinct in approximately 25% of cases. Positive identification of evoked responses emanating from the vestibular nerve would constitute a marked improvement over existing intraoperative techniques that use acoustic stimuli only. METHODS: Experiments were performed on 12 anesthetized cats. Electrical pulse stimuli were delivered using a bipolar electrode placed directly on the surface of the exposed VIIIth cranial nerve at several sites. Computer-averaged evoked responses were recorded from far-field electrodes placed on the scalp and from near-field electrodes stereotaxically positioned in or near the inferior colliculus and abducens nucleus. RESULTS: Latencies and morphologies of waves recorded in brainstem nuclei were compared with those of waves recorded extracranially. Direct electrical stimulation of the cochlear nerve elicited a four-wave, auditory brainstem response-like extracranial response, strong activity in the inferior colliculus, and weak activity in the abducens nucleus. Direct stimulation of the vestibular nerve produced a two-wave extracranial response, weak inferior colliculus activity, and strong abducens activation. Stimulation at the border of the cochlear and vestibular nerves produced intermediate responses that possessed both cochlear and vestibular characteristics. CONCLUSION: Direct electrical stimulation of the cochlear and vestibular subdivisions elicits evoked responses with distinctly different wave morphologies. Obtaining electrically evoked responses intraoperatively is feasible and may be of substantial value in the unambiguous identification of VIIIth cranial nerve subdivisions.

PMID: 11698824 [PubMed - indexed for MEDLINE]

38: Med Tr Prom Ekol. 2001;(9):6-10.

[Treatment of occupational neurosensory deafness by means of transcranial electric stimulation] [Article in Russian]

Baranova VM, Vasilets VM, Abbasov RIu, Lebedev VP, Bovt IG, Kolosov PG, Dovgusha LV.

Noise at work impairs hearing with consequent occupational neurosensory deafness and general health disorders. Transcranial electric stimulation betters hearing and improves the workers' general state.

PMID: 11685823 [PubMed - indexed for MEDLINE]

39: J Neurosurg. 2001 Oct;95(2 Suppl):161-8.

Threshold-level repetitive transcranial electrical stimulation for intraoperative monitoring of central motor conduction.

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OBJECT: The authors conducted a study to evaluate repetitive transcranial electrical stimulation (TES) to assess spinal cord motor tract function in individuals undergoing spine surgery, with emphasis on safety and efficacy. METHODS: Somatosensory evoked potentials (SSEPs) were elicited using standard technique. Muscle electromyographic values were measured in response to a three- or four-pulse train of stimulation delivered to the motor cortex via subdermal electrodes. They also evaluated whether changes in the minimum stimulus intensity (that is, threshold level) needed to elicit a response from a given muscle predict motor status immediately postoperatively, as well as whether changes in SSEP response amplitude and latency predict sensory status immediately postoperatively. Anesthesia was routinely induced with intravenous propofol and remifentanil, supplemented with inhaled nitrous oxide. Use of neuromuscular block was avoided after intubation. Satisfactory monitoring of muscle response to threshold-level repetitive TES was achieved in all but nine of the 194 patients studied. In contrast, cortical SSEP responses could not be elicited in 42 of 194 individuals. In cases in which responses were present, TES-based evoked responses proved to be extremely accurate for predicting postoperative motor status. Somatosensory evoked potential monitoring was nearly as accurate for predicting postoperative sensory status. There were frequent instances of postoperative motor or sensory deficit that were not predicted by SSEP- and TES-based monitoring, respectively. There were no adverse events attributable to TES-based monitoring, although since this study ended we have had a single adverse event attributable to threshold-level repetitive TES. CONCLUSIONS: Intraoperative threshold-level repetitive TES-based monitoring of central motor conduction has proven to be a simple, safe, and highly accurate technique for the prevention or minimization of inadvertent motor deficit during surgery involving the spine or spinal cord.

Publication Types:

Case Reports

Evaluation Studies

PMID: 11599831 [PubMed - indexed for MEDLINE]

40: Anesteziol Reanimatol. 2001 Jul-Aug;(4):21-3.

[Transcranial electric stimulation in anesthesiological support in emergency operations in patients with hypovolemia]

[Article in Russian]

Dimitrienko AI, Kovalev MG, Lebedev VP, Leosko VA, Fan AB.

Hemodynamics was studied in 60 patients with pronounced initial hypovolemia, urgently operated on for acute gastrointestinal disease under conditions of 4 anesthesia. In contrast to traditional anesthesia, transcranial electric stimulation (TCES) as a component of anesthesia stabilized hemodynamics without increasing the rate and volume of intraoperative infusion therapy. This makes total anesthesia with TCES preferable in urgent operations, particularly in cases when hypovolemia cannot be properly corrected before surgery.

PMID: 11586623 [PubMed - indexed for MEDLINE]

41: Neuroimage. 2001 Aug;14(2):366-75.

In vivo assessment of human visual system connectivity with transcranial electrical stimulation during functional magnetic resonance imaging.

Brandt SA, Brocke J, Roricht S, Ploner CJ, Villringer A, Meyer BU.

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Functional magnetic resonance imaging (fMRI) was used to investigate local and distant cerebral activation induced by transcranial electrical stimulation in order to noninvasively map functional connectivity in the human visual system. Stimulation with lateromedially directed currents and the anode 4.5 cm dorsally to the inion over the right visual cortex induced phosphenes extending into the contralateral lower quadrant of the visual field. fMRI showed a focal hemodynamic response underneath the anode in extrastriate cortex and distant coactivation in subcortical (lateral geniculate nucleus), cortical visual (striate and extrastriate), and visuomotor areas (frontal and supplementary eye fields). This pattern of activation resembles a network of presumably interconnected visual and visuomotor areas. Analysis of activation sites supplies new information about cerebral correlates of phosphenes and shows that the cortical region underneath the cranial stimulation site is not necessarily the origin of behavioral and/or perceptual effects of transcranial stimulation. We conclude that combining transcranial electrical stimulation of neural tissue with simultaneous fMRI offers the possibility to study noninvasively cerebral connectivity in the human brain. Copyright 2001 Academic Press.

PMID: 11467910 [PubMed - indexed for MEDLINE]

42: Clin Neurophysiol. 2001 Jun;112(6):1076-87.

Intraoperative motor evoked potentials to transcranial electrical stimulation during two anaesthetic regimens.

Pelosi L, Stevenson M, Hobbs GJ, Jardine A, Webb JK.

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OBJECTIVES: To study motor evoked potentials (MEPs) to multi-pulse transcranial electrical stimulation (MP-TES) during orthopaedic spinal surgery under different anaesthetic regimens. METHODS: MEPs to MP-TES were recorded from tibialis anterior and abductor hallucis bilaterally in 50 operations.

Anaesthesia was maintained with propofol and nitrous oxide in 29 operations and isoflurane (0.78+/-0.17% end-tidal) and nitrous oxide in 23 (two patients received both regimens). Analgesia was provided with fentanyl or remifentanil. RESULTS: Motor stimulation caused neither EEG changes nor seizures. MEPs were obtained in 97% of patients during propofol anaesthesia. The median amplitude and coefficient of variation (CV) at baseline (across all muscles) were 198 microV and 22%, respectively. Amplitudes throughout the operation paralleled the degree of neuromuscular block and were reduced after fentanyl bolus, isoflurane or morphine. Loss of MEPs or persistent amplitude decrements were associated with neurological complications in one patient and severe blood loss in another two patients. MEPs were obtainable in 61% of patients during isoflurane anaesthesia and became inconsistent for end-tidal concentrations >0.87+/-0.08%. Amplitudes were smaller (85 microV) and baseline variability higher (coefficient of variation 29%) than in the propofol group. The decrease in the number of recordings was greater for isoflurane than propofol when the number of pulses/train decreased from 4 to 2. CONCLUSIONS: Muscle MEPs to MP-TES are a safe, sensitive and reliable method for monitoring motor pathways during propofol/nitrous oxide and fentanyl or remifentanil anaesthesia. MEPs are also obtainable in the majority of patients during isoflurane/nitrous oxide anaesthesia, but quantitative monitoring is not always possible with this regimen.

PMID: 11377268 [PubMed - indexed for MEDLINE]

43: Ross Fiziol Zh Im I M Sechenova. 2000 Nov;86(11):1449-57.

[Effect of the transcranial electrical stimulation of the endorphinergic brain structures on the functional activity of hepatocytes after toxic exposure]

[Article in Russian]

Lebedev VP, Melikhova MV, Kolbasov SE, Stroikova GV, Zamuruev ON.

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Biochemical events of the rat hepatocytes cytolysis and deterioration of their synthetic activity and detoxification ability, as well as morphological events of lipid degeneration after acute poisoning with dichloretane and CCl4, were significantly reduced by effects of transcranial stimulation (TES). Blockade of the TES effects with naloxone revealed its endorphinergic nature. Combined effects of the TES and Essenciale preparation were lower than separate those of these agents. The TES effects were clinically corroborated in treatment of toxic hepatitis.

PMID: 11195212 [PubMed - indexed for MEDLINE]

44: J Neurosci Methods. 2000 Oct 15;102(1):81-9.

Enhancing the quality of studies using transcranial magnetic and electrical stimulation with a new computer-controlled system.

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Transcranial magnetic (TMS) and electrical (TES) stimulation of the human brain have become useful tools in neurophysiological and neuropsychological research. Here we describe an integrated system that allows experimental control, data recording and analysis of neurophysiological and neuropsychological TMS and TES procedures (including motor thresholds, recruitment curves, intracortical inhibition and facilitation with paired pulses). The system uses a multifunction input/output board and a set of virtual instruments (VI) programmed with the Labview graphical programming language. It also includes online curve fitting of recruitment curves using the Boltzmann sigmoid function and monitoring of the preinnervation grade of the target muscle. Modules for neuropsychological stimulus presentation or faster repetitive stimulation can be easily added. This system yields more accurate data recording and analysis in a user friendly and unified environment.

PMID: 11000414 [PubMed - indexed for MEDLINE]

45: Acta Anaesthesiol Scand. 2000 Aug;44(7):799-803.

The effect of two low-dose propofol infusions on the relationship between six-pulse transcranial electrical stimulation and the evoked lower extremity muscle response.

van Dongen EP, ter Beek HT, Aarts LP, Schepens MA, Morshuis WJ, Benning FJ, de Boer A, Boezeman EH.

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BACKGROUND: Transcranial stimulation of the motor cortex using high-voltage electrical stimuli given in train is a method of monitoring the integrity of the motor pathways during thoracoabdominal aortic aneurysm surgery. The purpose of this study was to assess the relationship between the stimulus intensity and the corresponding amplitude of the myogenic motor evoked potential (tcMEP) in response to six-pulse transcranial electrical stimulation during two levels of low-dose propofol infusion and stable fentanyl/nitrous oxide anaesthesia. METHODS: Nine patients (37-78 yr) scheduled to undergo surgery on the thoracoabdominal aorta were studied. After achieving a stable anaesthetic state the output voltage was decreased with 50 V intervals from 350 V to 200 V during a target propofol infusion aimed at a plasma steady-state concentration of 0.7 microg x ml(-1) and increased with 50 V intervals from 200 V to 450 V during a target propofol infusion aimed at a plasma steady-state concentration of 1.4 microg x ml(-1). TcMEPs were recorded from the right tibialis anterior muscle. RESULTS: Doubling the target propofol infusion to 1.4 microg x ml(-1) resulted in a 30-50% decrease in tcMEP amplitude. The largest tcMEP amplitude using the six-pulse paradigm was found during a propofol infusion aimed at a plasma concentration of 0.7 microg x ml(-1) and demanded a stimulus output of 350 V, corresponding to a charge density of 7.5 microC x cm(-2) per phase. CONCLUSION: Doubling the target propofol infusion to 1.4 microg x ml(-1) provides less

robust, but still recordable tcMEPs in response to six-pulse electrical stimulation. Safety guidelines are discussed.

Publication Types:

Clinical Trial

PMID: 10939692 [PubMed - indexed for MEDLINE]

46: Br J Neurosurg. 2000 Jun;14(3):240-3.

Subdural air limits the elicitation of compound muscle action potentials by high-frequency transcranial electrical stimulation.

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High-frequency transcranial electrical stimulation was performed in 8 patients undergoing surgery in the sitting position. Following the opening of the dura of the posterior fossa changes in compound muscle action potentials were observed. These changes were not attributable to surgical manoeuvres at the brain stem or spinal cord, or to anaesthetic changes. In all these cases intraoperative fluoroscopy of the skull revealed a subdural air collection underneath the stimulation electrodes. Such a subdural air collection, not infrequent in patients operated on in the sitting position, limits the application of high-frequency transcranial electrical stimulation as a monitoring technique. It remains unclear if this effect is due to the increasing distance between scalp and cortex and the insulating effect of subdural air, or due to displacement of the motor cortex. The practical importance of this report is derived from the increasing application of intraoperative motor pathway monitoring.

Publication Types:

Case Reports

PMID: 10912202 [PubMed - indexed for MEDLINE]

47: Electroencephalogr Clin Neurophysiol Suppl. 1999;51:120-6.

Direct recordings of descending volleys after transcranial magnetic and electric motor cortex stimulation in conscious humans.

Di Lazzaro V, Oliviero A, Profice P, Insola A, Mazzone P, Tonali P, Rothwell JC.

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PMID: 10590942 [PubMed - indexed for MEDLINE]

48: Muscle Nerve. 1999 Nov;22(11):1538-43.

Comment in:

Muscle Nerve. 2000 Sep;23(9):1445-6.

Intraoperative electrical stimulation for identification of cranial nerve nuclei.

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The purpose of this study was to evaluate the feasibility and usefulness of cranial nerve nuclei monitoring during resection of brainstem cavernous malformations. Eleven patients with brainstem cavernous malformations underwent resection of their malformations utilizing cranial nerve nuclei monitoring. Cranial nerves V and VII were monitored by placing electrodes in muscle groups innervated by these nerves and recording manipulation-induced neurotonic discharges and triggered electromyographic (EMG) activity, after electrical stimulation of the corresponding brainstem nuclei. Seven of 11 procedures (64%) with cranial nerve nuclei monitoring were noted to have cranial nerve nuclei activity corresponding to manipulation of the nuclei. The cavernous malformation was completely resected in 5 of 7 cases with cranial nerve nuclei activity and in all 4 cases without activity. In the remaining 2 cases, the cavernous malformation was not resected due to the proximity of the monitored cranial nerve nuclei to the cavernous malformation and to increasing neurotonic activity as the cavernous malformation was approached. None of the 11 patients had new permanent postoperative deficits corresponding to the cranial nerve nuclei monitored; 1 patient had a transient partial facial palsy lasting 2 days. Preliminary results indicate that cranial nerve nuclei monitoring proves useful in preserving neurologic function and reducing surgical morbidity during resection of brainstem cavernous malformations, particularly indicating when lesion resection places these nuclei at risk.

PMID: 10514231 [PubMed - indexed for MEDLINE]

49: Med Biol Eng Comput. 1999 May;37(3):322-6.

Instrumentation for the measurement of electric brain responses to transcranial magnetic stimulation.

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There is described a 60-channel EEG acquisition system designed for the recording of scalp-potential distributions starting just 2.5 ms after individual transcranial magnetic stimulation (TMS) pulses. The amplifier comprises gain-control and sample-and-hold circuits to prevent large artefacts from magnetically induced voltages in the leads. The maximum amplitude of the stimulus artefact during the 2.5 ms gating period is 1.7 microV, and 5 ms after the TMS pulse it is only 0.9 microV. It is also shown that mechanical forces to the electrodes under the stimulator coil are a potential source of artefacts, even though, with chlorided silver wire and Ag/AgCl-pellet electrodes, the artefact is smaller than 1 microV. The TMS-compatible multichannel EEG system makes it possible to locate TMS-evoked electric activity in the brain.

PMID: 10505382 [PubMed - indexed for MEDLINE]

50: Neuropsychopharmacology. 1999 Sep;21(3):391-8.

Electrical stimulation of rat medial prefrontal cortex enhances forebrain serotonin output: implications for electroconvulsive therapy and transcranial magnetic stimulation in depression.

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Decreased activity of the prefrontal cortex (PFC), as well as reduced serotonergic neurotransmission, is considered as a characteristic feature of major depression. The mechanism by which electroconvulsive therapy (ECT) and transcranial magnetic stimulation (TMS) achieve their antidepressant effects may involve changes in PFC activity. It is, however, still unclear whether these changes are accompanied by increased synaptic availability of serotonin (5-HT). In the present study, 5-HT efflux in the rat ventral hippocampus and amygdala was analyzed using in vivo microdialysis during low-current electrical stimulation of PFC and other cortical regions. Electrical stimulation of the medial PFC produced current-dependent increases in limbic 5-HT output in both urethane-anesthetized and behaving rats. No effects on 5-HT levels were seen after comparable stimulation of either the lateral parts of the PFC, the medial precentral area, the primary motor cortex or the parietal cortex. This pronounced regional specificity of the effect of medial PFC stimulation on limbic 5-HT output suggests that activation of this particular area might play a crucial role in such antidepressant treatments as ECT and TMS.

PMID: 10457536 [PubMed - indexed for MEDLINE]

51: Clin Neurophysiol. 1999 Jun;110(6):1144-8.

Within patient variability of lower extremity muscle responses to transcranial electrical stimulation with pulse trains in aortic surgery.

van Dongen EP, ter Beek HT, Schepens MA, Morshuis WJ, de Boer A, Aarts LP, Boezeman EH.

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Intraoperative recording of myogenic motor responses evoked by transcranial electrical stimulation is a method of controlling the integrity of the motor pathways during clamping of the aorta. It is important to know the within patient variability of the transcranial motor evoked potential (tcMEP), before changes within the variability range are interpreted as abnormal during the period of aortic cross clamping. Lower limb muscle responses were obtained in 11 patients, following transcranial electrical stimulation with pulse trains, of 4, 6 and 8 pulses. Under the conditions of partial neuromuscular blockade and a stable low dose propofol/fentanyl/nitrous oxide anaesthetic state, this study shows that multipulse transcranial electrical stimulation reliably produces muscle responses of the lower limb in all patients tested with a coefficient of variation (CV) of around 20%. Eight pulses in the stimulation train produce neurophysiological facilitation that exceeds a 4 pulse train in terms of area under the curve (AUC) and response duration. The use of multipulse stimulation rather than double or single pulse stimulation is recommended in order to increase the clinical efficacy of tcMEP monitoring in aortic surgery.

PMID: 10402103 [PubMed - indexed for MEDLINE]

52: Muscle Nerve. 1999 Jul;22(7):946-8.

Muscle vibration: different effects on transcranial magnetic and electrical stimulation.

Kossev A, Siggelkow S, Schubert M, Wohlfarth K, Dengler R.

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Transcranial magnetic stimulation (TMS) and transcranial electrical stimulation (TES) were applied before and 3 s after onset of vibration (0.5 mm, 80 Hz) of the right extensor carpi radialis muscle in 5 healthy subjects. Vibration induced significant augmentation and latency shortening of motor evoked potentials elicited by TMS, but not TES. This provides evidence for an involvement of cortical mechanisms by muscle vibration in the augmentation of MEPs following TMS. Copyright 1999 John Wiley & Sons, Inc.

Publication Types:

Clinical Trial

PMID: 10398217 [PubMed - indexed for MEDLINE]

53: Integr Physiol Behav Sci. 1999 Jan-Mar;34(1):43-53.

A study of the effects of cranial electrical stimulation on attention and concentration.

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There have been several anecdotal accounts that cranial electrical stimulation (CES) enhances attention and the ability to learn new tasks in a normal population, but only one published investigation confirms that CES improves attention using the Alpha Stim CES (Madden and Kirsch, 1987). The purpose of this study was to corroborate the findings of Madden and Kirsch, using more precise measures of attention, such as a Continuous Performance Test (CPT). A pretest and posttest CPT was given to two groups using the LISS CES device. The control group consisted of twenty-one subjects who received the placebo treatment. The experimental group of thirty-one subjects received twenty minutes of CES. Four measures of the CPT show significant gains in attention: Number of Hits, p =.010 Hit RT ISI Change, p =.016, Risk Taking, p =.055; and Attentiveness, p =.054. Based on subjects who demonstrated improvement by one standard deviation on two different measures of the CPT, thirty-one percent of the experimental group improved versus four percent of the control group. The use of CES as a method of increasing attention is a promising area that requires further investigation.

Publication Types:

Clinical Trial

Randomized Controlled Trial

PMID: 10381164 [PubMed - indexed for MEDLINE]

54: Exp Brain Res. 1999 Feb;124(4):525-8.

Effects of voluntary contraction on descending volleys evoked by transcranial electrical stimulation over the motor cortex hand area in conscious humans.

Di Lazzaro V, Oliviero A, Profice P, Insola A, Mazzone P, Tonali P, Rothwell JC. Istituto di Neurologia, Universita Cattolica, Rome, Italy. dilazzar@rm.ats.it

The spinal volleys evoked by electric anodal and cathodal stimulation over the cerebral motor cortex hand area were recorded from a bipolar electrode inserted into the cervical epidural space of two conscious human subjects. We measured the size of volleys elicited by electric stimulation at active motor threshold and at 3% of maximum stimulator output above this value with subjects at rest and during maximum voluntary contraction of the contralateral first dorsal interosseous muscle. Surface EMG activity was recorded at the same time. Electrical anodal stimulation evoked a single negative wave that we termed D-wave in analogy with data in experimental animals. Cathodal stimulation evoked a single negative wave with a latency of 0.2 ms longer than the D-wave recruited by anodal stimulation. At both intensities tested, voluntary contraction did not modify the amplitude of the descending waves. We conclude that changes in cortical excitability induced by voluntary activity do not modify the corticospinal volley evoked by electric stimulation and that the D-waves evoked by both anodal and cathodal electric stimulation are probably initiated several nodes distant to the cell body.

PMID: 10090665 [PubMed - indexed for MEDLINE]

55: Brain Res. 1999 Mar 20;822(1-2):132-41.

Transcranial electrical stimulation (Limoge's currents) potentiates the inhibition of righting reflex induced by droperidol in rats.

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The effects of transcranial electrical stimulation (TCES) on droperidol-treated rats were evaluated using the righting reflex latency (RRL) test. TCES (high frequency (HF)-166 kHz, intermittent-100 Hz current) delivered through three electrodes (a negative electrode placed between the eyebrows and positive electrodes located in the retro-mastoid region) was shown to potentiate the inhibition of righting reflex induced by droperidol. This potentiation was found to depend on the dose of the drug, the characteristics of the current delivered and the duration of stimulation. We also observed that TCES-induced potentiation of inhibition of righting reflex produced by droperidol injection was not reversed:

(I) after naltrexone administration, (ii) when measures were performed on p-chlorophenylalanine (pCPA)-treated animals. These results suggest that, under the experimental conditions: (I) TCES does not interact with opioid endogenous to potentiate droperidol effects, (ii) the effect of TCES on dopaminergic system prevails against TCES action on serotonergic system. Though these findings enlarge the comprehension of TCES effects on the central nervous system, further investigations are necessary to elucidate TCES mechanisms.

PMID: 10082891 [PubMed - indexed for MEDLINE]

56: Neurosci Biobehav Rev. 1999 Mar;23(4):529-38.

Transcutaneous cranial electrical stimulation (TCES): a review 1998.

Limoge A, Robert C, Stanley TH.

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The Transcutaneous Cranial Electrical Stimulation (TCES) technique appeared at the beginning of the 1960s and is aimed to act at the level of the central nervous system. The current, composed of high frequency pulses interrupted with a repetitive low frequency, is delivered through three electrodes (a negative electrode placed between the eyebrows while two positive electrodes are located in the retro-mastoid region). Due to the characteristics of the current delivered, shortcomings encountered with previous electrical stimulation techniques are avoided. The main property of TCES is to potentiate some drug effects, especially opiates and neuroleptics, during anesthetic clinical procedures. This potentiation effect permits drastic reduction of pharmacological anesthetic agent and reduces post-operative complications. Animal studies performed with TCES demonstrated that this stimulation releases 5-hydroxy-indol-acetic acid and enkephalins. Despite numerous clinical and animal studies performed with this technique for several decades, TCES mechanisms are not completely elucidated but results obtained without undesirable effect are encouraging signs to continue investigations of this particular technique.

Publication Types:

Review

PMID: 10073891 [PubMed - indexed for MEDLINE]

57: Anesth Analg. 1999 Mar;88(3):568-72.

A comparison of myogenic motor evoked responses to electrical and magnetic transcranial stimulation during nitrous oxide/opioid anesthesia.

Ubags LH, Kalkman CJ, Been HD, Koelman JH, Ongerboer de Visser BW.

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Transcranial motor evoked potentials (tc-MEPs) are used to monitor spinal cord integrity intraoperatively. We compared myogenic motor evoked responses with electrical and magnetic transcranial stimuli during nitrous oxide/opioid anesthesia. In 11 patients undergoing spinal surgery, anesthesia was induced with i.v. etomidate 0.3 mg/kg and sufentanil 1.5 microg/kg and was maintained with sufentanil 0.5 microg x kg(-1) x h(-1) and N2O 50% in oxygen. Muscle relaxation was kept at 25% of control with i.v. vecuronium. Electrical stimulation was accomplished with a transcranial stimulator set at maximal output (1200 V). Magnetic transcranial stimulation was accomplished with a transcranial stimulator set at maximal output (2 T). Just before skin incision, triplicate responses to single stimuli with both modes of cortical stimulation were randomly recorded from the tibialis anterior muscles. Amplitudes and latencies were compared using the Wilcoxon

signed rank test. Bilateral tc-MEP responses were obtained in every patient with electrical stimulation. Magnetic stimulation evoked only unilateral responses in two patients. With electrical stimulation, the median tc-MEP amplitude was 401 microV (range 145-1145 microV), and latency was 32.8 +/- 2.3 ms. With magnetic stimulation, the tc-MEP amplitude was 287 microV (range 64-506 microV) ($P < 0.05$), and the latency was 34.7 +/- 2.1 ms ($P < 0.05$). We conclude that myogenic responses to magnetic transcranial stimulation are more sensitive to anesthetic-induced motoneural depression compared with those elicited by electrical transcranial stimulation. IMPLICATIONS: Transcranial motor evoked potentials are used to monitor spinal cord integrity intraoperatively. We compared the relative efficacy of electrical and magnetic transcranial stimuli in anesthetized patients. It seems that myogenic responses to magnetic transcranial stimulation are more sensitive to anesthetic-induced motoneural depression compared with electrical transcranial stimulation.

Publication Types:

Clinical Trial

PMID: 10072007 [PubMed - indexed for MEDLINE]

58: Anesth Analg. 1999 Jan;88(1):22-7.

Within-patient variability of myogenic motor-evoked potentials to multipulse transcranial electrical stimulation during two levels of partial neuromuscular blockade in aortic surgery.

van Dongen EP, ter Beek HT, Schepens MA, Morshuis WJ, Langemeijer HJ, de Boer A, Boezeman EH.

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Intraoperative recording of myogenic motor responses evoked by transcranial electrical stimulation (tcMEPs) is a method of assessing the integrity of the motor pathways during aortic surgery. To identify conditions for optimal spinal cord monitoring, we investigated the effects of manipulating the level of neuromuscular blockade (T1 response of the train-of-four (TOF) stimulation 5%-15% versus T1 response 45%-55% of baseline), as well as the number of transcranial pulses (two versus six stimuli) on the within-patient variability and amplitude of tcMEPs. Ten patients (30-76 yr) scheduled to undergo surgery on the thoracic and thoracoabdominal aorta were studied. After achieving a stable anesthetic state and before surgery, 10 tcMEPs were recorded from the right extensor digitorum communis muscle and the right tibialis anterior muscle in response to two-pulse and six-pulse transcranial electrical stimulation with an interstimulus interval of 2 ms during two levels of neuromuscular blockade. The right thenar eminence was used for recording the level of relaxation. The tcMEP amplitude using the six-pulse paradigm was larger ($P < 0.01$; leg and arm) compared with the amplitude evoked by two-pulse stimulation during both levels of relaxation. The within-patient variability, expressed as median coefficient of variation, was less when six-pulse stimulation was used. At a T1 response of 45%-55% of baseline, larger, less variable tcMEPs were recorded than at a T1 response of 5%-15%. Our results suggest that the best quality of tcMEP signals (tibialis anterior muscle) is obtained when the six-pulse paradigm is used with a stable level of muscle relaxation (the first twitch of the TOF-thenar eminence-at 45%-55% of baseline). IMPLICATIONS: This study shows that six-pulse (rather than two-pulse) transcranial electrical stimulation during a stable anesthetic state and a stable neuromuscular blockade aimed at 45%-55% (rather than 5%-15%) of baseline provides reliable and recordable muscle responses sufficiently robust for spinal cord monitoring in aortic surgery.

Publication Types:

Clinical Trial

PMID: 9895060 [PubMed - indexed for MEDLINE]

59: Electroencephalogr Clin Neurophysiol. 1998 Oct;109(5):397-401.

Comparison of descending volleys evoked by transcranial magnetic and electric stimulation in conscious humans.

Di Lazzaro V, Oliviero A, Profice P, Saturno E, Pilato F, Insola A, Mazzone P, Tonali P, Rothwell JC.

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OBJECTIVES: The present experiments were designed to compare the understanding of the transcranial electric and magnetic stimulation of the human motorcortex. METHODS: The spinal volleys evoked by single transcranial magnetic or electric stimulation over the cerebral motor cortex were recorded from a bipolar electrode inserted into the cervical epidural space of two conscious human subjects. These volleys were termed D- and I waves, according to their latency. Magnetic stimulation was performed with a figure-of-eight coil held over the right motor cortex at the optimum scalp position, in order to elicit motor responses in the contralateral FDI using two different orientations over the motor strip. The induced current flowed either in a postero-anterior or in a latero-medial direction. RESULTS: At active motor threshold intensity, the electric anodal stimulation evoked pure D activity. At this intensity, magnetic stimulation with the induced current flowing in a posterior-anterior direction evoked pure I1 activity. When a latero-medial induced current was used, magnetic stimulation evoked both D and I1 activity. Using electric anodal stimulation, at a stimulus intensity of 9% of the stimulator output above the active motor threshold (corresponding approximately to 1.5 active motor threshold), a small I1 wave appeared only in subject 1. Using magnetic stimulation with a posterior-anterior induced current, at a stimulus intensity of 21% of maximum stimulator output above the active motor threshold (corresponding approximately to 1.8 times threshold in subject 1 and to two times threshold in subject 2), a small D wave appeared in subject 1 but not in subject 2. CONCLUSIONS: Present results demonstrate that, in conscious humans at threshold intensities, electric stimulation evokes D waves and magnetic stimulation (with a posterior-anterior induced current) evokes I waves, while magnetic stimulation (with a latero-medial induced current) evokes both activities.

PMID: 9851296 [PubMed - indexed for MEDLINE]

60: Electroencephalogr Clin Neurophysiol. 1998 Aug;109(4):369-75.

Peculiarity of soleus motor potentials evoked by transcranial magnetic stimulation and electrical stimulation of tibial nerve.

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OBJECTIVE: To reveal and discuss the peculiarities of soleus muscle in comparison with electrophysiological features of other leg muscles. METHODS: Vastus lateralis (L3), tibialis anterior (L4), extensor digitorum brevis (L5) and soleus (S1) muscles were tested at rest. Transcranial magnetic stimulation (TMS) combined which electrical stimulation of relevant peripheral nerves were applied. Cortically evoked motor potentials ©-MEP), peripheral compound muscle action potential (CMAP) and F-wave were recorded. Estimating F-wave conduction time allowed to calculated the central conduction time (CCT-F) within the cortex-spinal motoneurones segment for each muscle. RESULTS: One could expect that the lower spinal metameric representation of the muscle the longer a corresponding CCT-F. However, a study of 30 healthy subject (60 right and left muscles) reveals a relatively short CCT-F for the soleus muscle. Moreover, the mean amplitude of soleus C-MEP is the lowest, CMAP and F-wave amplitude are the highest and standardised distal motor latency is the longest compared to the analogous parameters for the other muscles. CONCLUSIONS: The reason for these special features can be attributed probably to a different structure and innervation of the soleus (mainly red, slow, tonic muscle) in contrast to the tibialis anterior and extensor digitorum brevis (mainly white, fast, phasic muscle).

PMID: 9751301 [PubMed - indexed for MEDLINE]

61: Electroencephalogr Clin Neurophysiol. 1998 Apr;109(2):114-8.

A simple method for recording motor evoked potentials of lingual muscles to transcranial magnetic and peripheral electrical stimulation.

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Motor evoked potentials were recorded from lingual muscles by means of clip electrodes applied on the lateral side of the tongue, following transcranial magnetic stimulation and peripheral electrical stimulation of the 12th cranial nerve at the mandible jaw. Using a circular coil, the stimulation of the cerebral cortex elicited a response of about 8 ms: its amplitude was higher in the right tongue placing the coil over the contralateral hemisphere, 4 cm from the vertex, with coil currents flowing counterclockwise. Coil position and current flow direction did not significantly modify the characteristics of responses recorded from the left side. The separate stimulation of either hemisphere was better obtained using an 8-shaped coil. The latency of the motor response measured 7.7-8.0 ms, the amplitude was greater on stimulation of the contralateral than the ipsilateral hemisphere and was larger recording from the right (3.3 +/- 1.1 mV) than from the left (1.2 +/- 0.7 mV) side. Positioning the circular coil over the parieto-occipital skull, a response of 4.1 +/- 0.3 ms was obtained, reflecting the intracranial activation of the hypoglossal nerve. The peripheral stimulation at the mandible elicited a response of 3.2 +/- 0.5 ms. The method described appears simple and reliable, potentially helpful in clinical practice.

Publication Types:

Clinical Trial

PMID: 9741801 [PubMed - indexed for MEDLINE]

62: Electroencephalogr Clin Neurophysiol. 1998 Jun;109(3):238-44.

Modeling direct activation of corticospinal axons using transcranial electrical stimulation.

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Corticospinal axons can be directly activated using anodal transcranial electrical stimulation. The purpose of this work was to find the location of the direct activation. The response to stimulation was modeled with a spherical head model and an active model of a corticospinal nerve. The nerve model had a deep bend at a location corresponding to a corticospinal fiber entering the midbrain. The threshold activation initiated close to brain surface; the exact location depended on whether the cell body located in the surface layers of the brain or in the bank of the central sulcus. The stimulation time constant was 44 micros. When the stimulus amplitude was increased, the site of activation shifted gradually to deeper level, until the activation initiated directly at the bend causing a half millisecond latency jump at spinal level. These results support the theory that the corticospinal axons can be directly activated at deep locations using anodal transcranial electrical stimulation. However, the high amplitude needed for the direct activation suggests that not only the bends on the fibers, but also the shape of surrounding volume conductor (intracranial cavity) favor activation at this location.

PMID: 9741790 [PubMed - indexed for MEDLINE]

63: J Neurosurg Anesthesiol. 1998 Jul;10(3):131-6.

The effect of sevoflurane on myogenic motor-evoked potentials induced by single and paired transcranial electrical stimulation of the motor cortex during nitrous oxide/ketamine/fentanyl anesthesia.

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To overcome anesthetic-induced depression of myogenic motor-evoked potentials (MEPs), several techniques of stimulation using paired pulses or trains of pulses are used. This study investigated the effect of sevoflurane on myogenic MEPs induced by single and paired transcranial electrical stimulation of the motor cortex. Nine patients undergoing elective spinal surgery were anesthetized with fentanyl-N2O-ketamine. Partial neuromuscular blockade (single-twitch height 15% of baseline) was maintained with vecuronium. Single and paired (interstimulus interval 2 milliseconds) electrical stimuli were delivered to the scalp, and compound muscle action potentials were recorded from the left and right tibialis anterior muscles. In all patients, baseline MEPs were recorded from both the left and right anterior tibialis muscles (in a total of 18 legs). During the administration of 0.25 MAC and 0.5 MAC sevoflurane, MEPs induced by stimulation with a single pulse could be recorded in 12 of 18 and 4 of 18 legs, respectively, and MEP amplitude was significantly reduced to 48% and 4% of the control value, respectively. During the administration of 0.75 MAC sevoflurane, MEPs following single-pulse stimulation could not be recorded in any legs. The success rate of MEP recording during the administration of sevoflurane was greater after paired stimulation than after single stimulation, and percentage MEP amplitude (percentage of the control value after single stimulation but before sevoflurane) after paired stimulation was significantly higher than after single stimulation before and during the administration of 0.25 MAC and 0.5 MAC sevoflurane. The success rate of MEP recording and MEP amplitude after paired stimulation decreased in a dose-dependent manner during the administration of sevoflurane. These results suggest that although facilitation by the second stimulus was considerable, paired stimuli are still not sufficient to overcome the depressant effects of sevoflurane in clinically used concentrations.

PMID: 9681399 [PubMed - indexed for MEDLINE]

64: J Neurosurg. 1998 Mar;88(3):457-70.

Comment in: J Neurosurg. 1999 Feb;90(2):376.

"Threshold-level" multipulse transcranial electrical stimulation of motor cortex for intraoperative monitoring of spinal motor tracts: description of method and comparison to somatosensory evoked potential monitoring.

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Numerous methods have been pursued to evaluate function in central motor pathways during surgery in the anesthetized patient. At this time, no standard has emerged, possibly because each of the methods described to date requires some degree of compromise and/or lacks sensitivity. OBJECT: The goal of this study was to develop and evaluate a protocol for intraoperative monitoring of spinal motor conduction that: 1) is safe; 2) is sensitive and specific to motor pathways; 3) provides immediate feedback; 4) is compatible with anesthesia requirements; 5) allows monitoring of spontaneous and/or nerve root stimulus-evoked electromyography; 6) requires little or no involvement of the surgical team; and 7) requires limited equipment beyond that routinely used for somatosensory evoked potential (SSEP) monitoring. Using a multipulse electrical stimulator designed for transcranial applications, the authors have developed a protocol that they term "threshold-level" multipulse transcranial electrical stimulation (TES). METHODS: Patients considered at high risk for postoperative deficit were studied. After anesthesia had been induced and the patient positioned, but prior to incision, "baseline" measures of SSEPs were obtained as well as the minimum (that is, threshold-level) TES voltage needed to evoke a motor response from each of the muscles being monitored. A brief, high-frequency pulse train (three pulses; 2-msec interpulse interval) was used for TES in all cases. Data (latency and amplitude for SSEP; threshold voltage for TES) were collected at different times throughout the surgical procedure. Postoperative neurological status, as judged by evaluation of sensory and motor status, was compared with intraoperative SSEP and TES findings for determination of the sensitivity and specificity of each electrophysiological monitoring technique. Of the 34 patients enrolled, 32 demonstrated TES-evoked responses in muscles innervated at levels caudal to the lesion when examined after anesthesia induction and positioning but prior to incision (that is, baseline). In contrast, baseline SSEPs could be resolved in only 25 of the 34 patients. During surgery, significant changes in SSEP waveforms were noted in 12 of these 25 patients, and 10 patients demonstrated changes in TES thresholds. Fifteen patients experienced varying degrees and durations of postoperative neurological deficit. Intraoperative changes in TES thresholds accurately predicted each instance of postoperative motor weakness without error, but failed to predict four instances of postoperative sensory deficit. Intraoperative SSEP monitoring was not 100% accurate in predicting postoperative sensory status and failed to predict five instances of postoperative motor deficit. As a result of intraoperative TES findings, the surgical plan was altered or otherwise influenced in six patients (roughly 15% of the sample population), possibly limiting the extent of postoperative motor deficit experienced by these patients. CONCLUSIONS: This novel method for intraoperative monitoring of spinal motor conduction appears to meet all of the goals outlined above. Although the risk of postoperative motor deficit is relatively low for the majority of spine surgeries (for example, a simple disc), high-risk procedures, such as tumor resection, correction of vascular

abnormalities, and correction of major deformities, should benefit from the virtually immediate and accurate knowledge of spinal motor conduction provided by this new monitoring approach.

PMID: 9488299 [PubMed - indexed for MEDLINE]

65: J Oral Rehabil. 1997 Dec;24(12):920-8.

Electric versus magnetic transcranial stimulation of the trigeminal system in healthy subjects. Clinical applications in gnathology.

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This investigation is focused on the analysis of the masseter responses evoked by means of magnetic and electric stimulation of the cortex and root of the trigeminal system of 20 healthy subjects.

Moreover, in order to determine jaw elevation in centric occlusion, the analysis also focused on the motor response of the trigeminal bilateral roots evoked simultaneously using two stimulators. The masseter responses show a high level of symmetry in both latency and amplitude. The difference between the hinge axis in natural centric occlusion (CO) and in centric relation (CR) as determined by electric and magnetic transcranial stimulation is lesser than 2.5 mm. This is due to two main factors: (I) the response is evoked from the trigeminal motor neural pool involving all the masticatory muscles and hence simulating the natural 'muscular coactivation'; (ii) there is no manual manipulation to guide the jaw into the centric relation (CR). This method could be of some help for diagnosis in patients suffering from TMJ dysfunction who have lost stereognostic control over the jaw and display obvious signs of deviation during closure of the mandible.

PMID: 9467995 [PubMed - indexed for MEDLINE]

66: J Neurol Sci. 1997 Oct 22;151(2):217-21.

Spatial distribution of corticospinal potentials following transcranial electric and magnetic stimulation in human spinal cord.

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To investigate the spatial distribution of the human corticospinal tract in the spinal cord, evoked spinal cord potentials (ESCPs) following transcranial electrical and magnetic stimulation were recorded simultaneously from both the anterior and posterior epidural space in five anesthetized patients. One ESCP component following transcranial electrical stimulation (D-wave) and at least two ESCP components (initially D-wave and later I-wave) following transcranial magnetic stimulation were recorded in all subjects. The negative peak latency of all the potentials recorded from the posterior epidural space was the same as that recorded anteriorly. The amplitude ratio of the ESCP following electrical stimulation (posterior/anterior) was 1.10+/-0.12, while that of ESCPs following magnetic stimulation was 1.08+/-0.12 (N1) and 1.15+/-0.16 (N2). These results suggest that lateral

corticospinal tract descending dorsolateral fasciculus in the spinal cord is main corticospinal pathway and spatial distribution of D and I-waves are similar in the human cervical cord.

Publication Types:

Clinical Trial

PMID: 9349679 [PubMed - indexed for MEDLINE]

67: Neurosurgery. 1997 Dec;41(6):1319-25; discussion 1325-6.

Stereotactic transcranial magnetic stimulation: correlation with direct electrical cortical stimulation.

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Department of Neurosurgery, Massachusetts General Hospital, Harvard Medical School, Boston, Massachusetts, USA.

OBJECTIVE: To evaluate stereotactic transcranial magnetic stimulation (TMS) as a tool for presurgical functional mapping of human motor cortex. METHODS: Transcranial magnetic stimulation using a frameless stereotactic system was performed in two patients with tumors near the central sulcus. TMS motor function maps were plotted on the patients' three-dimensional volumetric magnetic resonance imaging data and compared with direct electrical cortical stimulation at surgery with the patient under local anesthesia. RESULTS: Stereotactic TMS was well tolerated by both patients and was consistent with known somatotopic representation of human motor cortex. The results demonstrated a good correlation between the TMS and electrical cortical stimulation maps, with all TMS responses eliciting more than 75% of the maximum motor evoked potential falling within 1 cm of the electrical cortical stimulation site. CONCLUSIONS: Our findings indicate that stereotactic TMS is feasible and can provide accurate noninvasive localization of cortical motor function. It may prove to be a useful method for presurgical planning.

Publication Types:

Case Reports

PMID: 9402583 [PubMed - indexed for MEDLINE]

68: Am J Vet Res. 1997 Dec;58(12):1473-8.

Rehabilitation of dogs with surgically treated cranial cruciate ligament-deficient stifles by use of electrical stimulation of muscles.

Johnson JM, Johnson AL, Pijanowski GJ, Kneller SK, Schaeffer DJ, Eurell JA, Smith CW, Swan KS.

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OBJECTIVE: To determine effect of electrical muscle stimulation (EMS) on rate and degree of return to function of the limb and development of degenerative joint disease (DJD) after surgical creation and subsequent stabilization of the cranial cruciate ligament (CrCL)-deficient stifle. ANIMALS: 12 clinically normal adult large (19.5 to 31.5 kg) dogs. PROCEDURE: Dogs were anesthetized, and the

right CrCL was severed via arthrotomy, destabilizing the stifle. After 3 weeks, the stifle was surgically stabilized. Three weeks later, 6 dogs were subjected to an EMS treatment protocol for the thigh muscles. At 5, 9, 13, and 19 weeks after stifle destabilization, treated (n = 6) and control (n = 6) dogs were evaluated for return of stifle function. Gross and histologic evaluations of the stifles were performed at 19 weeks after stifle destabilization. RESULTS: Treated dogs had significantly (P = 0.001) better lameness score than did control dogs. There was less palpable crepitation of the stifle in treated dogs (P = 0.06); treated dogs also had significantly (P = 0.01) fewer radiographic signs of bone changes. Thigh circumference was significantly (P = 0.02) larger in treated dogs. There was less gross cartilage damage (P = 0.07) in the EMS-treated dogs, but more medial meniscal damage (P = 0.058, cranial pole; P = 0.051, caudal pole). CONCLUSIONS: Improved lameness scores, larger thigh circumference, and decreased radiographically apparent bony changes observed for the treated group of dogs support the hypothesis that dogs treated by EMS after surgical stabilization of the CrCL-deficient stifle had improved limb function, with less DJD, than did dogs treated with the currently accepted clinical protocol of cage rest and slow return to normal activity. However, results of force plate evaluation did not support the hypothesis. Increased meniscal damage in dogs treated by EMS may be cause for concern.

PMID: 9401702 [PubMed - indexed for MEDLINE]

69: Brain Res. 1997 Jul 18;763(1):14-20.

Potentiation of fentanyl suppression of the jaw-opening reflex by transcranial electrical stimulation.

Alantar A, Azerad J, Limoge A, Robert C, Rokyta R, Pollin B.

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Stinus et al. [L. Stinus, M. Auriacombe, J. Tignol, A. Limoge, M. Le Moal, Transcranial electrical stimulation with high frequency intermittent current (Limoge's) potentiates opiate-induced analgesia: blind studies, Pain, 42 (1990) 351-363.] observed that transcranial electrical stimulation (TCES) with high-frequency intermittent current potentiated opiate-induced analgesia using the tail-flick test. In unanesthetized, chronic preparations, electrical stimulation (0.5 Hz) of the lower incisor pulp of rats elicits a short-(6 ms) and a long-latency (12-18 ms) jaw-opening reflex (JOR) without any evidence of aversive behavior [J. Azerad, F. Fuentes, I. Lendais, A. Limoge, B. Pollin, Methods for selective tooth pulp stimulation in acute and chronic preparations in rats, J. Physiol., 406 (1988) 3P.]. Fentanyl increases thresholds of both reflexes and transiently suppresses the long-latency JOR. We then decided to look at the influence of TCES on both drug-induced mean of maximal threshold variation (MMTV) and duration of JOR suppression period. These parameters have been investigated in 43 Wistar rats with or without TCES administered for 3 h before the drug injection and throughout the testing period. TCES alone has no effect. In contrast, it significantly increases the duration of the reflex suppression period (149 +/- 5% vs. control, P < 0.001) while fentanyl-increased reflex thresholds remain unchanged. The fentanyl-induced JOR suppression period returns to the control values 2 days later. When a second 3-h TCES session is delivered 2 or 4 days after the first TCES session, a similar increase of this suppression period is observed. Moreover, 2 days after a second TCES session, an increase of the duration of the fentanyl-induced JOR suppression period is systematically observed. In contrast, a 6-h TCES session never induces such effects. These results confirm a potentiating effect of TCES on opioid action and demonstrate the value of repeated TCES sessions.

PMID: 9272823 [PubMed - indexed for MEDLINE]

70: Brain. 1997 May;120 (Pt 5):839-53.

Comparison of activation of corticospinal neurons and spinal motor neurons by magnetic and electrical transcranial stimulation in the lumbosacral cord of the anaesthetized monkey.

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To illuminate the action of non-invasive stimuli on the human cerebral cortex, responses of corticospinal axons and of plantar alpha-motor neurons following transcranial magnetic (TMS) and electrical stimulation (TES) were recorded in the lumbosacral cord in the anaesthetized macaque monkey. A round coil was used for TMS, and the anode was located at the vertex for TES. The responses of 175 identified corticospinal axons (conduction velocities of 24-95 m/s) were recorded from the lateral corticospinal tract at the T12-L3 spinal level. A single magnetic or electrical stimulus could evoke an early spike corresponding to the direct (D) wave in surface recorded volleys and was termed a D response. In the same axon, up to four further spikes, termed indirect (I) responses, could also be evoked. At a given intensity of stimulation, D responses had clear thresholds and fixed latencies, whereas I responses were labile in both respects. For TMS and TES, the thresholds of both D and I responses were inversely correlated with axonal conduction velocity. For TMS, fast conducting axons (> 75 m/s) had lower thresholds for D responses, while more slowly conducting axons (< 55 m/s) had lower thresholds for I responses. Very few of the axons with a conduction velocity of < 40 m/s (three out of 23) gave a D response to TMS. For TES, the majority of axons had lower thresholds for D responses or a similar threshold for both D and I responses. At threshold, the latencies of D responses evoked by TMS and TES were consistent with activation within the cortex, while TES also excited some corticospinal axons deep to the cortex. At 2.5 times threshold for the D response, TMS still excited axons mostly within the cortex, but with TES the site of activation shifted by as much as 65 mm below the cortex (mode 20 mm). Intracellular responses were recorded in 23 plantar alpha motor neurons supplying intrinsic muscles of the foot. All showed monosynaptic excitatory post-synaptic potentials (EPSPs) to both TMS and TES with no significant differences in the rise times of the evoked EPSPs. At threshold for a surface corticospinal volley, the average EPSP to TES began 0.5 ms earlier than that to TMS, and 1.0 ms earlier at 2.5 times this threshold. The different sites of activation of corticospinal neurons by TMS and TES, as well as the different distribution of D and I responses that they evoke, may both contribute to the differences in the onset latencies of the EMG responses evoked by these methods in human subjects.

PMID: 9183254 [PubMed - indexed for MEDLINE]

71: Electroencephalogr Clin Neurophysiol. 1997 Apr;105(2):87-93.

Effects of transcranial electrical and magnetic stimulation on reciprocal inhibition in the human arm.

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We studied the effects of transcranial electrical stimulation (TES) and transcranial magnetic stimulation (TMS), delivered at intensities below the threshold for evoking an electromyographic response, on the disynaptic and presynaptic phases of reciprocal inhibition in 8 healthy subjects. After

TES, the H-reflex evoked in the flexor carpi radialis (FCR) muscle was strongly facilitated when the cortical stimulus was given 4.0-4.5 ms after the test stimulus (median nerve stimulus). TES reduced the disynaptic phase of reciprocal inhibition most strongly when the cortical stimulus followed the test stimulus by 3.0-3.5 ms. TES also reduced presynaptic inhibition, but with a time course that was identical to that of the facilitation of the uninhibited H-reflex. After subthreshold TMS, the facilitation of the H-reflex showed at least 2 peaks, one occurring when the cortical stimulus was given 2 ms after the test stimulus and the other when the cortical stimulus followed the test stimulus by 0.5 to -1.5 ms. The effects of TMS on the 2 phases of reciprocal inhibition were similar, and in both cases the disinhibitory effects had essentially the same time course as the facilitatory effect of TMS on the uninhibited H-reflex. The different effects of TES on the 2 phases of reciprocal inhibition provide evidence of the presynaptic nature of the second phase. The absence of a difference in the effect of TMS on the 2 phases could be due to the more temporally dispersed descending volley after TMS.

PMID: 9152200 [PubMed - indexed for MEDLINE]

72: Anesth Analg. 1996 Oct;83(4):771-5.

Transcutaneous cranial electrical stimulation (Limoge's currents) decreases early buprenorphine analgesic requirements after abdominal surgery.

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Transcutaneous cranial electrical stimulation with Limoge's currents (TCES) consists of high frequency, low intensity currents which decreased anesthetic requirements during elective surgery. This action is likely to be mediated by the release of central endogenous opioids. In the present study, we hypothesized that TCES applied intraoperatively may decrease early postoperative narcotic requirements. Thirty-nine ASA physical status I and II patients undergoing elective abdominal surgery were enrolled in this prospective, randomized, double-blind, placebo-controlled study. Just before induction of anesthesia, patients were connected to the electrical stimulator and randomly allocated to be either stimulated (TCES group, n = 20) or not (control group, n = 19) during surgery. The managing anesthesiologist was unaware of which group the patient was assigned. Postoperatively, patients were given a patient-controlled analgesia (PCA) device delivering buprenorphine for the first four postoperative hours. The recorded variables included postoperative buprenorphine requirements, pain scores (0-10 visual analog scale [VAS]), sedation (0-4 scale), and intraoperative isoflurane requirements. Patients were comparable with respect to age, sex ratio, weight, duration of surgery, intraoperative hemodynamics, fentanyl requirements, and time from skin closure to tracheal extubation. Buprenorphine requirements were significantly reduced in the TCES group versus the control group (2.36 vs 3.43 micrograms.kg-1.h-1; P = 0.002). Intraoperative isoflurane anesthetic requirements, as well as hourly postoperative scores for pain and sedation, were the same for the two groups. These data indicate that TCES reduces narcotic requirements for early postoperative analgesia. This technique might have potential to facilitate early postoperative analgesia in patients undergoing elective abdominal surgery.

Publication Types:

Clinical Trial

Randomized Controlled Trial

PMID: 8831319 [PubMed - indexed for MEDLINE]

73: Neurosurgery. 1996 Aug;39(2):335-43; discussion 343-4.

Transcranial high-frequency repetitive electrical stimulation for recording myogenic motor evoked potentials with the patient under general anesthesia.

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OBJECTIVE: To demonstrate the feasibility of transcranial high-frequency electrical stimulation with the patient under general anesthesia with propofol and alfentanil. This method may be a useful tool for intraoperative monitoring of the motor pathways during cerebral and spinal operations. METHODS: A short train from one to eight monopolar anodal electrical pulses was applied transcranially to the motor cortex with a frequency from 100 to 500 Hz in 10 patients. Myogenic motor evoked potentials (MEPs) were recorded from forearm flexor muscles, thenar, and hypothenar. Amplitude and latency of MEPs were evaluated after different stimulation parameters. This combination of anesthetic and transcranial stimulation technique allows recording of myogenic MEPs during general anesthesia, which was found not to be possible with single pulse transcranial stimulation. RESULTS: To elicit myogenic MEPs from the target muscles, stimulation had to be applied within the following parameters: minimum threshold intensity was 60 mA for forearm flexor and thenar and 80 mA for hypothenar; minimum number of pulses was two for forearm flexor muscles and thenar and three for hypothenar; minimum stimulation frequency was 200 Hz for thenar and hypothenar and 100 Hz for forearm flexor muscles. CONCLUSION: Transcranial high-frequency repetitive electrical stimulation seems to be a new method for monitoring the motor tract. With this method, it is possible to monitor the motor function without interfering with the surgical team or with the surgical treatment of infratentorial and spinal lesions. Monitoring of relaxation is necessary to compare the amplitude of MEPs.

PMID: 8832671 [PubMed - indexed for MEDLINE]

74: Neurosci Lett. 1996 May 24;210(1):45-8.

Direct and indirect activation of human corticospinal neurons by transcranial magnetic and electrical stimulation.

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Corticospinal volleys and surface electromyographic (EMG) responses evoked by magnetic and electrical transcranial stimulation were recorded simultaneously in three conscious human subjects. For magnetic stimulation, the figure-of-eight coil was held on the hand motor area either with the induced current through the brain flowing in a postero-anterior direction (P-A stimulation) or in a latero-medial direction (L-M stimulation). For electrical stimulation, the anode was placed 7 cm lateral to the vertex and cathode at the vertex (anodal stimulation). The P-A stimulation that was generally used preferentially evoked I waves, whereas the L-M and anodal stimulation preferentially evoked D wave. The results suggested that the mode of activation by transcranial magnetic stimulation altered,

depending on its current direction, and the difference between P-M magnetic and electrical stimulation can be explained by the context of the D and I hypothesis.

PMID: 8762188 [PubMed - indexed for MEDLINE]

75: Anesth Analg. 1996 Apr;82(4):744-9.

Variability of motor-evoked potentials recorded during nitrous oxide anesthesia from the tibialis anterior muscle after transcranial electrical stimulation.

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When recorded as a compound muscle action potential (CMAP), the motor-evoked potential (MEP) is affected by volatile anesthetics and nitrous oxide. However, MEPs recorded using epidural electrodes in the presence of nitrous oxide are highly reproducible from trial to trial. We wished to establish the reproducibility over time of the CMAP produced by supramaximal transcranial electrical stimulation of the human motor cortex. Cascades of 100 successive CMAPs were recorded from the tibialis anterior muscles of six anesthetized patients undergoing scoliosis surgery, in response to transcranial electrical stimuli of > 500 V. Satisfactory CMAPs could be recorded in the presence of nitrous oxide, but not isoflurane. Latencies and amplitudes were reproducible in repeated sequences of 100 responses. However, amplitude and, to a lesser extent, latency, were highly variable within a sequence. In addition, occasional individual stimuli, although rarely successive ones, failed to evoke a CMAP. CMAPs have a much higher trial-to-trial variability than corticospinal volleys recorded from the epidural space. Using the present methodology it would be difficult to rely on CMAP recordings as an indicator of corticospinal function in the clinical monitoring situation.

PMID: 8615491 [PubMed - indexed for MEDLINE]

76: Electromyogr Clin Neurophysiol. 1995 Oct;35(6):377-83.

Which structures are sensitive to painful transcranial electric stimulation?

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Electric transcranial stimulation (TCS) is useful for clinical studies. It is, however, painful and not generally used for awake subjects. By means of topical anaesthesia and nerve blockades we wanted to find out which structures of the scalp and cranium are sensitive to electric TCS. Altogether 21 subjects participated in the present study. Our data show that pain experienced by the subjects during electric TCS is brought about by activation of the pain receptors in the scalp under the stimulating electrodes. Topical anaesthetic cream is incapable of attenuating this pain. The periosteum does not seem to be much more sensitive electric stimulation than rest of the scalp. Furthermore, contractions of facial and neck muscles do not seem to have a significant role in pain generation in electric TCS. Pain can be prevented if sufficiently large areas of the scalp are properly anaesthetized before stimulation by e.g. blockade of the major nerves responsible for the sensation of the stimulus area.

PMID: 8785936 [PubMed - indexed for MEDLINE]

77: J Neurosci Methods. 1995 Sep-Oct;61(1-2):91-7.

Rapid on-line estimation of responses to transcranial magnetic and peripheral nerve electrical stimulation in single human motoneurons. Awiszus F, Feistner H.

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Cross-correlation experiments allow to obtain information about synaptic potentials in human motoneurons. However, recording cross-correlation responses of one motoneuron to transcranial magnetic and electrical peripheral nerve stimulation requires a considerable recording time when both responses are recorded consecutively. In this paper a method is introduced yielding the same information about the responses of a single motoneuron to both types of stimuli while requiring only a fraction of the recording time necessary for a conventional cross-correlation experiment. The main features of the method introduced were: (I) use of the recharging time of the magnetic stimulator for response recording to the electrical stimulus, (ii) use of specific stimulus timing with respect to the motor unit discharges, and (iii) on-line display with statistical testing of the response functions allowing to stop stimulus application, if the responses to both types of stimuli had reached statistical significance. Application of the method is demonstrated with response recording of 70 tibialis anterior motor units from five healthy volunteers to transcranial magnetic and peroneal nerve electrical stimulation.

PMID: 8618430 [PubMed - indexed for MEDLINE]

78: Anesthesiology. 1995 Aug;83(2):270-6.

Improved amplitude of myogenic motor evoked responses after paired transcranial electrical stimulation during sufentanil/nitrous oxide anesthesia.

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BACKGROUND: Measurement of motor evoked responses to transcranial stimulation (tc-MER) is a technique for intraoperative monitoring of motor pathways in the brain and spinal cord. However, clinical application of tc-MER monitoring is hampered because most anesthetic techniques severely depress the amplitude of motor evoked responses. Because paired electrical stimuli increase tc-MER responses in awake subjects, we examined their effects in anesthetized patients undergoing surgery.

METHODS. Eleven patients whose neurologic condition was normal and who were undergoing spinal or aortic surgery were anesthetized with sufentanil-N20-ketamine. Partial neuromuscular blockade (single-twitch height 25% of baseline) was maintained with vecuronium. Single and paired electrical stimuli were delivered to the scalp, and compound action potentials were recorded from the tibialis anterior muscle. The amplitude and latency of the tc-MERs were measured as the interval between paired stimuli was varied between 0 (single stimulus) and 10 ms. All recordings were completed before spinal manipulation or aortic clamping. RESULTS: Median amplitude of the tc-MER after a single stimulus was 106 microV (10th-90th percentiles: 23-1,042 microV), and the latency to onset

was 33.2 +/- 1.4 ms (SD). With paired stimuli (interstimulus interval 2-3 ms), tc-MER amplitudes increased to 285 (79-1,605) microV, or 269% of the single-pulse response (P < 0.01). Reproducibility of individual responses increased with paired stimulation. Onset latency decreased to 31.4 +/- 3.2 ms (P < 0.05). Maximum amplitude augmentation was observed with interstimulus intervals between 2 and 5 ms and in patients with low-amplitude responses after single-pulse stimulation. CONCLUSIONS: Application of paired transcranial electrical stimuli increases amplitudes and reproducibility of tc-MERs during anesthetic-induced depression of the motor system. The effect may represent temporal summation of stimulation at cortical or spinal sites. The results of this study warrant further clinical evaluation of paired transcranial stimulation.

PMID: 7631948 [PubMed - indexed for MEDLINE]

79: Eur Arch Otorhinolaryngol. 1994 Dec;:S227-9.

Electrical evaluation of the facial nerve in acoustic neuroma patients comparing transcranial magnetic stimulation and electroneurography.

Hoehmann D, DeMeester C, Duckert LG.

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PMID: 10774357 [PubMed - indexed for MEDLINE]

80: Electroencephalogr Clin Neurophysiol. 1994 Dec;93(6):417-20.

Facilitation and disfacilitation of muscle responses after repetitive transcranial cortical stimulation and electrical peripheral nerve stimulation.

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Compound muscle responses were recorded after repetitive electrical stimulation of the peripheral nerve and after transcranial electrical and magnetic stimulation in 5 healthy persons. The enlargement of the second response at intervals between 30 and 50 msec is more pronounced after cortical magnetic and electrical stimulation than after peripheral nerve stimulation. This difference is believed to be a result of facilitatory mechanisms involving the summation of effects from conditioning and test stimuli along the entire central motor pathway. The facilitation at 10 msec interval, which is only seen after magnetic, but not after electrical transcranial stimulation could indicate an intracortical mechanism.

PMID: 7529690 [PubMed - indexed for MEDLINE]

81: J Physiol. 1994 Nov 15;481 (Pt 1):243-50.

Transcranial electrical stimulation of the motor cortex in man: further evidence for the site of activation.

Rothwell J, Burke D, Hicks R, Stephen J, Woodforth I, Crawford M.

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1. The motor cortex was stimulated electrically (vertex anode; cathode 6 cm lateral) in neurologically normal subjects undergoing surgery for scoliosis, and the evoked corticospinal volleys were recorded from the spinal cord using epidural electrodes. 2. Stimuli > 330 V produced a complex D-wave volley containing three separate peaks, with high-threshold components, 0.8 ms (D2) and 1.6 ms (D3), in advance of the lowest-threshold component (D1). As stimuli increased up to 1500 V, D3 replaced the later components completely, but there was no further latency 'jump'. 3. Brainstem stimulation using electrodes over each mastoid process produced a descending volley that had the same latencies as D3. At threshold, stimulation of the brainstem or spinal cord attenuated the D wave evoked by simultaneous cortical stimulation. 4. It is concluded that transcranial electrical stimulation of the motor cortex at high intensities can access corticospinal neurones at the pyramidal decussation, and that stimulation of the brainstem (and the spinal cord) preferentially accesses corticospinal axons. At threshold, motor cortex stimulation probably activates corticospinal neurones at or near the cerebral cortex.

PMID: 7853247 [PubMed - indexed for MEDLINE]

82: Fiziol Cheloveka. 1994 Sep-Oct;20(5):12-8.

[Omega-potential dynamics during lateralized transcranial electric stimulation]

[Article in Russian]

Lomarev MP, Malinina SA, Kozhushko NIu, Eryshev OF, Eroshin SP.

PMID: 7843530 [PubMed - indexed for MEDLINE]

83: Electroencephalogr Clin Neurophysiol. 1994 Apr;93(2):113-20.

Magnetic transcranial and electrical stylomastoidal stimulation of the facial motor pathways in Bell's palsy: time course and relevance of electrophysiological parameters.

Glocker FX, Magistris MR, Rosler KM, Hess CW.

Department of Neurology, University of Berne, Switzerland.

Facial nerve motor neurography was performed at various times after the onset of Bell's palsy in 97 patients. Stimulation of the facial nerve was performed (1) electrically in the fossa stylomastoidea (ElStim), and (2) magnetically in the labryinthine segment of the facial canal (MagStim), evaluating different coil positions over the skull. Additionally, the face-associated motor cortex was stimulated magnetically in 47 patients (CxStim). A marked reduction of the amplitudes of the compound muscle action potentials (CMAP) evoked by MagStim on either m. nasalis or mentalis, or both, was observed which was clearly more pronounced than the amplitude reduction to ElStim. This discrepancy occurred very early during the disease, the mean amplitude (expressed in percent of the amplitude on the unaffected side) being 82% (S.D. 9.1) for ElStim and 1% (2.7) for MagStim at days 0-4. It persisted for several months, often when facial nerve function had recovered to normal, as assessed by clinical observation, ElStim, and CxStim. This amplitude decrease to MagStim, which appears to

be related to a locally enhanced stimulation threshold of the facial nerve, is a very sensitive and reproducible finding in Bell's palsy. It may prove specific of the disorder, of diagnostic value, and of interest in the follow-up of patients during treatment trials.

PMID: 7512917 [PubMed - indexed for MEDLINE]

84: Acta Neurol Scand. 1994 Jan;89(1):15-7.

Transcranial electrical stimulation in patients with apallic syndrome.

Inghilleri M, Formisano R, Berardelli A, Saltuari L, Gerstenbrand F, Manfredi M.

Department of Neurological Sciences, University La Sapienza, Rome, Italy.

Muscle responses (MEPs) to transcranial electrical stimulation were studied in 7 patients with apallic syndrome. All the patients showed clinical signs of upper motor neurone impairment in the upper and lower limbs. MEPs were absent or markedly delayed in 4 of the 7 patients. Since patients with apallic syndrome show only minimal voluntary movement, transcranial stimulation is the only way to demonstrate abnormalities of fast corticospinal axons in these patients. Even though these patients often look similar clinically, with tetraplegia and decorticate or decerebrate posture, only some cases showed dysfunction of fast corticospinal neurons.

PMID: 8178621 [PubMed - indexed for MEDLINE]

85: J Physiol. 1993 Oct;470:383-93.

Erratum in: J Physiol (Lond) 1994 May 1;476(3):553.

Direct comparison of corticospinal volleys in human subjects to transcranial magnetic and electrical stimulation.

Burke D, Hicks R, Gandevia SC, Stephen J, Woodforth I, Crawford M.

Prince of Wales Medical Research Institute, University of New South Wales, Sydney, Australia.

1. The effects of graded transcranial magnetic and anodal electrical stimulation of the human motor cortex were compared in human subjects undergoing orthopaedic operations on the spine, before and after withdrawal of volatile anaesthesia. Corticospinal volleys were recorded from the spinal cord in the low-cervical and low-thoracic regions (six subjects) or the mid-thoracic region (two subjects) using bipolar electrodes inserted into the epidural space. 2. Electrical stimuli were delivered using anode at the vertex and cathode 7 cm laterally. The corticospinal volley at threshold consisted of a single deflection with a mean latency to peak of 4.17 ms at the rostral recording site. With further increases in stimulus strength the latency of this D wave shortened in two steps, first by 0.89 ms (seven subjects) and then by a further 0.8 ms (two subjects), indicating that the site of activation of some corticospinal neurones had shifted to deep subcortical sites. 3. When volatile anaesthetics were given, a corticospinal volley could not be defined in three subjects with magnetic stimuli of 70, 80 and 100% maximal stimulator output with the coil at the vertex (Novametrix Magstim 200, round coil, external diameter 14 cm). In the remaining five subjects, the component of lowest threshold was a D wave recorded at the rostral site at 4.0 ms when stimulus intensity was, on average, 70%. With stimuli of 90-100% a total of five small I waves could be defined in the five subjects (i.e. on average one I

wave per subject). 4. After cessation of volatile anaesthetics in seven subjects, the thresholds for D and I waves were lower and their amplitudes were greater. The D wave remained the component of lowest threshold in all subjects, appearing at the low-cervical level with magnetic stimuli of 50%. However, in three subjects I waves also appeared at D wave threshold, and the D wave was smaller than with electrical stimulation at I wave threshold. There was no consistent change in latency of the magnetic D wave as stimulus intensity was increased to 100%. 5. These findings suggest that the previously reported difference in latency of the EMG potentials produced in upper-limb muscles by anodal stimulation and magnetic stimulation of the human motor cortex is not because the corticospinal volley induced by magnetic stimulation lacks a D wave.(ABSTRACT TRUNCATED AT 400 WORDS)

PMID: 8068071 [PubMed - indexed for MEDLINE]

86: Electroencephalogr Clin Neurophysiol. 1993 Apr;89(2):131-7.

Transcranial electric and magnetic stimulation of the leg area of the human motor cortex: single motor unit and surface EMG responses in the tibialis anterior muscle.

Priori A, Bertolasi L, Dressler D, Rothwell JC, Day BL, Thompson PD, Marsden CD.

MRC Human Movement and Balance Unit, Institute of Neurology, London, UK.

We compared single motor unit and surface EMG responses in the active right tibialis anterior following anodal electrical or magnetic stimulation of the motor cortex over the vertex. Magnetic stimulation used a monophasic current pulse through a circular coil centred 3 cm anterior to the vertex. Lowest threshold magnetic stimulation occurred when the current in the coil flowed from the left to the right side at the posterior rim of the coil. Such stimulation produced single unit and surface EMG responses which had the same latency as those produced by anodal electric stimulation. If the direction of the magnetic stimulating current was reversed, response latencies became more variable from unit to unit, and on average they occurred 1.0 +/- 0.5 msec later. In single motor units anodal and magnetic post-stimulus time histogram (PSTH) peaks had the same duration. This was similar to the duration of the PSTH peaks produced by a single low intensity stimulus given to the common peroneal nerve. We conclude that magnetic stimulation can produce direct activation of corticospinal neurones to the tibialis anterior if the direction of induced current flow is optimal. This projection is likely to be either monosynaptic or oligosynaptic.

PMID: 7683603 [PubMed - indexed for MEDLINE]

87: Am J Physiol. 1993 Feb;264(2 Pt 1):G213-9.

Swallowing and upper esophageal sphincter contraction with transcranial magnetic-induced electrical stimulation.

Valdez DT, Salapatek A, Niznik G, Linden RD, Diamant NE.

Department of Medicine, University of Toronto, Ontario, Canada.

This study in three dogs explores the effect of magnetically induced electrical stimulation of the brain to induce swallowing and produce contraction of the upper esophageal sphincter (UES). Single stimuli were delivered at intervals from 15 s to 3 min. Studies were performed with and without

perfusion of fluid into the pharynx and upper esophagus. Results showed that magnetic stimulation produced a twitch contraction of the UES when stimulus intensity was above a threshold that varied between 14 and 20% of the stimulator output. Increasing stimulus intensity progressively increased twitch amplitude. Magnetic stimulation also induced swallowing, above a stimulus threshold similar to that for induction of the UES twitch contraction. Fluid perfusion augmented the ability of the magnetic stimulus to induce swallowing. We concluded that a magnetically induced single electrical stimulus of the cerebral cortex produces UES contraction and induces swallowing. The effect on swallowing is facilitated by sensory stimulation of the pharynx. This technique holds the potential for further study of 1) motor and sensory neural mechanisms involved in the control of swallowing and 2) the assessment and management of oropharyngeal dysphagia in humans.

PMID: 8447403 [PubMed - indexed for MEDLINE]

88: Adv Neurol. 1993;63:29-42.

Transcranial electrical and magnetic stimulation.

Beric A.

Department of Neurology, Hospital for Joint Diseases, New York University School of Medicine 10003.

Publication Types:

Review

PMID: 8279314 [PubMed - indexed for MEDLINE]

89: Anesth Analg. 1992 Oct;75(4):584-9.

Intraoperative monitoring of tibialis anterior muscle motor evoked responses to transcranial electrical stimulation during partial neuromuscular blockade. Kalkman CJ, Drummond JC, Kennelly NA, Patel PM, Partridge BL.

Department of Anesthesiology, University of Amsterdam, The Netherlands.

We studied the feasibility of recording motor evoked responses to transcranial electrical stimulation (tce-MERs) during partial neuromuscular blockade (NMB). In 11 patients, compound muscle action potentials were recorded from the tibialis anterior muscle in response to transcranial electrical stimulation during various levels of vecuronium-induced NMB. The level of NMB was assessed by accelerometry of the adductor pollicis muscle after train-of-four stimulation of the ulnar nerve. The compound muscle action potential was also recorded from the tibialis anterior muscle after direct stimulation of the peroneal nerve (—response) as an alternative means of assessing the degree of NMB. In all patients, tce-MERs could be recorded reliably during anesthesia with N2O and a continuous infusion of sufentanil (0.5 micrograms.kg-1.h-1). An intact train-of-four was present in all patients, and the amplitude of the first twitch was recorded and designated as the control value. Before administration of vecuronium, the —response amplitude was 9.6 +/- 3.6 (mean +/- SD) mV, and the tce-MER amplitude was 1.21 +/- 0.66 mV. Although administration of vecuronium (0.05 mg/kg) resulted in loss of the mechanical adductor pollicis response in 8 of the 11 patients, the —response and the tce-MER remained recordable. Subsequently, during an infusion of vecuronium,

adjusted to maintain one or two mechanical responses to train-of-four stimulation, the average — response to peroneal nerve stimulation was 5.2 +/- 2.5 mV (53% of the control value), and tce-MER amplitude was 0.59 +/- 0.36 mV (59% of the control value).(ABSTRACT TRUNCATED AT 250 WORDS)

PMID: 1356320 [PubMed - indexed for MEDLINE]

90: Electroencephalogr Clin Neurophysiol. 1992 Aug;85(4):248-52.

Motor potentials of inferior orbicularis oculi muscle to transcranial magnetic stimulation. Comparison with responses to electrical peripheral stimulation of facial nerve.

Ghezzi A, Callea L, Zaffaroni M, Zibetti A.

Centro Studi Sclerosi Multipla, Ospedale di Gallarate, Universita di Milano, Gallarate, Italy.

Magnetic stimulation at the vertex evoked a motor potential (MP) in the inferior orbicularis oculi muscle of 10 healthy subjects with an onset latency of 8-13 msec. Its amplitude increased and its latency decreased when the muscle was contracted: the latency measured 9.5 +/- 1.3 msec with an intensity of stimulation 10-15% above threshold in the contracted muscle. This MP is secondary to excitation of the motor cortex. With the coil placed over the occipital scalp and the same stimulation intensity, an MP was recorded with an onset latency at 4.5 +/- 0.6 msec. This response reflects the activation of the facial nerve root. The peripheral electrical stimulation of the facial nerve at the mandible angle elicited an MP with an onset latency at 3.5 +/- 0.4 msec. Most records showed the presence of late components at about 30 msec for all types of stimulation.

PMID: 1380912 [PubMed - indexed for MEDLINE]

91: Acupunct Electrother Res. 1992 Jul-Sep;17(3):221-7.

Frequency-dependent effects of sine-wave cranial transcutaneous electrical nerve stimulation in human subjects.

Taylor DN, Lee CT.

National Development Institute, New York, NY 10013.

In a double-blind protocol, ninety healthy volunteer subjects received 30 minutes of constant current sine-wave cranial transcutaneous electrical nerve stimulation (TENS) of 5 Hertz (Hz), 100 Hz, or 2000 Hz frequency (current maintained below .5 mA for safety), placebo TENS, or no treatment. The five groups were compared on pre- to posttreatment changes in blood pressure, heart rate, peripheral temperature, and anxiety. Analysis showed significant reductions in systolic and diastolic blood pressure and heart rate after 100 Hz cranial TENS as compared to the other groups. No other differences achieved significance.

Publication Types:

Clinical Trial

Controlled Clinical Trial

PMID: 1357927 [PubMed - indexed for MEDLINE]

92: J Neurol. 1992 Apr;239(4):218-22.

Neurophysiological evaluation of sensorimotor functions of the leg: comparison of evoked cortical potentials following electrical and mechanical stimulation, long-latency muscle responses, and transcranial magnetic stimulation.

Ackermann H, Thomas C, Guschlbauer B, Dichgans J.

Neurologische Universitatsklinik, Tubingen, Federal Republic of Germany.

Twenty-two patients with localized lesions of the central nervous system (unilateral cerebral ischaemia, cervical myelopathy, spinal tumour, familial spastic paraplegia) underwent neurophysiological evaluation of sensorimotor deficits of the leg. Functional methods using muscle stretch as stimulus, i.e. long-latency muscle responses and cortical potentials evoked by dorsiflection of the foot, were compared with transcranial magnetic stimulation and somatosensory evoked cortical potentials following electrical stimulation of the posterior tibial nerve. The functional neurophysiological methods yielded no diagnostic superiority with respect to the procedures using artificial (i.e. magnetic and electrical) stimulation. However, in most cases of missing compound motor action potentials following transcranial magnetic stimulation or missing electrically evoked cortical potentials, the long-latency muscle responses still allowed quantitative assessment of sensorimotor function.

PMID: 1597688 [PubMed - indexed for MEDLINE]

93: Anesthesiology. 1992 Apr;76(4):502-9.

Effects of propofol, etomidate, midazolam, and fentanyl on motor evoked responses to transcranial electrical or magnetic stimulation in humans.

Kalkman CJ, Drummond JC, Ribberink AA, Patel PM, Sano T, Bickford RG.

University of California, San Diego.

The effects of propofol, etomidate, midazolam, and fentanyl on motor evoked responses to transcranial stimulation (tc-MERs) were studied in five healthy human volunteers. Each subject, in four separate sessions, received intravenous bolus doses of propofol 2 mg.kg-1, etomidate 0.3 mg.kg-1, midazolam 0.05 mg.kg-1, and fentanyl 3 micrograms.kg-1. Electrical tc-MERs (tce-MERs) were elicited with anodal stimuli of 500-700 V. Magnetic tc-MERs (tcmag-MERs) were elicited using a Cadwell MES-10 magnetic stimulator at maximum output. Compound muscle action potentials were recorded from the tibialis anterior muscle. Duplicate tce-MERs and tcmag-MERs were recorded before and up to 30 min after drug injection. Reproducible baseline tce-MERs (amplitude 4.7 +/- 0.43 (SEM) mV, latency 29.4 +/- 0.35 ms) and tcmag-MERs (amplitude 3.7 +/- 0.43 mV, latency 31.1 +/- 0.39 ms) were obtained in all subjects. Pronounced depression of tce-MER amplitude to 2% of baseline values (P less than 0.01) was observed 2 min after injection of propofol. Thirty minutes after injection of propofol, amplitude depression to 44% of baseline (P less than 0.05) was still present, despite an apparent lack of sedation. Midazolam caused significant (P less than 0.01) amplitude depression, e.g., tcmag-MER to 16% of baseline values 5 min after injection. Significant depression

persisted throughout the 30-min study period. Fentanyl did not cause any statistically significant amplitude changes in this small population. Etomidate caused significant but transient depression of tc-MER amplitude. However, there was considerable intersubject variability. Latency did not change significantly after any drug.(ABSTRACT TRUNCATED AT 250 WORDS)

PMID: 1550274 [PubMed - indexed for MEDLINE]

94: Am J Otol. 1992 Mar;13(2):113-6.

Electrical evaluation of the facial nerve in acoustic neuroma patients: preliminary comparison between transcranial magnetic coil stimulation and electroneurography.

Duckert LG, Hohmann D, DeMeester C.

Department of Otolaryngology-Head and Neck Surgery, University of Washington, Seattle 98195.

Subclinical involvement of the facial nerve by acoustic neuromas may be identified preoperatively using conventional electroneurography (ENoG). The clinical application of extratemporal stimulation distal to the stylomastoid foramen is limited in these cases by the more proximal site of the lesion. Transcranial magnetic coil stimulation (MCS) is a noninvasive means by which the facial nerve is stimulated at the level of the motor cortex or the brain stem, before it enters the internal auditory canal. Topographically such an assessment may have more diagnostic relevance than other forms of electrical stimulation in acoustic neuroma patients. To test this theory the facial nerves of 20 patients with acoustic neuromas were stimulated using ENoG and MCS preoperatively and 1 week postoperatively. Stimulation parameters were comparable and included threshold and suprathreshold levels of stimulation while compound action potential amplitudes and early and late response latencies were monitored. Facial nerve function was assessed clinically using the Stennert grading system. All the patients had clinically normal facial nerve function preoperatively. Normative data suggested a close correlation between threshold and suprathreshold amplitudes generated by both ENoG and MCS. To the contrary, in the pathologic ears there was a higher incidence of stimulus response abnormality determined by MCS than by ENoG. A comparison of these data, tumor size, and postoperative results promotes further evaluation of MCS as a prognostic index in acoustic neuroma patients.

PMID: 1599000 [PubMed - indexed for MEDLINE]

95: Anesthesiology. 1992 Feb;76(2):253-60.

Transcranial electrical stimulation with Limoge's currents decreases halothane requirements in rats. Evidence for the involvement of endogenous opioids.

Mantz J, Azerad J, Limoge A, Desmonts JM.

Department of Anesthesiology, Hospital Bichat, Paris, France.

Transcutaneous cranial electrical stimulation with Limoge's currents has been shown to facilitate anesthesia/analgesia in surgical patients. However, the neurobiologic substrate of this effect remains unknown. The present study was designed to analyze the influence of transcranial electrical stimulation (TCES) on halothane requirements in rats and the contribution of the central endogenous opioid, alpha 2-adrenergic and 5-hydroxytryptamine (5-HT1 and 5-HT2) serotonergic systems to this

effect. The influence of TCES on the MAC of halothane (MACH) and its reversibility by a subcutaneous 2 mg/kg naloxone injection were first determined in 20 rats using a randomized blinded protocol. MACH was decreased markedly in stimulated animals (TCES, n = 10) in comparison with sham-operated nonstimulated rats (controls, n = 10): MACH = 0.60 +/- 0.15, mean +/- SD, versus 1.07 +/- 0.05 vol%, P less than 0.001. In TCES animals, naloxone administration restored MACH values to the levels of controls but failed to affect MACH in controls. The influence of the duration of TCES applied prior to MACH determination was further investigated in 30 animals. The magnitude of MACH reduction was significantly increased with the cumulative duration of stimulation. For each duration of stimulation tested, administration of a 5-micrograms intracerebroventricular (icv) dose of the enkephalinase inhibitor thiorphan significantly enhanced TCES effects (P less than 0.05). Finally, the icv administration of a 15-micrograms naloxone dose appeared to reverse completely the MACH reduction elicited by TCES (n = 8, P less than 0.01).(ABSTRACT TRUNCATED AT 250 WORDS)

PMID: 1736702 [PubMed - indexed for MEDLINE]

96: Percept Mot Skills. 1992 Feb;74(1):259-64.

Perception of different frequencies of cranial transcutaneous electrical nerve stimulation in normal and HIV-positive individuals.

Taylor DN, Wallace JG, Masdeu JC.

City University of New York, NY.

Sine-wave transcutaneous electrical nerve stimulation (TENS) of varying frequencies applied across the cranium (ear to ear) has been demonstrated to evoke three different noncutaneous sensations in three discrete, nonoverlapping frequency bands in normal, healthy subjects. This report describes two studies which evaluate perception of these cranial TENS-evoked, frequency-dependent sensations in normal and HIV-positive individuals. In Exp. I, all of 50 normal, healthy subjects reported perceiving the same three noncutaneous sensations in the same three nonoverlapping frequency bands as long as stimulated and over repeated trials. In Exp. II, 34 HIV-positive individuals (14 asymptomatic, 9 ARC, 11 AIDS) who were free of neurological symptoms differed significantly from 10 normal, healthy controls, and from the norms observed in Exp. I, on perception of the three different TENS-evoked sensations. Also, inability to maintain perception of the stimulus over repeated trials, observed only in the HIV-positive individuals, increased significantly with severity of HIV infection.

PMID: 1313960 [PubMed - indexed for MEDLINE]

97: Anesth Analg. 1991 Oct;73(4):410-5.

Low concentrations of isoflurane abolish motor evoked responses to transcranial electrical stimulation during nitrous oxide/opioid anesthesia in humans.

Kalkman CJ, Drummond JC, Ribberink AA.

Department of Anesthesiology, University of California, San Diego, La Jolla 92093-0629.

To study the feasibility of noninvasive monitoring of motor pathways in anesthetized patients, we evaluated the effect of isoflurane on motor evoked responses to constant-voltage transcranial electrical stimulation (tce-MERs). Reproducible tce-MERs were recordable from the tibialis anterior

muscle during nitrous oxide/opioid anesthesia in 11 patients. Before the introduction of isoflurane, tce-MER onset latency was 30.8 +/- 1.9 ms, and amplitude ranged from 19 microV to 2.6 mV (median, 209 microV). Operating conditions necessitated neuromuscular blockade in three patients before administration of isoflurane. In the remaining eight patients, introduction of isoflurane in low concentrations resulted in an immediate increase in the latency and a decrease in the amplitude of tce-MERs. The tce-MERs were completely obliterated in all subjects at end-tidal isoflurane concentrations between 0.2% and 0.6% (median, 0.24%). After discontinuation of isoflurane, the tce-MER returned in all patients. The authors conclude that, during nitrous oxide/opioid anesthesia, with the stimulus and recording variables used, isoflurane even at very low concentrations precludes recording of tce-MERs.

PMID: 1832825 [PubMed - indexed for MEDLINE]

98: Electroencephalogr Clin Neurophysiol. 1991 Oct;81(5):389-96.

Electrical and magnetic transcranial stimulation in patients with corticospinal damage due to stroke or motor neurone disease.

Berardelli A, Inghilleri M, Cruccu G, Mercuri B, Manfredi M.

Dipartimento Scienze Neurologiche, Universita La Sapienza, Rome, Italy.

Twenty patients with hemiplegia and 13 patients with motor neurone disease were studied with electrical and magnetic transcranial stimulation. Motor evoked potentials were recorded from the biceps, thenar and tibialis anterior muscles. In both groups of patients magnetic stimulation with a Novametrix stimulator revealed fewer abnormalities than electrical stimulation with a Digitimer D180 stimulator. In patients with hemiplegia, motor evoked potentials after electrical stimulation were absent in 70% of muscles, delayed in 22% and normal in 8%; after magnetic stimulation, they were absent in 53% of muscles, delayed in 28% and normal in 19%. In patients with motor neurone disease, motor evoked potentials after electrical stimulation were absent in 62% of muscles, delayed in 10%, and normal in 29%; after magnetic stimulation, they were absent in 45% of muscles, delayed in 15%, and normal in 40%. The reason why magnetic stimulation reveals fewer abnormalities than electrical stimulation could be that magnetic stimulation repetitively discharges the pyramidal cells and, because of temporal summation mechanisms, produces more powerful excitatory potentials at the lower motoneurone synapse.

PMID: 1718725 [PubMed - indexed for MEDLINE]

99: Ann Neurol. 1991 Jun;29(6):646-50.

Motor responses after transcranial electrical stimulation of cerebral hemispheres with a degenerated pyramidal tract.

Fries W, Danek A, Witt TN.

Neurologische Klinik, Klinikum Grosshadern, Munich, Germany.

Motor responses were evoked in the thenar muscles by transcranial electrical cortex stimulation in 5 stroke patients with an isolated lacuna in the internal capsule, in whom wallerian degeneration of the pyramidal tract was demonstrated in vivo. Suprathreshold stimulation of the affected hemisphere

elicited bilateral motor responses; whereas, stimulation at identical intensities of the undamaged hemisphere yielded strictly unilateral responses in the contralateral hand, like the responses of all normal control subjects. Focused magnetic brain stimulation was performed in 1 patient and gave identical results. Because muscular excitability to cortical stimulation is preserved in spite of pyramidal tract disruption, other pathways must bypass the lesion. Because of the bilaterality of responses, we suggest polysynaptic corticoreticulospinal connections.

PMID: 1892367 [PubMed - indexed for MEDLINE]

100: Exp Brain Res. 1991;83(2):403-10.

Effects of electric and magnetic transcranial stimulation on long latency reflexes.

Deuschl G, Michels R, Berardelli A, Schenck E, Inghilleri M, Lucking CH.

Neurologische Klinik und Poliklinik, Universitat Freiburg, Federal Republic of Germany.

The interaction of transcranial electric and magnetic brain stimulation with electrically elicited short- and long latency reflexes (LLR) of hand and forearm flexor muscles has been investigated in normal subjects. In the first paradigm, the motor potential evoked in thenar muscles by transcranial stimulation was conditioned by median nerve stimulation at various conditioning-test intervals. At short intervals (electric: 5-12.5 ms, magnetic: 0-7.5 ms) facilitation occurred that corresponded to the H-reflex and at longer intervals (electric: 25-40 ms, magnetic: 22.5-35 ms) there was a facilitation corresponding to the LLR. Electric and magnetic stimulation resulted in a similar degree of facilitation. A second paradigm investigated the facilitation of the forearm flexor H-reflex by a cutaneo-muscular LLR elicited by radial superficial nerve stimulation and transcranial stimulation used separately or together. When electric and magnetic brain stimulation were compared, magnetic brain stimulation was followed by significant extrafacilitation but electric stimulation was not. This result favours an interaction between the afferent volley eliciting the LLR and transcranial magnetic stimulation most likely at supraspinal level.

PMID: 2022246 [PubMed - indexed for MEDLINE]

101: Electromyogr Clin Neurophysiol. 1991 Jan-Feb;31(1):47-52.

Estimation of normal motor conduction velocity of spinal cord by using transcranial electric stimulation and F-wave study. Chang CW, Lien IN.

Department of Physical Medicine and Rehabilitation, National Taiwan University, Republic of China.

A non-invasive method for estimation of motor conduction velocity of the spinal cord was performed by transcranial electric stimulation of motor cortex and an F-wave study of the peripheral nerve. Fourty normal persons including 24 men and 16 women ranging in age from 24 to 55 years (mean, 32 years) participated in the study. With a transcortical electric stimulation over the motor cortex, both the conduction time to the contralateral abductor pollicis brevis and the anterior tibial muscles, and the amplitude of the muscle action potentials were recorded. F-wave studies were performed in the median and peroneal nerves. Motor spinal cord conduction velocity (SCCV) was calculated by measuring the distance from 7th cervical to 12th thoracic spinal processes and dividing by the central conduction time obtained by the motor evoked potential studies and the F-wave latencies. The results showed a motor SCCV of 63.3 +/- 8.6 (mean +/- 1 SD) m/sec in all subjects. There was no difference

in male and female groups. The conduction time from the motor cortex to the target muscles was not different in both sex groups correlating to the factor of body height. From these results the conclusion was made that the estimation of motor SCCV is measurable and provides valuable data in the detection of electrophysiological function of spinal motor pathways.

PMID: 2009825 [PubMed - indexed for MEDLINE]

102: Patol Fiziol Eksp Ter. 1991;(6):10-2.

[Nonspecific resistance of the body to transcranial electric stimulation in the analgesia regimen]

[Article in Russian]

Gritskevich NL, Gushchin GV, Katsnel'son IaS, Korneva EA, Lebedev VP, Lobzhanidze NSh, Fomicheva EE.

The authors studied the level of proteins in the acute phase of inflammation and the level of glucocorticoid hormones, the leukocyte composition, the functional activity of the peripheral blood phagocytes, and the body temperature in rabbits under normal conditions and in subcutaneous turpentine injection in transcranial electric stimulation in the analgesia regimen. Changes of the studied parameters and activation of the mechanisms of the organism's nonspecific resistance occurred on a model of aseptic inflammation. It is suggested that endogenous opioid peptides play a significant role in these changes.

PMID: 1818274 [PubMed - indexed for MEDLINE]

103: Exp Brain Res. 1991;87(2):402-6.

Corticobulbar and corticospinal projections to neck muscle motoneurons in man. A functional study with magnetic and electric transcranial brain stimulation.

Berardelli A, Priori A, Inghilleri M, Cruccu G, Mercuri B, Manfredi M.

Dipartimento di Scienze Neurologiche, Universita' di Roma "La Sapienza", Italy.

The cortical projections to neck muscle motoneurons were studied in normal subjects by electrical and magnetic transcranial brain stimulation. After magnetic stimulation with a large coil, motor evoked potentials were present in about 20% of relaxed and 100% of contracting neck muscles. The latency of these responses was short: about 7 ms in the sternomastoid and splenius and 9 ms in the trapezius muscles. Subtraction of the —wave latency after stimulation of the accessory nerve at the skull base resulted in a central latency of about 4.5 ms. We suggest that rapid cortical projections connect with neck muscle motoneurons mono or disynaptically. The latency difference between the responses after electrical and magnetic stimulation was smaller in neck than in limb muscles but similar to that seen in masticatory muscles. A small magnetic coil was used to study the pattern of functional lateralization of cortical projections to neck muscle motoneurons; the projections for the sternomastoid and splenius are bilateral but predominantly contralateral, whereas those for the trapezius are exclusively contralateral.

PMID: 1769390 [PubMed - indexed for MEDLINE]

104: Acupunct Electrother Res. 1991;16(1-2):65-74.

Effects of cranial transcutaneous electrical nerve stimulation in normal subjects at rest and during psychological stress.

Taylor DN, Lee CT, Katims JJ.

Department of Psychology, City University of New York, Brooklyn College 11210.

Some effects of sub-threshold sine-wave transcutaneous electrical nerve stimulation (TENS), passed between earlobe electrodes at a constant alternating current (AC) frequency of 100 Hertz (Hz), were investigated in 90 normal subjects after 30 minutes of treatment, and after 3 minutes of standardized mental stress (mental arithmetic) which immediately followed the 30 minute treatment. In a double-blind protocol, five groups received 1) active TENS during treatment and active TENS during stress; 2) active TENS during treatment and placebo TENS during stress; 3) placebo TENS during treatment and placebo TENS during stress; 4) placebo TENS during treatment and active TENS during stress; and 5) no treatment during both treatment and stress. Results showed significant reductions in systolic blood pressure, pulse rate and anxiety, but not in diastolic blood pressure or peripheral vascular tension, after 30 minutes of active TENS as compared to no treatment. No placebo TENS effect was observed. No significant differences were observed between active TENS; placebo TENS and no treatment in physiological or psychological response to the stress procedure. Results are discussed in terms of the applicability of this technique to the management of stress.

Publication Types:

Clinical Trial

Controlled Clinical Trial

PMID: 1674835 [PubMed - indexed for MEDLINE]

105: Zh Nevropatol Psikhiatr Im S S Korsakova. 1991;91(7):75-8.

[Transcranial electric stimulation therapy in the treatment of neurocirculatory asthenia]

[Article in Russian]

Akimov GA, Zabolotnykh VA, Lebedev VP, Zabolotnykh II, Chuprasova TV, Afoshin SA, Rozanov SI, Kassin PL, Preobrazhenskaia SL.

Transcranial electric stimulation (TES), a combination of direct and pulse current totally up to 5 mA, rectangular impulses lasting 3-4 ms at a frequency of 75-80 Mz, via frontal and retromastoid electrodes was carried out for 30 minutes every other day. The treatment consisted of 7 to 10 sessions. Overall 189 patients suffering from vegetovascular dystonia were examined. Of these, 114 persons (group I) received pharmacotherapy and TES, 61 TES (group II), and 14 were on placebo. 83% of the group I patients and 80.3% of the group II patients manifested an appreciable improvement of the well-being which was supported by the data of its general estimation. 22 patients were examined for blood beta-endorphin. It has been shown that its concentration increased and returned to normal during TES.

Publication Types:

Clinical Trial

Controlled Clinical Trial

PMID: 1661490 [PubMed - indexed for MEDLINE]

106: Klin Med (Mosk). 1990 Sep;68(9):37-9.

[Cranial electric stimulation in the treatment of patients with initial stages of hypertension and signs of masked depression]

[Article in Russian]

Mel'nikova TS, Podzolkov VI.

PMID: 2290324 [PubMed - indexed for MEDLINE]

107: Pain. 1990 Sep;42(3):351-63.

Transcranial electrical stimulation with high frequency intermittent current (Limoge's) potentiates opiate-induced analgesia: blind studies.

Stinus L, Auriacombe M, Tignol J, Limoge A, Le Moal M.

INSERM U259, Universite de Bordeaux II, France.

Transcutaneous cranial electrical stimulation (TCES) with high frequency (166 kHz) intermittent current (100 Hz: Limoge current) has been used for several years in cardiac, thoracic, abdominal, urological and micro-surgery. The main benefits are a reduced requirement for analgesic drugs, especially opiates, and a long-lasting postoperative analgesia. We have confirmed these clinical observations in rats using the tail-flick latency (TFL) test to measure pain threshold. TCES was not found to modify the pain threshold in drug-free rats, but it potentiated morphine-induced analgesia (systemic injection). To obtain a maximal effect, the stimulation must be initiated 3 h before the drug injection and be maintained throughout the duration of its pharmacological action. TCES potentitation was found to depend on the dose of the drug, the intensity of the current and the polarity of electrodes. These findings were confirmed by blind tests of the efficiency of TCES on several opiate analgesic drugs currently used in human surgery (morphine, fentanyl, alfentanil and dextromoramide). The analgesic effect of these 4 opiates (TFL as % of baseline without or with TCES) were respectively: 174%, 306%; 176%, 336%; 160%, 215%; and 267%, 392%. The results were obtained not only after systemic opiate treatment, but also after intracerebroventricular injection of morphine (10 micrograms; analgesic effect 152%, 207% with TCES) suggesting that TCES potentiation of opiate-induced analgesia is centrally mediated.

PMID: 2250924 [PubMed - indexed for MEDLINE]

108: Otolaryngol Head Neck Surg. 1990 Sep;103(3):439-42.

Magnetic transcranial and electric direct stimulation of the facial motor cortex in dogs.

Estrem S, Haghighi S, Davis WE.

Division of Otolaryngology, University of Missouri-Columbia 65212.

Magnetic stimulation may allow noninvasive study of the entire course of the facial nerve. Our goal was to determine if evoked muscle action potentials can be obtained in facial musculature using electric direct cortical and noninvasive transcranial magnetic stimulation of the canine motor cortex. Thirty-four dogs were studied with electric direct cortical stimulation through a craniotomy and magnetic transcranial stimulation of the facial motor cortex. Facial nerve stimulation in the cerebellopontine angle allowed comparison to cortical responses. Latencies of 6.08 and 9.52 msec for orbicularis oculi and levator nasolabialis, respectively, were determined with magnetic transcranial stimulation, compared with 4.22 and 5.78 msec with electric direct cortical stimulation. In conclusion, magnetic stimulation of the facial motor cortex is possible in dogs, with longer central conduction times than with electric direct stimulation.

PMID: 2122375 [PubMed - indexed for MEDLINE]

109: Neurosci Lett. 1990 Apr 20;112(1):54-8.

Descending volley after electrical and magnetic transcranial stimulation in man.

Berardelli A, Inghilleri M, Cruccu G, Manfredi M.

Dipartimento Scienze Neurologische, Universita di Roma La Sapienza, Italy.

The descending volley evoked by electrical and magnetic transcranial stimulation was recorded with spinal electrodes in 3 subjects undergoing spinal surgery. The descending volley evoked by electrical stimulation, as previously described, was composed by a short-latency initial wave followed by later waves. In two subjects magnetic stimulation evoked an initial wave of slightly longer latency (0.2-0.3 ms), smaller amplitude and higher threshold than the initial wave evoked by electrical stimulation. In these two subjects, magnetic stimuli probably activated the pyramidal axons directly. In the third subject the initial wave evoked by magnetic stimulation had a latency of 1.4 ms longer and a considerably smaller amplitude than that evoked by electrical stimulation. In this case magnetic stimulation may activate the pyramidal axons indirectly.

PMID: 2385364 [PubMed - indexed for MEDLINE]

110: Eur J Pharmacol. 1990 Jan 10;175(2):187-95.

Trans-cranial electrical stimulation attenuates abrupt morphine withdrawal in rats assayed by remote computerized quantification of multiple motor behavior indices.

Dougherty PM, Dong WQ, Faillace LA, Dafny N.

Department of Neurobiology and Anatomy, University of Texas Health Science Center, Houston 77225.

The goal of the present study was to assess the effects of trans-cranial electrical stimulation on the behavioral signs of the abrupt withdrawal syndrome of rats. However, this goal also necessitated the

introduction of an experimental model measuring animal behavior for prolonged periods of time using a computerized animal activity monitoring system to quantify spontaneous motor activities associated with abstinence behavior. Comparable withdrawal severity was obtained by both the activity monitoring system and investigator observation of motor signs of abstinence behavior. Moreover, using this system we demonstrate a time-dependent effect of electrical stimulation in reducing the severity of various indices of motor hyperactivity associated with abrupt morphine withdrawal in rats.

PMID: 2311653 [PubMed - indexed for MEDLINE]

111: Vestn Khir Im I I Grek. 1989 Nov;143(11):106-7.

[Anesthesiologic procedures based on the use of transcranial electric stimulation of the antinociceptive system in surgery of the lungs]

[Article in Russian]

Katsnel'son IaS, Leosko VA, Lebedev VP, Khorokhordin NE, Fan AB.

PMID: 2534446 [PubMed - indexed for MEDLINE] 112: Funct Neurol. 1989 Jul-Sep;4(3):299-300.

Influence of anesthetics on the electromyographic response evoked by transcranial electrical cortex stimulation.

Zentner J.

Publication Types:

Letter

PMID: 2792866 [PubMed - indexed for MEDLINE]

113: Electromyogr Clin Neurophysiol. 1989 Mar;29(2):93-7.

Modified impulse diminishes discomfort of transcranial electrical stimulation of the motor cortex.

Zentner J, Neumuller H.

Transcranial electrical stimulation of the motor cortex has been developed in 1980 for electrophysiological assessment of the descending pathways. However, the widespread use of this procedure is limited by its painfulness due to simultaneous excitation of the sensory receptors and muscles of the scalp, especially if higher stimulus strengths are necessary in patients with motor deficits to evoke electromyographic responses. The present invention concerns a device which allows modification of the impulse delivered by a commercially available motor stimulator. By interruption on the exponentially decreasing impulse, "cutting" it after a freely selectable time by a low resistant short circuit on the patient's side, discomfort due to excitation of the sensory receptors and muscles of the scalp can be diminished with identical electromyographic responses regarded amplitudes and latencies of the potentials, thus making electrical stimulation less painful. Considering the applied charges we found a marked reduction of charge per phase using the modified impulse as compared to the original one with the difference increasing linearily depended on the preselected voltage.

PMID: 2707146 [PubMed - indexed for MEDLINE]

114: Brain Res. 1989 Feb 6;479(1):98-104.

Electric vs magnetic trans-cranial stimulation of the brain in healthy humans: a comparative study of central motor tracts 'conductivity' and 'excitability'.

Caramia MD, Pardal AM, Zarola F, Rossini PM.

Dipartimento di Sanita Pubblica, II Universita di Roma Tor Vergata, Italy.

Motor evoked potentials (MEPs) were elicited in the thenar muscles of 11 healthy volunteers via individual electric unifocal and magnetic trans-cranial stimuli (TCS). The effects of TCS strength, of the muscular state (relaxed, contracted) as well as of the amplitude-latency characteristics and the duration of the motor tracts central conduction times (CCTs) to hand muscles, were evaluated and compared between the two types of brain excitation. MEPs with the shortest latency (18.91 +/- 1.31 ms) were recorded in the voluntarily contracted muscle during electric TCS, whilst those with maximal latency (23.3 +/- 1.63 ms) were found after magnetic TCS with an intensity at threshold for eliciting an MEP of about 0.1 mV in the relaxed muscle. Mean CCTs for electric and magnetic TCS calculated in the contracted target muscles, were respectively 5.07 +/- 0.51 and 6.34 +/- 0.46 ms. MEPs with larger amplitudes and durations were observed during magnetic TCS, being maximal when suprathreshold stimuli were delivered. A restricted range of liminar values of magnetic TCS was obtained by defining the threshold for raising motor responses in complete muscle relaxation, indicating that magnetic pulses might represent a useful probe for testing the 'excitability' of the motor tracts.

PMID: 2924156 [PubMed - indexed for MEDLINE]

115: Neurosurgery. 1989 Feb;24(2):253-6.

Influence of anesthetics--nitrous oxide in particular--on electromyographic response evoked by transcranial electrical stimulation of the cortex.

Zentner J, Kiss I, Ebner A.

Department of Neurosurgery, University of Freiburg, Medical School, Federal Republic of Germany.

The influence of anesthetics usually used for neuroleptic anesthesia--nitrous oxide, fetanyl, flunitrazepam, and thiopental sodium--on motor evoked potentials (MEP) was examined in 15 patients during neurosurgical operations on the spinal cord, in 16 patients in traumatic coma, and in 6 healthy volunteers. MEP were recorded from the contralateral thenar and anterior tibial muscles in response to single transcranial electrical stimuli on the motor cortex. Intraoperatively, during neuroleptic anesthesia we found the amplitudes to be reduced to an average of 11% of the preoperative baselines for the thenar potentials, and to 7% of the preoperative baselines for the anterior tibial muscle potentials, despite a maximum stimulus strength of 750 V. A similar reduction of MEP amplitudes was observed in 6 volunteers during breathing of an oxygen/nitrous oxide mixture (34%/66%), whereas fentanyl, flunitrazepam, and thiopental had only a minor effect on MEP. We conclude that with respect to anesthesia-related suppression of amplitudes, an average of 5 to 15 electromyographic responses should be evaluated for intraoperative monitoring of MEP using the technique described here.

PMID: 2918976 [PubMed - indexed for MEDLINE]

116: Life Sci. 1989;44(26):2051-6.

Trans-cranial electrical stimulation attenuates the severity of naloxone-precipitated morphine withdrawal in rats.

Dougherty PM, Dafny N.

University of Texas Medical School, Department of Neurobiology and Anatomy, Houston 77225.

The expression of morphine withdrawal in rats has been demonstrated as dependent upon the integrity of specific brain regions. Focal intracranial electrical stimulation of some of these sites results in the attenuation of withdrawal severity. The present study demonstrates that electrical auricular stimulation, in a paradigm known to attenuate nociceptive responses of several brain nuclei, attenuates the severity of naloxone-precipitated morphine withdrawal in rats. This simple non-invasive treatment, based on long-standing principles of electroacupuncture, may provide a useful adjunct for therapy of the narcotic withdrawal syndrome.

PMID: 2747416 [PubMed - indexed for MEDLINE]

117: Neurologija. 1989;38(4):271-83.

Transcranial electrical and magnetic motor cortex stimulation: studies in intact man.

Zidar J, Zgur T, Kiprovski K.

The new method of transcranial electrical and magnetic brain stimulation was tested in 41 normal subjects. Stimulation on the scalp excites corticospinal neurones in the motor cortex while stimulation over the spine excites spinal nerve roots. The difference between EMG response latencies after both stimulations represents conduction in the central motor pathways and is called central motor latency (CML). The aim of out experiments was to investigate certain methodological aspects of the technique in order to standardize the procedure. Recordings were done from slightly contracted abductor digiti minimi and tibialis anterior muscles after electrical stimulation on the scalp and from the relaxed and contracted abductor digiti minimi and biceps brachii muscles after magnetic brain stimulation. Stimulation over the spine (C7/T1 interspace in case of upper limb muscles stimulation and T12/L1 interspace in case of tibialis anterior stimulation) was always electrical. Using a rather weak non-commercial magnetic stimulator we were not able to activate lower limb muscles, neither we succeeded to evoke responses from the relaxed arm muscles in all subjects. Electrical scalp stimulation proved successful in all cases. Muscle response after cortical stimulation in contracting muscles and shorter latencies and provided more accurate estimate of conduction time in the central motor pathways than responses in the relaxed muscles. Latencies should be measured from several superimposed responses and not from averaged ones. The intensity of stimulation over the neck did not affect CML. We nevertheless suggest that the strongest stimulus intensities should not be used in order to avoid CML overestimation.

PMID: 2702329 [PubMed - indexed for MEDLINE]

118: C R Seances Soc Biol Fil. 1989;183(4):329-36.

[Effect of transcranial electrical stimulation on sleep in rats] [Article in French]

Lendais I, Chaouloff F, Laude D, Limoge A, Elghozi JL.

Laboratoire d'Electrophysiologie, Faculte de Chirurgie dentaire, Montrouge.

Transcranial electrical stimulation with high frequency intermittent current (Limoge's current) was delivered to normal rats and to PCPA-treated rats with impaired sleep. Electrocorticogram was continuously recorded for quantifying the stage of the sleep-waking cycle. The current did not affect the sleep pattern of normal rats whereas the number of paradoxical sleep episodes increased in insomniac animals. The increased duration of paradoxical sleep in PCPA-treated rats favored the recovery of sleep in this group. The stimulation increased the brain serotonin turnover, which could possibly contribute to its hypnogenic action.

PMID: 2533519 [PubMed - indexed for MEDLINE]

119: EEG EMG Z Elektroenzephalogr Elektromyogr Verwandte Geb. 1988 Dec;19(4):216-21.

[Characteristics of electrical discharges by transcranial cortex stimulation activated motor units of the hand muscles of the human]

[Article in German]

Hess CW, Mills KR, Murray NM.

Neurologische Universitatsklinik Bern.

Using concentric needle electrode recording from hand muscles (abductor digiti minimi, first dorsal interosseus, or abductor pollicis brevis muscle) the latencies of single motor unit potentials in response to threshold magnetic brain stimuli were studied under different conditions. It has been shown that the motor units activated by threshold brain stimuli had the lowest threshold for voluntary activation (A = vol. activated, B = brain stim.). Onset latencies of 23 motor unit potentials from different sites in the relaxed muscles of four healthy subjects ranged from 22.4 to 32.4 ms (average: 26.4 ms; SD: 2.80 ms) but proved to be relatively stable when stimulating and recording conditions were kept constant (variation less than 0.5 ms, see poststimulus time histogram in Fig. 2). With concurrent contraction of an ipsilateral neighbouring or of the contralateral homologous muscle the motor unit potentials from the relaxed target muscle jumped to an earlier latency by 1.2 to 1.7 ms © in Fig. 3 and B-2 in Fig. 4). On one occasion another motor unit of higher threshold was alternatively activated by this procedure (B-3 in Fig. 4). Since the same procedures are known to enhance the compound muscle action potentials as recorded from the relaxed muscle with surface electrodes, the shorter latencies of single motor units are considered to be caused by a facilitatory influence on the motoneurones. A possible explanation for these latency shifts would be that the motor units discharge later in response to the brain stimulus induced repetitive cortico-spinal impulses when there is no facilitation, whereas during facilitation the firing level is reached earlier.(ABSTRACT TRUNCATED AT 250 WORDS)

PMID: 3145182 [PubMed - indexed for MEDLINE]

120: EEG EMG Z Elektroenzephalogr Elektromyogr Verwandte Geb. 1988 Dec;19(4):207-8.
[Transcranial magneto-electric stimulation]

[Article in German] Benecke R, Hess CW.
PMID: 3145180 [PubMed - indexed for MEDLINE]

121: Fiziol Cheloveka. 1988 Mar-Apr;14(2):212-8.

[Use of transcranial electrical stimulation for managing the alcohol abstinence syndrome]

[Article in Russian]

Grinenko AIa, Krupitskii EM, Lebedev VP, Katsnel'son IaS, Karandashova GF.

PMID: 2970412 [PubMed - indexed for MEDLINE]

122: Neurosurgery. 1987 Jan;20(1):164-8.

Magnetic and electrical transcranial brain stimulation: physiological mechanisms and clinical applications.

Mills KR, Murray NM, Hess CW.

The human brain can be stimulated by electric shocks or by brief intense magnetic fields. The latter cause only a trivial scalp sensation. Stimuli exciting the motor cortex cause contralateral muscle responses, but the threshold for excitation is markedly reduced by slight voluntary contraction of the target muscle. For small hand muscles, the overall latency from scalp to muscle is shorter by 1.8 ms when electrical stimuli are used than when stimuli are magnetic. Central motor conduction time (CMCT) can be estimated by stimulating over the scalp and then over the cervical area. In healthy subjects, the CMCT is 6.1 +/- 0.8 (SD) (n = 29). Physiological studies have shown that the facilitation of responses in hand muscles produced by voluntary contraction is also present when contralateral muscles are used, but not when a leg muscle is contracted. The mechanism of facilitation may involve neural activity at both spinal and cortical levels. Single motor units can be caused to discharge by threshold brain stimuli. These motor units are the same ones activated first during weak voluntary contractions. Clinical studies have shown that the CMCT may be greatly prolonged in patients with multiple sclerosis and that subclinical motor pathway lesions can be detected. Central conduction may also be abnormal in patients with motor neuron disease and cervical myelopathy. Side effects have not been encountered with either type of stimulator.

Publication Types:

Review

PMID: 3543723 [PubMed - indexed for MEDLINE]

123: Anesthesiology. 1983 Sep;59(3):264.

Cranial electric stimulation used during anesthesia.

Nicosia F, Lombardi M.

Publication Types:

Letter

PMID: 6881600 [PubMed - indexed for MEDLINE]

124: Anesth Analg. 1982 Oct;61(10):863-6.

Transcutaneous cranial electrical stimulation decreases narcotic requirements during neurolept anesthesia and operation in man.

Stanley TH, Cazalaa JA, Atinault A, Coeytaux R, Limoge A, Louville Y.

The influence of transcutaneous cranial electrical stimulation (TCES) on fentanyl requirements was evaluated in 50 patients undergoing urologic operations with pure neuroleptanesthesia (droperidol, diazepam, fentanyl, and air oxygen) with (group I) or without (group II) simultaneous TCES. All patients had silver electrodes (three) applied between the eyebrows and behind each mastoid process and attached to a 167-kHz current generator. Current was delivered only to group I. The wave form was a complex nonsinusoidal, nonsquare wave pattern which was applied intermittently in a 3-msec-on 10-msec-off sequence. All patients had anesthesia induced with droperidol (0.20 mg/kg IV), diazepam (0.2 mg/kg IV), and pancuronium (0.08 mg/kg IV), and, after tracheal intubation, had anesthesia maintained with fentanyl in 100-microgram intravenous increments every 3 minutes whenever and as long as systolic arterial blood pressure and/or heart rate were greater than 20% of control (preanesthetic induction) values. Fentanyl requirements averaged 6.1 +/- 0.5 and 7.9 +/- 0.4 microgram/kg/min for a mean total dosage of 9.0 +/- 0.9 and 12.5 +/- 0.8 microgram/kg for the entire operation in groups I and II, respectively. These differences between groups were statistically significant (p less than 0.05). The data demonstrate that TCES augments the analgesic effects of fentanyl and thus reduces fentanyl requirements during urologic operations with neuroleptanesthesia.

PMID: 7125252 [PubMed - indexed for MEDLINE] 125: Anesthesiology. 1982 Oct;57(4):293-7.

Transcutaneous cranial electrical stimulation increases the potency of nitrous oxide in humans.

Stanley TH, Cazalaa JA, Limoge A, Louville Y.

The potency, amnesic, and postanesthetic analgesic effects of transcutaneous cranial electrical stimulation (TCES) were evaluated during N2O anesthesia in 120 unpremedicated patients, prior to urologic or general surgical operations. The patients were divided into six groups of 20 each with respect to what concentration of N2O in oxygen they were allowed to breathe (75, 62.5, and 50%), and whether they were or were not stimulated with TCES. Recordings of heart and respiratory rates, systolic arterial blood pressure, and minute ventilation were made prior to and after 20 min of N2O, and one minute later following application of a Kocker clamp to the upper inner thigh for one minute. The presence or absence of movement during the painful stimulus, memory of the painful stimulus, and postanesthetic pain at the clamp site (20 min after anesthesia) were also evaluated. Patients who received TCES had significantly lower incidences of movement, memory of the painful stimulus, and postanesthetic pain at the stimulation site at each N2O concentration than patients not getting TCES. TCES did not alter circulatory and respiratory dynamics prior to painful stimulation and prevented an increase in arterial blood pressure during painful stimulation in patients receiving 50% N2O. These data indicate that TCES significantly increases the analgesic potency of N2O and probably also the depth of anesthesia.

PMID: 6982009 [PubMed - indexed for MEDLINE]

126: Circ Res. 1979 Jul;45(1):48-62.

Central neural mechanisms of the cerebral ischemic response. Characterization, effect of brainstem and cranial nerve transections, and simulation by electrical stimulation of restricted regions of medulla oblongata in rabbit.

Dampney RA, Kumada M, Reis DJ.

PMID: 445698 [PubMed - indexed for MEDLINE]

127: Exp Eye Res. 1979 Feb;28(2):229-38.

Electrical stimulation of the fifth cranial nerve in rabbits: effects on ocular blood flow, extravascular albumin content and intraocular pressure.

Stjernschantz J, Geijer C, Bill A.

PMID: 446564 [PubMed - indexed for MEDLINE]

128: Physiol Behav. 1977 May;18(5):979-81.

A method for intra-cranial electrical stimulation in the pig using movable electrodes.

Baldwin BA, Parrott RF, Ryder CM, Cooper TR.

PMID: 905406 [PubMed - indexed for MEDLINE]

129: Boll Soc Ital Biol Sper. 1967 Sep 30;43(18):1157-8.

[Action potentials of the mandibular branch of cranial nerve V during electric stimulation of the trigeminal cells of the posterior commissure in ducks. Preliminary note]

[Article in Italian]

Azzena GB, Palmieri G.

PMID: 6073069 [PubMed - indexed for MEDLINE]

130: Arch Otolaryngol. 1964 Oct;80:388-91.

ELECTRICAL STIMULATION OF EIGHT CRANIAL NERVE.

DOYLE JH, DOYLE JB Jr, TURNBULL FM Jr.

PMID: 14198701 [PubMed - OLDMEDLINE for Pre1966]

131: Ideggyogy Sz. 1964 Jan;17:1-12.

[TREATMENT OF NEURO-ENDOCRINE SYNDROMES WITH TRANSCEREBRAL ELECTRIC STIMULATION.]

[Article in Hungarian]

NYIRO G, FORNADI F, BARTOS V, KAFFKA K.

PMID: 14135423 [PubMed - OLDMEDLINE for Pre1966]

ELECTROSLEEP

1: Vopr Kurortol Fizioter Lech Fiz Kult. 1995 Nov-Dec;(6):29-30.

[The use of an electrosleep method for restoring the performance capacity and relieving the psychoemotional stress of athletes in cyclic sports]

[Article in Russian]

Liubimskaia II, Radzievskii SA, Bugaev SA, Orekhova EM, Gigineishvili GR.

44 boat-racing sportsmen entered the study which aimed at elucidation of electric sleep action on restoration of muscular performance and relief of psychoemotional stress. The electric sleep procedures were found to stimulate regeneration processes, improve cardiovascular function and myocardial contractility, normalise arterial and capillary tonicity, to potentiate muscular performance and aerobic power of the body.

PMID: 8713305 [PubMed - indexed for MEDLINE]

2: Vopr Kurortol Fizioter Lech Fiz Kult. 1995 Nov-Dec;(6):27-9.

[A trial of the clinical use of a new method of electrosleep]

[Article in Russian]

Guliaev Vlu, Oranskii IE.

A novel device and technique of interference electric sleep therapy have been developed and tried in 125 children and 324 adults with different diseases. The highest clinical response, especially in children, was achieved on Elson unit.

Publication Types:
Clinical Trial

PMID: 8713304 [PubMed - indexed for MEDLINE]

3: Vopr Kurortol Fizioter Lech Fiz Kult. 1994 Jul-Aug;(4):31-4.

[The differential use of electrosleep for restoring the work capacity of athletes]

[Article in Russian]

Gigineishvili GR, Dombrovskaia II, Orekhova EM, Radzievskii SA.

A comparative study has been made of the effects which might be produced on body functions of athletes by electric sleep. The induction of the sleep was conducted using square electric pulses with 10 and 100 Hz frequencies. The latter frequency (8-10 sleep procedures) stimulated the examinees somatically and psychologically, whereas electrotherapeutic sleep procedures at 10 Hz displayed sedative effects and thus were indicated for overstrained sportsmen and in some diseases.

PMID: 7846883 [PubMed - indexed for MEDLINE]

4: Vopr Kurortol Fizioter Lech Fiz Kult. 1991 Mar-Apr;(2):24-6.

[The combined use of electrosleep and intranasal lithium electrophoresis at the sanatorium stage of postinfarct rehabilitation]

[Article in Russian]

Mikhno LE, Novikov SA, Pavlenko AS.

Ninety postmyocardial infarction convalescents were treated by electrical sleep (impulse frequency 50-70 Hz) in combination with intranasal electrophoresis of 3% solution of lithium chloride to improve cardiocerebral relationships. The studies involved the clinical pattern, myocardial bioelectrical activity, exercise tolerance and cerebral hemodynamics. The results pointed to therapeutic benefit of the combination in sanatorium management of the patients.

PMID: 1653505 [PubMed - indexed for MEDLINE]

5: Am J Psychiatry. 1990 Jul;147(7):952-3.

Comment on:
Am J Psychiatry. 1989 Oct;146(10):1349.

Rapid opioid detoxification with electrosleep and naloxone.

Westermeyer J.

Publication Types:
Comment
Letter

PMID: 2393441 [PubMed - indexed for MEDLINE]

6: Fiziol Cheloveka. 1990 May-Jun;16(3):151-4.

[Human functional states during electrosleep]

[Article in Russian]

Galeev AL.

PMID: 2210133 [PubMed - indexed for MEDLINE]

7: Vopr Kurortol Fizioter Lech Fiz Kult. 1989 Nov-Dec;(6):9-13.

[The use of sinusoidal modulated currents as a method of electrosleep]

[Article in Russian]

Danilova IN, Orekhova EM.

The study in 100 patients with stage II essential hypertension showed the validity of introduction of sinusoidal modulated currents into the technique of electric sleep. The results obtained served the basis for creation of the optimal therapeutic regime associated with a 94% response marked in hypertensive patients subjected to correction of systemic and cerebral hemodynamics.

PMID: 2629233 [PubMed - indexed for MEDLINE]
8: Feldsher Akush. 1989 Feb;54(2):42-3.
[Electrosleep in the treatment of patients with periodontal diseases]

[Article in Russian]

Samoilovich VA.

PMID: 2721698 [PubMed - indexed for MEDLINE]

9: Med Sestra. 1988 Dec;47(12):43-6.

[Electrosleep]

[Article in Russian]

Orekhova EM.

PMID: 3237022 [PubMed - indexed for MEDLINE]

10: Pediatriia. 1987;(6):88-90.

[Effectiveness of iodine-bromine baths and electrosleep in the treatment of primary arterial hypertension in children]

[Article in Russian]

Karachevtseva TV, Nadezhdina EA, Danilova NV, Kuprianova OO.

PMID: 3658613 [PubMed - indexed for MEDLINE]

11: Ter Arkh. 1987;59(7):95-7.

[Mental functions (memory and attention) and their dynamics during the use of sinusoidal modulated currents by the electrosleep method on patients in the early recovery period following operations on the intracranial arteries]

[Article in Russian]

Danilova DP.

Clinicopsychological studies on memory and attention functions with the help of psychological tests in 34 patients in an early rehabilitation period after operations on cerebral vessels have shown the efficacy of a new method of therapy with sinusoidal modulated currents based on electric sleep methods contributing to the regression of focal neurological symptomatology and improvement of memory and attention functions.

PMID: 3672369 [PubMed - indexed for MEDLINE]

12: Zh Nevropatol Psikhiatr Im S S Korsakova. 1987;87(5):684-5.

[Various syndromes of vibration disease and the use of electrosleep in the complex treatment of it]

[Article in Russian]

Asadullaev MM.

Proceeding from the existing notions about the neuroreflectory and neurohumoral changes in patients with vibration disease associated with impairment of the central mechanisms of hemodynamic regulation and functional involvement of the hypothalamic centres of vegetative regulation and reticular formation of the brain stem, the authors studied the efficacy of electric sleep in combination with drug therapy in 96 patients. Positive effect was elicited in 70% of those examined which makes it possible to consider electric sleep as an adequate pathogenetic method for treatment of angiodystonic syndromes of vibration disease.

PMID: 3618036 [PubMed - indexed for MEDLINE]

13: Zh Vyssh Nerv Deiat Im I P Pavlova. 1987 Jan-Feb;37(1):180-3.

[Recording the electrophysiologic indices of the functional state of man during electrosleep]

[Article in Russian]

Galeev AL, Konovalov VF.

PMID: 3577413 [PubMed - indexed for MEDLINE]

14: J Pain Symptom Manage. 1986 Summer;1(3):151-5.

Electrosleep and chronic pain.

Schoenfeld LS, Walsh NE, Ramamurthy S.

Publication Types:
Case Reports

PMID: 2945872 [PubMed - indexed for MEDLINE]

15: Zh Vopr Neirokhir Im N N Burdenko. 1986 Jul-Aug;(4):43-5.

[Cerebral hemodynamics according to the results of REG when using sinusoidally modulated currents in accordance with the electrosleep method during the early recovery period after surgery on intracranial arteries]

[Article in Russian]

Danilova DP.

On the basis of clinical observations and REG recorded in 50 patients in the early restorative period after operations on intracranial cerebral arteries the author recommends a new effective and pathogenetically substantiated method of treatment--sinusoidal modulated currents (SMC) after the method of electric sleep. SMC promotes regression of the focal neurological symptomatology and increases the intensity of cerebral blood flow, evidence of which is the positive time course of REG values.

Publication Types:
Clinical Trial

PMID: 3532648 [PubMed - indexed for MEDLINE]

16: Vopr Kurortol Fizioter Lech Fiz Kult. 1986 May-Jun;(3):33-5.

[Optimization of methodology of electrosleep treatment of myocardial infarct patients in the reconvalescent stage]

[Article in Russian]

Tsulin VIa.

PMID: 3750933 [PubMed - indexed for MEDLINE]

17: Vopr Kurortol Fizioter Lech Fiz Kult. 1986 Mar-Apr;(2):38-41.

[Electrosleep in the treatment of diabetes mellitus patients]

[Article in Russian]

Sorokina EI, Vishniakova NS.

PMID: 3716257 [PubMed - indexed for MEDLINE]

18: Gig Tr Prof Zabol. 1985 May;(5):42-4.

[Prevention of the cumulative manifestations of fatigue in sailors during prolonged cruises by means of electrosleep]

[Article in Russian]

Sten'ko IuM, Varenikov II, Skrupskii VA.

PMID: 4029693 [PubMed - indexed for MEDLINE]

19: Basal Facts. 1985;7(1):71-4.

Holistic electrosleep. An electrophysiologic equivalent of meditation or deep muscular relaxation.

Gilula MF, Markovich SE.
PMID: 3160334 [PubMed - indexed for MEDLINE]

20: Vopr Kurortol Fizioter Lech Fiz Kult. 1984 Sep-Oct;(5):37-40.

[Use of a modified method of electrosleep in the treatment of neurostomatological diseases]

[Article in Russian]

Grechko VE, Stepanchenko AV, Puzin MN.

PMID: 6506564 [PubMed - indexed for MEDLINE]

21: Fiziol Cheloveka. 1984 Jan-Feb;10(1):47-51.

[Electrosleep as a method of preventing neuropsychic overstrain and of restoring operator mental work capacity]

[Article in Russian]

Goncharenko AM, Kandror IS, Popova II, Roitenburd SR, Shakhnarovich VM.

PMID: 6532829 [PubMed - indexed for MEDLINE]

22: Vopr Kurortol Fizioter Lech Fiz Kult. 1984 Jan-Feb;(1):21-3.

[Electrosleep in the combined treatment of patients with a history of myocardial infarct at the early sanatorium stage of rehabilitation]

[Article in Russian]

Kamenev BA, Khil'ko AS, Popov VI, Kushakova NI.

PMID: 6710912 [PubMed - indexed for MEDLINE]

23: Vopr Kurortol Fizioter Lech Fiz Kult. 1984 Jan-Feb;(1):12-5.

[Effect of combined treatment using the drinking of sodium bicarbonate mineral water and electrosleep procedures on lipid metabolism in ischemic heart disease patients]

[Article in Russian]

Kosoverov EO.

PMID: 6324481 [PubMed - indexed for MEDLINE]

24: Vopr Kurortol Fizioter Lech Fiz Kult. 1983 May-Jun;(3):13-6.

[Effect of electrosleep on the clinico-electroencephalographic indices of ischemic heart disease patients in the early periods following surgical treatment]

[Article in Russian]

Kniazeva TA, Grigor'eva VD, Andreeva VM, Bezzubik VV.

PMID: 6604992 [PubMed - indexed for MEDLINE]

25: Vrach Delo. 1983 Apr;(4):87-9.

[Electrosleep in the combined sanatorium and health resort treatment of cerebral arteriosclerosis patients]

[Article in Russian]

Ezhova VA, Kunitsyna LA, Kornienko EG, Tsarev AIu, Cherfus IS.

PMID: 6223448 [PubMed - indexed for MEDLINE]

26: Vopr Kurortol Fizioter Lech Fiz Kult. 1983 Jan-Feb;(1):51-2.

[Choice of the optimum frequency of current impulses during electrosleep treatment in children with biliary tract diseases]

[Article in Russian]

Chistonogova EA, Lovchikova NN.

PMID: 6868450 [PubMed - indexed for MEDLINE]

27: Vopr Kurortol Fizioter Lech Fiz Kult. 1982 Sep-Oct;(5):56-8.

[Effectiveness of the sanatorium and health resort treatment, including massage of the collar area and electrosleep, of early cerebral arteriosclerosis patients with a history of transient cerebral circulatory disorder]

[Article in Russian]

Tsarev AIu.

PMID: 6217638 [PubMed - indexed for MEDLINE]

28: Tokushima J Exp Med. 1981 Dec;28(3-4):69-83.

Studies of electrosleep on normal adults, insomniacs, and hypertensive patients.

Nagata K, Morita Y, Seno H, Matsumoto J.

PMID: 7339998 [PubMed - indexed for MEDLINE]

29: Vopr Kurortol Fizioter Lech Fiz Kult. 1981 Sep-Oct;(5):68-70.
[Electrosleep treatment methods]

[Article in Russian]

Kuleshova ZS.

PMID: 7303550 [PubMed - indexed for MEDLINE]

30: Vopr Kurortol Fizioter Lech Fiz Kult. 1981 Jul-Aug;(4):62.

[Use of electrosleep in treating neuroses in children]

[Article in Russian]

Poliakova NN, Tiktinskaia EA.

PMID: 7293073 [PubMed - indexed for MEDLINE]

31: Med Sestra. 1981 Jun;40(6):40-2.

[Use for therapeutic purposes of electrosleep and musical melodies]

[Article in Russian]

Sdobnov LP, Shabogina AF.

PMID: 6912365 [PubMed - indexed for MEDLINE]

32: Vopr Kurortol Fizioter Lech Fiz Kult. 1981 Jan-Feb;(1):34-8.

[Clinico-electroencephalographic index dynamics as affected by electrosleep in renovascular hypertension after renal artery surgery]

[Article in Russian]

Kniazeva TA, Andreeva VM.

PMID: 7222508 [PubMed - indexed for MEDLINE]

33: Cesk Psychiatr. 1980 Jun;76(3):172-5.

[Comparison of active and placebo effect of electrosleep (author's transl)]

[Article in Czech]

Ambrus O, Jedlickova A.

Publication Types:
Clinical Trial

PMID: 7000385 [PubMed - indexed for MEDLINE]
34: Can J Psychiatry. 1980 Apr;25(3):213-9.

Electrosleep therapy: a controlled study of its effects in anxiety neurosis.

Von Richthofen CL, Mellor CS.

PMID: 7370903 [PubMed - indexed for MEDLINE]

35: Biofeedback Self Regul. 1980 Mar;5(1):57-73.

A comparison of relaxation techniques with electrosleep therapy for chronic, sleep-onset insomnia a sleep-EEG study.

Coursey RD, Frankel BL, Gaarder KR, Mott DE.

Two methods of relaxation therapy, electromyograph biofeedback and autogenic training, were compared to a nonrelaxation treatment, electrosleep therapy, in reducing sleep latency among 22 chronic, sleep-onset insomniacs. While none of the electrosleep patients improved on all-night laboratory electroencephalographic sleep records or daily home sleep logs, approximately one-half of the relaxation-treated patients showed marked improvement, which was sustained over a 1-month follow-up period. Although some sleep and treatment variables differentiated relaxation therapy responders from nonresponders, external stress appeared to be the most salient factor. Successful and unsuccessful patients could not be differentiated on any of the psychological variables studied.

PMID: 6989409 [PubMed - indexed for MEDLINE]

36: Vestn Dermatol Venerol. 1980 Jan;(1):38-42.

[Clinico-morphological appearance of the skin in neurodermatitis treated with electrosleep and complamine]

[Article in Russian]

Eteeva VE.

PMID: 7368863 [PubMed - indexed for MEDLINE]

37: Vopr Okhr Materin Det. 1979 Jul;24(7):14-8.

[Hemodynamics in children with primary arterial hypertension in the process of treating them with beta-adrenoblockaders and electrosleep]

[Article in Russian]

Oskolkova MK, Kupriianova OO.

PMID: 43024 [PubMed - indexed for MEDLINE]

38: Br J Psychiatry. 1979 Jun;134:650-1.

Electrosleep.

Hall P.

Publication Types:
Letter

PMID: 476383 [PubMed - indexed for MEDLINE]

39: Vopr Kurortol Fizioter Lech Fiz Kult. 1979 Mar-Apr;(2):19-24.

[Use of electrosleep in the restorative treatment of oncological patients]

[Article in Russian]

Gerasimenko VN, Varlamov VA, Dorogova EV, Davydova IG, Shvetsova GN.

PMID: 433177 [PubMed - indexed for MEDLINE]

40: Br J Psychiatry. 1979 Jan;134:111-3.

Treatment of methadone withdrawal with cerebral electrotherapy (electrosleep).

Gomez E, Mikhail AR.

The use of cerebral electrotherapy (CET) in methadone detoxification was studied in 28 patients. Fourteen patients received active CET; the other 14 acted as controls and received either stimulated CET or only methadone detoxification therapy. One patient dropped out of the study. The Taylor Manifest Anxiety Scale and the Hamilton Anxiety Scale were administered before and after the study period. Nine of the patients receiving active CET were drug-free by the end of 8 to 10 days, and all experienced a marked reduction of their symptoms; the control group did not show significant changes. CET was clearly beneficial in the treatment of patients undergoing methadone withdrawal.

PMID: 760910 [PubMed - indexed for MEDLINE]

41: Voen Med Zh. 1978 Dec;(12):53-6.

[Electrosleep as a means of preserving and increasing the work capacity of ship

crews]

[Article in Russian]

Isaev IA, Kablashov VI.

PMID: 734963 [PubMed - indexed for MEDLINE]

42: Vopr Kurortol Fizioter Lech Fiz Kult. 1978 Jul-Aug;(4):83-4.
[Use of low-frequency and low-intensity pulse currents (electrosleep) for treating and rehabilitating ischemic heart disease patients (a note on methodological recommendations)]

[Article in Russian]

Kamenskaia NS.

PMID: 695395 [PubMed - indexed for MEDLINE]

43: Vopr Kurortol Fizioter Lech Fiz Kult. 1978 Jul-Aug;(4):23-5.

[Effect of electrosleep in the overall health resort and climate treatment of coronary arteriosclerosis patients with an asthenic state]

[Article in Russian]

Ponomarev FI.

PMID: 151377 [PubMed - indexed for MEDLINE]

44: Boll Soc Ital Biol Sper. 1978 Apr 30;54(8):705-8.

[Experimental syndrome induced by reserpine: changes produced by electroshock and electrosleep]

[Article in Italian]

Carchedi F, Cerbo R, Accornero N, Bini G, Casacchia M, Meco G.

PMID: 567998 [PubMed - indexed for MEDLINE]

45: Hum Physiol. 1978 Jan-Feb;4(1):75-9.

Effect of electrosleep on adaptive powers of the organism.

Roitenburd SR.

PMID: 751896 [PubMed - indexed for MEDLINE]

46: Dis Nerv Syst. 1977 Jul;38(7):515-7.

The role of sleep in electrosleep therapy for anxiety.

Ryan JJ, Souheaver GT.

PMID: 872716 [PubMed - indexed for MEDLINE]

47: Pediatriia. 1977 Apr;(4):75-7.

[Experience with electrosleep in therapy of arterial hypertension in children and adolescents]

[Article in Russian]

Krasnova KN, Khodakova II, Kupriianova OO, Kustareva KS.

PMID: 866036 [PubMed - indexed for MEDLINE]

48: Sov Med. 1977 Mar;(3):24-6.

[Evaluation of sedative action of electrosleep in patients during preoperative period]

[Article in Russian]

Ivashchenko ON, Moskovets ON, Abramov IuB, Bol'shakova TD.

PMID: 867093 [PubMed - indexed for MEDLINE]

49: Vopr Kurortol Fizioter Lech Fiz Kult. 1977 Mar-Apr;(2):80-1.

[Electrosleep in complex treatment of ishemic heart disease]

[Article in Russian]

Chistiakova NS, Grigor'ev PS, Andreeva NIa, Arapova AD, Rozhdestvenskaia OA.

PMID: 888387 [PubMed - indexed for MEDLINE]

50: Dokl Akad Nauk SSSR. 1977;232(5):1204-7.

[Changes in human EEG rhythms upon switching on and switching off the current during an electrosleep session]

[Article in Russian]

Voronin LG, Senina RIa, Galeev AL.

PMID: 852385 [PubMed - indexed for MEDLINE]

51: J Nerv Ment Dis. 1976 Oct;163(4):263-6.

The effects of cerebral electric therapy (electrosleep) on anxiety, depression, and hostility in psychiatric patients.

Passini FG, Watson CG, Herder J.

The effects of cerebral electric therapy (electrosleep) and placebo on self-ratings of anxiety, depression, and hostility were compared. No difference in the amount of improvement shown by the two groups appeared on any of the five measures employed, although a major placebo effect was evident on all of the criteria. The results argue against the use of electrosleep as a treatment for these symptoms except when it may be employed for its placebo value.

Publication Types:
Clinical Trial
Controlled Clinical Trial

PMID: 972328 [PubMed - indexed for MEDLINE]

52: Dokl Akad Nauk SSSR. 1976 JUL-AUG;229(1):230-2.

[Changes in human EEG rhythms due to electrostimulation (electrosleep)]

[Article in Russian]

Voronin LG, Konovalov VF, Fedorov AU.

PMID: 954574 [PubMed - indexed for MEDLINE]

53: Dis Nerv Syst. 1976 Jun;37(6):347-53.

The management of chronic hysteria: a review and double-blind trial of electrosleep and other relaxation methods.

Scallet A, Cloninger CR, Othmer E.

The effectiveness and mode of action of electrosleep therapy in chronic hysteria was evaluated in a double blind trial with a 1 month follow-up. Matched groups of hysterics were treated with central electrical stimulation and relaxation, peripheral electrical stimulation and relaxation, or relaxation only. Autogenic training exercises were used initially to standarize the relaxation instructions for all the patients. Central electrical stimulation has no specific benefit for hysteria. Rhythmic peripheral stimulation does increase the effect of verbal suggestions to relax initially but has no long term advantage over relaxation alone. Regular brief periods of relaxation can improve the mood and diminish the anxiety level of psychiatric outpatients with hysteria but have no persistant benefit for sleep disturbance or hypochondriasis. The best treatment of depression in chronic hysterics was found at follow-up to be relaxation without electrostimulation. Specialized somatic and psychotherapeutic methods have no advantage over treatment with low doses of anxiolytic drugs, reassurance, suggestion, and regular periods of relaxation.

Publication Types:
Clinical Trial
Controlled Clinical Trial

PMID: 776551 [PubMed - indexed for MEDLINE]

54: Fiziol Zh SSSR Im I M Sechenova. 1976 May;62(5):649-57.

[Spectral-correlation analysis of the bioelectrical activity of rabbit brain structures during electrosleep]

[Article in Russian]

Potulova LA, Trush VD.

Changes of electric activity of the rabbit cortical and subcortical structures were studied by means of spectrum-correlation analysis during sleep caused by low-frequency stimulation of the supraoptic hypothalamic nucleus. The electrosleep affected the similarity of the electric events in neocortex and subcortical structures. The disturbance of the spatial synchronization is supposed to be due to the activity of nonsynchronized autonomous bioelectric pace-makers in different brain structures.

PMID: 1278542 [PubMed - indexed for MEDLINE]

55: Biol Psychiatry. 1976 Apr;11(2):233-7.

Effects of transcrerebral electrotherapy (electrosleep) on state anxiety according to suggestibility levels.

Ryan JJ, Souheaver GT.

Publication Types:
Clinical Trial

PMID: 786380 [PubMed - indexed for MEDLINE]

56: Stomatologiia (Mosk). 1976 Mar-Apr;55(2):50-4.

[The use of electrosleep for the elimination of emotional stress in dental practice]

[Article in Russian]

Ivashchenko ON, Bazhanov NN, Sudakov KV, Bol'shakova TD, Tiabenkova VF.

PMID: 1063465 [PubMed - indexed for MEDLINE]

57: Vopr Kurortol Fizioter Lech Fiz Kult. 1976 Jan-Feb;(1):32-9.

[Use of electrosleep in the early stage of post-hospitalization medical rehabilitation of myocardial infarct patients]

[Article in Russian]

Sorokina EI, Krasnikov BE, Gigineishvili GR, Monakhova ME.

PMID: 1014415 [PubMed - indexed for MEDLINE]

58: Vopr Kurortol Fizioter Lech Fiz Kult. 1976 Jan-Feb;(1):26-32.
[Effect of electrosleep on the sympathetic-adrenal system of patients with ischemic heart disease associated with angina pectoris]

[Article in Russian]

Efendieva AT.

PMID: 1014413 [PubMed - indexed for MEDLINE]

59: Zh Nevropatol Psikhiatr Im S S Korsakova. 1976;76(3):443-6.

[Electrosleep and rhythmotherapeutic sleep]

[Article in Russian]

Rabichev LIa, Il'ina TG, Il'in VA, Raku PV.

The paper is a summary of the therapeutical effectiveness of rhythmotherapeutical sleep in some neuropsychic and neurosomatic disorders. During 8 years of approbation of this method 740 patients (adults and children) received such treatment. The positive therapeutical effect seen in more than than 80% of the cases permits to highly estimate this method and the apparatus (LIDA) used for these purposes.

PMID: 1266521 [PubMed - indexed for MEDLINE]

60: Aust N Z J Psychiatry. 1975 Dec;9(4):287-90.

A clinical trial of electrosleep therapy with a psychiatric inpatient sample.

Levitt EA, James NM, Flavell P.

The study assessed the effectiveness of electrosleep therapy in the treatment of depression, anxiety, and sleep difficulties in a small, heterogenous sample of psychiatric inpatients. A double-blind format was employed, one group receiving active treatment while the other received simulated treatment. The results showed active electrosleep to be no better than placebo in bettering quality of sleep or in lessening symptoms of depression or anxiety.

Publication Types:
Clinical Trial
Controlled Clinical Trial

PMID: 769773 [PubMed - indexed for MEDLINE]

61: Biol Psychiatry. 1975 Dec;10(6):675-80.

Electrosleep in the management of alcoholism.

Smith RB, O'Neill L.

PMID: 1201324 [PubMed - indexed for MEDLINE]

62: Can Psychiatr Assoc J. 1975 Dec;20(8):607-13.

The efficacy of electrosleep therapy.

Templer DI.

Publication Types:
Clinical Trial
Review

PMID: 779945 [PubMed - indexed for MEDLINE]

63: Dis Nerv Syst. 1975 Dec;36(12):661-5.

Evaluation of the electrosleep machine.

Jordan JE, Morris D.

Seven dogs were intensively studied to determine the clinical, physiological, biochemical, and pathological effects of the electrosleep machine. Both the normal dose and a high dose of current was studied. The most notable finding was an increasing number of histologic findings with increasing current dose. There is some question regarding the true nature of these findings. Other changes which were less definite included: EEG slowing and depression of the amplitude of the B-wave in the ERG. Suggestive changes included a chronic increase in pulse rate. Because of the small number of subjects, further studies are indicated to investigate further the findings of this study.

PMID: 1192925 [PubMed - indexed for MEDLINE]

64: Vopr Kurortol Fizioter Lech Fiz Kult. 1975 Nov-Dec;(6):514-7.

[Dynamics of the functional state of the parenchymal cells of the liver in patients with gout and deforming osteoarthritis under the influence of radon baths and their combination sith electrosleep (according to the data of radiohepatography with Bengal red-I131)]

[Article in Russian]

Ryzhkin AI.

PMID: 1229092 [PubMed - indexed for MEDLINE]

65: J Nerv Ment Dis. 1975 Aug;161(2):134-7.

The effects of electrosleep on insomnia revisited.

Cartwright RD, Weiss MF.

Ten subjects who had suffered from sleep onset insomnia for a minimun of 2 years participated in a double blind study of the effects of electrosleep on this disorder. This paper reports a 2-year follow-up of these subjects. Of the five subjects who received 24 live treatments, four appeared to be able to fall asleep with little difficulty and to awake feeling moderately to very well rested. Only one appeared to have relapsed during the 2-year-no-treatment period. Of those receiving sham treatment four were having quite a bit of difficulty falling asleep but three of the five awoke feeling moderately well rested. Although the number of subjects is small, the trends appear consistent with the interpretation that sleep habits were improved for most of the real treatment subjects and for few of those receiving sham treatment.

Publication Types:
Clinical Trial
Controlled Clinical Trial

PMID: 1097597 [PubMed - indexed for MEDLINE]

66: Med Tekh. 1975 May-Jun;(3):39-40.

[Use of rotary polarization current in the apparatus for electrosleep in the treatment of hypertension]

[Article in Russian]

Liventsev NM, Drevush VP, Sanzharov AV, Stubnitsyna LA, Orekhova ZM.

PMID: 1152648 [PubMed - indexed for MEDLINE]

67: Am Psychol. 1975 Mar;30(3):402-10.

Electroanesthesia and electrosleep.

Brown CC.

PMID: 1137232 [PubMed - indexed for MEDLINE]

68: Biol Psychiatry. 1975 Feb;10(1):101-4.

Intracerebral current levels in man during electrosleep therapy.

Dymond AM, Coger RW, Serafetinides EA.

PMID: 1120172 [PubMed - indexed for MEDLINE]

69: Biol Psychiatry. 1975 Feb;10(1):59-63.

A double-blind study of electrosleep for anxiety and insomnia.

Moore JA, Mellor CS, Standage KF, Strong H.

Despite largely negative findings, several subjects reported a remarkable

improvement in their symptoms some two to three weeks after electrosleep (ES) treatment was concluded, so that it remains unclear whether or not ES may be an effective treatment. The clinical experience reported suggests that five half-hour ES treatments may not be sufficient to produce significant changes in the patient's anxiety and insomnia. Further investigations are required to examine the effects of varying durations of treatment.

Publication Types:
Clinical Trial
Controlled Clinical Trial

PMID: 1091305 [PubMed - indexed for MEDLINE]

70: Hippokrates. 1975 Feb;46(1):98-104.

[Electrosleep and electronarcosis]

[Article in German]

Steinbrecher W.

Publication Types:
Review

PMID: 1091608 [PubMed - indexed for MEDLINE]

71: Biomed Eng (NY). 1975 Jan;8(2):116-7.

Evaluation of the electrosleep apparatus for postoperative analgesia.

Proshina IV.

PMID: 1109141 [PubMed - indexed for MEDLINE]

72: Curr Psychiatr Ther. 1975;15:195-202.

Cerebral electrotherapy (electrosleep): a review.

Flemenbaum A.

Publication Types:
Clinical Trial

PMID: 1102263 [PubMed - indexed for MEDLINE]

73: Eksp Khir Anesteziol. 1975 Jan-Feb;(1):63-4.

[State of certain biochemical indicators of blood in electrosleep]

[Article in Russian]
Mkrtichian SM, Amirian SG.

PMID: 1140158 [PubMed - indexed for MEDLINE]

74: Zh Eksp Klin Med. 1975;15(1):84-8.

[Effect of electrosleep on the motility of the gastrointestinal tract]

[Article in Russian]

Mkrtichian SM.

PMID: 1136629 [PubMed - indexed for MEDLINE]

75: Vopr Kurortol Fizioter Lech Fiz Kult. 1974 Nov-Dec;(6):496-502.

[Role of electrosleep in complex treatment of patients with chronic coronary insufficiency and angina pectoris]

[Article in Russian]

Kamenskaia NS.

PMID: 4454249 [PubMed - indexed for MEDLINE]

76: Med Sestra. 1974 Sep;33(9):59-60.

[Use of music and electrosleep for therapeutic purposes]

[Article in Russian]

Sdobnov LP.

PMID: 4499357 [PubMed - indexed for MEDLINE]

77: Vopr Kurortol Fizioter Lech Fiz Kult. 1974 Sep-Oct;(5):445-9.

[Effect of sinusoidal currents with phase shifts (according to method of electrosleep) on certain indicators of hemodynamics in patients with hypertensive disease]

[Article in Russian]

Orekhova EM.

PMID: 4446435 [PubMed - indexed for MEDLINE]

78: Arch Gen Psychiatry. 1974 Apr;30(4):463-6.

Electrosleep therapy: a double-blind trial.

Hearst ED, Cloninger CR, Crews EL, Cadoret RJ.

Publication Types:
- Clinical Trial
- Randomized Controlled Trial

PMID: 4592898 [PubMed - indexed for MEDLINE]

79: Biol Psychiatry. 1974 Feb;8(1):115-7.

A follow-up study of electrosleep.

Astrup C.

PMID: 4815339 [PubMed - indexed for MEDLINE]

80: Am J Psychiatry. 1974 Jan;131(1):95-8.

Research on cerebral electrotherapy (electrosleep): some suggestions.

Frankel BL.

PMID: 4808438 [PubMed - indexed for MEDLINE]

81: Psychosomatics. 1974 1st Quarter;15(1):20-4.

Cerebral electrotherapy (electrosleep): an open-clinical study with a six month follow-up.

Flemenbaum A.

PMID: 4412369 [PubMed - indexed for MEDLINE]

82: Zh Eksp Klin Med. 1974;14(6):20-6.

[Effect of electrosleep therapy on the course and outcome of experimental radiation injuries]

[Article in Russian]

Dzhavalian NS, Abgarian DzhV, Kheifets IuB.

PMID: 4456925 [PubMed - indexed for MEDLINE]

83: Electroencephalogr Clin Neurophysiol. 1973 Dec;35(6):663-4.

Clinical note. Does electrosleep induce natural sleep?

Empson JA.

PMID: 4128164 [PubMed - indexed for MEDLINE]
84: Arch Gen Psychiatry. 1973 Oct;29(4):563-8.

Ineffectiveness of electrosleep in chronic primary insomnia.

Frankel BL, Buchbinder R, Snyder F.

Publication Types:

Clinical Trial
Randomized Controlled Trial

PMID: 4748315 [PubMed - indexed for MEDLINE]

85: J Nerv Ment Dis. 1973 Aug;157(2):121-8.

Electrosleep therapy. A controlled double blind study.

Feighner JP, Brown SL, Olivier JE.

Publication Types:
Clinical Trial
Controlled Clinical Trial

PMID: 4724809 [PubMed - indexed for MEDLINE]

86: J Nerv Ment Dis. 1973 Aug;157(2):108-20.

The treatment of insomnia through the use of electrosleep: an EEG study.

Weiss MF.

PMID: 4146811 [PubMed - indexed for MEDLINE]

87: Feldsher Akush. 1973 Feb;38(2):22-5.

[Electrosleep therapy]

[Article in Russian]

Kunichev LA.

PMID: 4488821 [PubMed - indexed for MEDLINE]

88: Arch Gen Psychiatry. 1973 Jan;28(1):28-9.

Alterations in serum thyroxine with cerebral electrotherapy (electrosleep).

Rosenthal SH.

PMID: 4539515 [PubMed - indexed for MEDLINE]

89: Dis Nerv Syst. 1973 Jan;34(1):57-8.
Changes in urinary free catecholamines and 17-ketosteroids with cerebral electrotherapy (electrosleep).

Briones DF, Rosenthal SH.

PMID: 4709193 [PubMed - indexed for MEDLINE]

90: Nebr Med J. 1973 Jan;58(1):9-11.

New frontier: electrosleep therapy.

Alberto Pleitez J.

PMID: 4682790 [PubMed - indexed for MEDLINE]

91: Vopr Kurortol Fizioter Lech Fiz Kult. 1973;38(2):130-3.

[Effect of inductothermy and electrosleep on external respiratory function in bronchial asthma]

[Article in Russian]

Davydova OB, Danilov VI.

PMID: 4774968 [PubMed - indexed for MEDLINE]

92: Vopr Kurortol Fizioter Lech Fiz Kult. 1973;38(2):175-6.

[Experience with electrosleep treatment under polyclinic conditions]

[Article in Russian]

Shikhova SI.

PMID: 4272761 [PubMed - indexed for MEDLINE]

93: Akush Ginekol (Mosk). 1972 Sep;48(9):3-7.

[Use of electronarcosis, electrosleep and electroanalgesia in obstetrics (review of the literature)]

[Article in Russian]

Persianinov LS, Kastrubin EM.

Publication Types:
Review

PMID: 4579211 [PubMed - indexed for MEDLINE]

94: Dis Nerv Syst. 1972 Jun;33(6):376-81.
Quantitative EEG analysis of electrosleep using analog frequency analyzer and digital computer methods.

Itil T, Gannon P, Akpinar S, Hsu W.

PMID: 4668957 [PubMed - indexed for MEDLINE]

95: Med Sestra. 1972 May;31(5):32-4.

[Electrosleep as a therapeutic factor. Methods and indications]

[Article in Russian]

Studnitsyna LA.

PMID: 4482745 [PubMed - indexed for MEDLINE]

96: Biol Psychiatry. 1972 Apr;4(2):187-90.

Electrosleep: personal subjective experiences.

Rosenthal SH, Calvert LF.

PMID: 5027162 [PubMed - indexed for MEDLINE]

97: Biol Psychiatry. 1972 Apr;4(2):179-85.

Electrosleep: a double-blind clinical study.

Rosenthal SH.

Publication Types:
Clinical Trial
Controlled Clinical Trial

PMID: 4554818 [PubMed - indexed for MEDLINE]

98: Curr Psychiatr Ther. 1972;12:104-7.

Electrosleep therapy.

Rosenthal SH.

PMID: 4537505 [PubMed - indexed for MEDLINE]

99: Nurs Times. 1971 Oct 21;67(42):1310-2.

Electrosleep therapy.

Jenkins JB, Spensley J.

PMID: 5098901 [PubMed - indexed for MEDLINE]

100: Med Lett Drugs Ther. 1971 Oct 1;13(20):81-2.

Electrosleep and cerebral electrotherapy.

[No authors listed]

PMID: 5317358 [PubMed - indexed for MEDLINE]

101: Stomatologiia (Mosk). 1971 Sep-Oct;50(5):63-5.

[Electrosleep treatment of patients with glossalgia]

[Article in Russian]

Nikitina TV, Khartulari NI.

PMID: 5286952 [PubMed - indexed for MEDLINE]

102: Pol Przegl Chir. 1971 Jul;43(7):1185-91.

[Electrosleep and its use in surgery]

[Article in Polish]

Heftman WR.

Publication Types:
Review

PMID: 4328761 [PubMed - indexed for MEDLINE]

103: Z Arztl Fortbild (Jena). 1971 Apr 15;65(8):417-20.

[Problems in electrosleep with reference to neuropathologic and electron microscopic studies]

[Article in German]

Sommer H.

PMID: 5006540 [PubMed - indexed for MEDLINE]

104: Dis Nerv Syst. 1971 Feb;32(2):100-4.

Medical and psychiatric use of electrosleep. Transcerebral electrotherapy.

Koegler RR, Hicks SM, Barger JH.

PMID: 5313321 [PubMed - indexed for MEDLINE]
105: Cas Lek Cesk. 1970 Nov 27;109(49):1137-42.

[Electrosleep]

[Article in Czech]

Grunner O.

PMID: 5488971 [PubMed - indexed for MEDLINE]

106: Am J Psychiatry. 1970 Oct;127(4):533-4.

Electrosleep--a clinical trial.

Rosenthal SH, Wulfsohn NL.

PMID: 5459518 [PubMed - indexed for MEDLINE]

107: J Assoc Adv Med Instrum. 1970 Sep-Oct;4(5):203-4.

Conference report: report on the second international symposium on electrosleep and electroanesthesia.

[No authors listed]

PMID: 5521214 [PubMed - indexed for MEDLINE]

108: J Nerv Ment Dis. 1970 Aug;151(2):146-51.

Electrosleep. A preliminary communication.

Rosenthal SH, Wulfsohn NL.

PMID: 5457619 [PubMed - indexed for MEDLINE]

109: Vopr Kurortol Fizioter Lech Fiz Kult. 1970 May-Jun;35(3):233-6.

[Content of desoxyribose and acid phosphatase activity in the blood serum of patients with infectious arthritis during electrosleep therapy]

[Article in Russian]

Gerasimenko VN, Chepoi FM.

PMID: 5489644 [PubMed - indexed for MEDLINE]

110: Curr Ther Res Clin Exp. 1970 Mar;12(3):126-30.

Studies of electrosleep with active and simulated treatment.

Rosenthal SH, Wulfsohn NL.
Publication Types:
Clinical Trial

PMID: 4985490 [PubMed - indexed for MEDLINE]

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[Perspectives of further use of electrosleep in the therapy of patients with eczema and neurodermatitis]

[Article in Russian]

Zheltakov MM, Skripkin IuK, Somov BA, Butov IuS.

PMID: 5378861 [PubMed - indexed for MEDLINE]

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Advances in electrosleep and electroanesthesia during the past decade.

Van Poznak A.

Publication Types:
Review

PMID: 4941535 [PubMed - indexed for MEDLINE]

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Electrosleep therapy in bronchial asthma.

Glazer I, Ashkenazi A, Magora F.

PMID: 5809811 [PubMed - indexed for MEDLINE]

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Clinical observations in the use of electrosleep.

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PMID: 5265051 [PubMed - indexed for MEDLINE]

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[Reactions of the cerebral cortex in patients with incipient cerebral atherosclerosis to the effects of electrosleep and Bourguignon's galvanization (based on electroencephalographic data)]

[Article in Russian]

Khobta VD.

PMID: 5309834 [PubMed - indexed for MEDLINE]

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[Hypotheses on the effect of the stimulating currents in the so-called electrosleep]

[Article in German]

Taaks H.

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[Experience in the application of electrosleep in a pediatric polyclinic]

[Article in Russian]

Khaitin ZI.

PMID: 5309832 [PubMed - indexed for MEDLINE]

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Electrosleep and brain function.

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Cortico-dynamic decapsulation against the background of electrosleep.

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PMID: 4971828 [PubMed - indexed for MEDLINE]

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On "electrosleep" therapy.

Achte KA, Kauko K, Seppala K.

PMID: 5648893 [PubMed - indexed for MEDLINE]

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[Electrosleep and electronarcosis]

[Article in Swedish]

Bona G, Thulin CA, Waller SO, Vinnars E.

PMID: 5300698 [PubMed - indexed for MEDLINE]

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[First International Symposium for therapeutic electrosleep and electroanesthesia]

[Article in German]

Rentsch W.

PMID: 5300638 [PubMed - indexed for MEDLINE]

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[Electrosleep therapy]

[Article in Russian]

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PMID: 5986989 [PubMed - indexed for MEDLINE]

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[On the problems of electrosleep and electronarcosis]

[Article in French]

Wageneder F, Shuy S.

PMID: 5933547 [PubMed - indexed for MEDLINE]

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Electrosleep therapy. Some results with the use of electrically induced sleep in the treatment of psychiatric patients.

Long RC.

PMID: 5295206 [PubMed - indexed for MEDLINE]

126: Zh Nevropatol Psikhiatr Im S S Korsakova. 1966;66(6):870-6.

[Treatment with electrosleep and ganglionic blocking preparations of patients with diencephalic syndrome and neurasthenia with autonomic and cardiovascular disorders]

[Article in Russian]

Sorokina EI.

PMID: 4386124 [PubMed - indexed for MEDLINE]

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The use and effectiveness of electrosleep in the treatment of some common psychiatric problems.

Miller EC, Mathas JL.

PMID: 5825399 [PubMed - indexed for MEDLINE]

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[FIRST EXPERIENCES OF ELECTROSLEEP THERAPY IN THE OBSTETRIC AND GYNECOLOGIC
FIELD.]

[Article in Italian]

SBRIGLIO VS.

PMID: 14308974 [PubMed - OLDMEDLINE for Pre1966]

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[Induction of sleep through the stimulation of cutaneous receptors with impulse current. (Electrosleep)]

[Article in Russian]

Povorinskii IuA.

PMID: 5883067 [PubMed - indexed for MEDLINE]

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[USE OF PULSATING ELECTRICAL CURRENT (ELECTROSLEEP) FOR TREATMENT OF PATIENTS
WITH PREGNANCY TOXEMIAS.]

[Article in Russian]

PASTERNAK MD.

PMID: 14162869 [PubMed - OLDMEDLINE for Pre1966]

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PRELIMINARY OBSERVATIONS ON ELECTROSLEEP.

FORSTER S, POST BS, BENTON JG.

PMID: 14050721 [PubMed - OLDMEDLINE for Pre1966]

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ELECTROSLEEP AS A METHOD OF NEUROTROPIC THERAPY OF PATIENTS WITH HYPERTENSIVE
DISEASE.

SERGEEV GV.

PMID: 14045977 [PubMed - OLDMEDLINE for Pre1966]

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[GENERAL CONSIDERATIONS ABOUT "ELECTROSLEEP".]

[Article in Spanish]

RIU JA.

PMID: 14069265 [PubMed - OLDMEDLINE for Pre1966]

134: Vopr Eksper Klinicheskoi Urol. 1961;7:51-4.

[On treatment of phantom pains with "electrosleep".]

[Article in Russian]

KONOVALOVA MZ.

PMID: 14458254 [PubMed - OLDMEDLINE for Pre1966]

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[Treatment of certain dermatoses with electrosleep.]

[Article in Russian]

BABAIANTS RS.

PMID: 13675920 [PubMed - OLDMEDLINE for Pre1966]

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Electrosleep therapy in psychoses.

BUCKMAN C, PINSLEY I, FENICHEL M.

PMID: 13447803 [PubMed - OLDMEDLINE for Pre1966]

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[Electrosleep; clinical experiences.]

[Article in Italian]

ARIAN E.

PMID: 13451371 [PubMed - OLDMEDLINE for Pre1966]

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[Experimental research on electrosleep.]

[Article in German]

KLEINSORGE H, ROSNER K, DRESSLER S.

PMID: 13435843 [PubMed - OLDMEDLINE for Pre1966]

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[Therapeutic sleep induced by weak galvanic impulses of low frequency (electrosleep); physiological premises.]

[Article in Italian]

ARIAN E.

PMID: 13387233 [PubMed - OLDMEDLINE for Pre1966]

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[Clinical experiences with electrosleep.]

[Article in Czech]

HADLIK J.

PMID: 14370368 [PubMed - OLDMEDLINE for Pre1966]

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Twelve years' experience with electrosleep (shock) therapy.

HOLBROOK CS.

PMID: 13130962 [PubMed - OLDMEDLINE for Pre1966]

ELECTROANESTHESIA

1: Anesteziol Reanimatol. 1993 Jul-Aug;(4):32-5.

[Electroanesthesia during conservation of spontaneous respiration with an apparatus of novel construction]

[Article in Russian]

Gurskii NM, Poliukhov SM.

PMID: 8239024 [PubMed - indexed for MEDLINE]

2: Anesteziol Reanimatol. 1993 May-Jun;(3):21-3.

[Combined electroanesthesia: a nontraditional method of anesthesia in pediatric neurosurgery]

[Article in Russian]

Mal'kovskaia EV, Gudumak EM, Salalykin VI, Iova AS, Aksentiuk VI, Petraki VL, Shiriaeva NV.

A combination of electrical anesthesia with calypsol and nitrous oxide has been developed and used in neurosurgical operations performed to 142 children aged 8 days to 15 years, who were divided into two groups. Group 1 included 89 children administered electrical anesthesia in combination with calypsol and nitrous oxide, Group 2 consisted of 53 children, to whom only routine calypsol and nitrous oxide anesthesia was administered. The Lennar apparatus was used to administer electrical anesthesia. The adequacy of anesthesia was estimated on the basis of the clinical data and laboratory findings. The results have shown that a combination of electrical analgesia with calypsol and nitrous oxide provided sufficient protection of a child from surgical stress, was not associated with significant changes of the hypothalamo-hypophyseo-adrenal and thyroid functions and permitted a significant reduction (by 80.8%) of the drug load.

PMID: 7943896 [PubMed - indexed for MEDLINE]

3: Anesteziol Reanimatol. 1991 Jan-Feb;(1):10-2.

[Hemodynamics during epidural anesthesia in combination with transcranial electroanesthesia in pulmonary surgery]

[Article in Russian]

Sokolov EA, Tsvetkov VA, Losev IF.

Pulmonary surgery performed under epidural anesthesia (EA) combined with transcranial electrical anesthesia (TEA) was characterized by minimum adverse hemodynamic reactions, typical of EA alone, and reduced overall dose of the local anesthetic with minimum volume of the infusion therapy and adequate anesthetic protection. The absence of marked hemodynamic reactions in this type of combined anesthesia made it possible to use it during pulmonary surgery in the most severely ill patients whose cardiovascular system is already compromised by the primary pulmonary disease.

PMID: 1862953 [PubMed - indexed for MEDLINE]

4: Probl Tuberk. 1990;(12):67-8.

[Regional scientific and practical conference of anesthesiologists from Siberia and Far East on the topic "Current problems of using electroanesthesia in surgical practice]

[Article in Russian]

Vasil'eva LD.

PMID: 2084703 [PubMed - indexed for MEDLINE]

5: Probl Tuberk. 1990;(10):39-41.

[Status of hepatic blood flow in patients with tuberculosis during electroanesthesia and operations on the lungs]

[Article in Russian]

Muratkhanov EZh, Lysikova GK, Kliudt KA.

The effect of different options of a combined electroanesthesia (CEA) and operation on the central hemodynamics (CHD) and regional liver blood flow (RLBF) in 59 pulmonary tuberculosis patients was investigated with rheographic and radioisotopic methods. It was found that the initial liver blood flow became lowered, and initial and general anaesthesia in every group was accompanied by a moderate drop of CHD, while RLBF varied differently. Though a central electroneurostimulation promoted the rise of LIBF, its intensity at the peak of a surgical trauma was decreased without neurovegetative protective means. The

studies established the relationship between RLBF and the circulating blood volume level, the index of peripheral vascular resistance and the extent of anesthetic effect of CEA options. It is recommended to combine CEA with ganglionic or peridural block.

PMID: 2080157 [PubMed - indexed for MEDLINE]

6: Anesteziol Reanimatol. 1989 May-Jun;(3):59-61.

[Use of combined electroanesthesia in maxillo-facial surgery]

[Article in Russian]

Gritsuk SF, Epshtein SL.

Mathematical analysis of the heart rhythm and central hemodynamic tests have been performed in patients after surgery for congenital palatal defects and posttraumatic defects of soft facial tissues performed under combined electroanalgesia. Stability of the heart rhythm and hemodynamic patterns has been revealed, which is indicative of an adequate anesthesiological protection.

PMID: 2802249 [PubMed - indexed for MEDLINE]

7: Anesteziol Reanimatol. 1989 May-Jun;(3):49-51.

[Effect of electroanesthesia and neuroleptanalgesia on blood plasma beta-endorphin level during surgical intervention in cancer patients]

[Article in Russian]

Goloskov NP, Saltanov AI, Mistakopulo NF, Kushlinskii NE, Rylov VV.

Beta-endorphin release was studied in 40 patients after surgery for thyroid cancer or after femoral amputation due to malignant malformations in bones and soft tissues of the lower extremities. In thyroid surgery beta-endorphin release was more marked under neuroleptanalgesia than under combined electroanesthesia. A correlation between beta-endorphin and ACTH levels has been established. It indicates a stress nature of neuropeptide release. In patients with femoral amputation an increased beta-endorphin release was not observed. Possible mechanisms of beta-endorphin level elevation are discussed in terms of modern concepts of pain modulation.

PMID: 2529796 [PubMed - indexed for MEDLINE]

8: Khirurgiia (Mosk). 1989 Apr;(4):139-42.

[Main stages of development and prospects of electroanesthesia (review of the literature)]

[Article in Russian]

Sigaev VV, Bobrinskaia IG, Zverev VV, Akimov AA, Stepanov IuP.

Publication Types:
Review

PMID: 2661902 [PubMed - indexed for MEDLINE]

9: Anesteziol Reanimatol. 1989 Mar-Apr;(2):7-11.

[Present status of the problem of combined electroanesthesia]

[Article in Russian]

Sachkov VI, Abramov IuB.

Publication Types:
Review

PMID: 2662824 [PubMed - indexed for MEDLINE]

10: Vestn Akad Med Nauk SSSR. 1988;(9):65-7.

[Evaluation of the analgesic effect of an improved method of local electroanesthesia using electrodes implanted in the wound]

[Article in Russian]

Reshetniak VK, Sigaev VV, Meizerov EE, Akimov AA, Travkina OV.

PMID: 3264433 [PubMed - indexed for MEDLINE]

11: Khirurgiia (Mosk). 1987 Apr;(4):48-51.

[Regional electroanesthesia in complex rehabilitation measures after radical mastectomy]

[Article in Russian]

Rozanov IuL, Pronin VI, Sigaev VV, Akimov AA, Stepanov IuP.

PMID: 3496483 [PubMed - indexed for MEDLINE]

12: Vestn Akad Med Nauk SSSR. 1987;(2):10-7.

[Biological and clinical aspects of the participation of neuropeptides in the mechanisms of electroanesthesia]

[Article in Russian]

Kuzin MI, Shatalov VN, Avrutskii MIa, Shloznikov BM, Machulin AV.

Publication Types:
Review

PMID: 2953138 [PubMed - indexed for MEDLINE]

13: Anesteziol Reanimatol. 1986 Nov-Dec;(6):38-40.

[Choice of drugs for neurovegetative stabilization during electroanesthesia in hypertensive patients]
[Article in Russian]

Sachkov VI, Vorob'ev IV, Nedashkovskii EV.

PMID: 3103489 [PubMed - indexed for MEDLINE]

14: Urol Nefrol (Mosk). 1986 Sep-Oct;(5):18-21.

[Effect of combined electroanesthesia on indicators of central hemodynamics in urologic surgery]

[Article in Russian]

Karpenko VV, Osintseva EIu.

PMID: 3491455 [PubMed - indexed for MEDLINE]

15: Vestn Akad Med Nauk SSSR. 1986;(6):23-8.

[Effect of combined electroanesthesia on the hemodynamic function of children]

[Article in Russian]

Makoev VO, Mikhel'son VA, Kuzovlev VV, Makarov AP.

PMID: 3751259 [PubMed - indexed for MEDLINE]

16: Grudn Khir. 1985 Nov-Dec;(6):44-9.

[Electroanesthesia in the surgery of pulmonary tuberculosis]

[Article in Russian]

Sachkov VI, Rumiantsev VB, Savonicheva IP, Albegov EA, Andrzheiuk NI.

PMID: 4076821 [PubMed - indexed for MEDLINE]

17: Kosm Biol Aviakosm Med. 1985 Mar-Apr;19(2):81-5.

[Electroanesthesia as a means of controlling cold stress during regional hypothermia]

[Article in Russian]

Stazhadze LL, Sigaev VV, Titov AA, Romanov AN, Repenkova LG.

PMID: 3990238 [PubMed - indexed for MEDLINE]

18: Anaesthesiol Reanim. 1985;10(6):341-5.

[Early experiences with central electroanesthesia and transcutaneous electrostimulation analgesia in surgery]

[Article in German]

Damir E, Borchert K, Burov N, Karpenko V, Ewdokimov E, Moltschanov I, Konkel J, Gluschenko E, Kasper E.

PMID: 3879585 [PubMed - indexed for MEDLINE]

19: Vopr Onkol. 1985;31(2):73-8.

[Combination electroanesthesia in oncological patients during surgery and in the early postoperative period]

[Article in Russian]

Khonelidze GB, Kamyshov IaM, Piterskii NI, Soltan AF, Gerasimova GA.

Pelan and Elnar type electric stimulators were used to produce analgesia in 178 cancer patients in the course of surgery and in early postoperative period. The results of a complex study using rhythmography, acid-base balance, blood-sugar level, arterial and central venous pressure measurements and psychophysiologic examination with the Neuron type installation showed that joint application of electric stimulation and local anesthesia as well as the use of electric stimulation in combination with intravenous injection of hydroxybutyric acid, seduxen and ketalar provide adequate intraoperative anesthesia in 85% of cases. Postoperative application of electroanesthesia in cancer patients was followed by a significantly lower requirement of narcotic analgetics. Moreover, the procedure did not involve depressive or hyperkinetic complications, characteristic of morphine and promedol treatment. The results of the study suggest that electroanesthesia be used in cancer treatment.

PMID: 3976211 [PubMed - indexed for MEDLINE]

20: Voen Med Zh. 1984 Dec;(12):51-2.

[Effectiveness of various methods of electroanesthesia]

[Article in Russian]

Mosonov EP, Liashenko VG, Kozyriatskaia LI.

PMID: 6528509 [PubMed - indexed for MEDLINE]

21: Anesteziol Reanimatol. 1984 Nov-Dec;(6):14-6.

[Effect of combined electroanesthesia on catecholamine, cortisol and insulin concentrations in the peripheral blood of urological patients]

[Article in Russian]

Karpenko VV, Osintseva EIu, Sergeeva NA, Makarova LD.

PMID: 6398000 [PubMed - indexed for MEDLINE]

22: Anesteziol Reanimatol. 1984 Jul-Aug;(4):43-6.

[Use of polyglucin to increase the effect of anesthesia during combined electroanesthesia]

[Article in Russian]

Maslakov DA, Gubar' VV.

PMID: 6208818 [PubMed - indexed for MEDLINE]

23: Biull Eksp Biol Med. 1984 May;97(5):515-6.

[Effect of transcutaneous transcerebral electrostimulation as electroanesthesia on the beta-endorphin content of the cerebrospinal fluid and blood plasma]

[Article in Russian]

Kuzin MI, Avrutskii MIa, Shliuznikov BM, Lakhter MA, Panchenko LF.

The beta-endorphin content was measured in the cerebrospinal fluid (CSF) and blood plasma of patients before and after 30 minutes of transcutaneous transcerebral electric stimulation in the electric anesthesia mode. The output current was biphasic and rectangular. It was composed of high-frequency pulse trains (peak-to-peak intensity 250-300 mA, frequency 167 kHz) modulated by low frequency (77 Hz). Electrical stimulation resulted in an appreciable increase in the beta-endorphin content in the CSF and blood plasma of patients. The data

obtained attest to the intensification of the neuromodulator release to the CSF and blood plasma and to the involvement of the endorphinergic brain systems in the realization of the analgetic effect of transcutaneous transcerebral electric stimulation.

PMID: 6326889 [PubMed - indexed for MEDLINE]

24: Can Med Assoc J. 1984 May 1;130(9):1191-3, 1196-7, 1200.

Can Aime Limoge sell electroanesthesia to North America?

Goldman B.

PMID: 6713340 [PubMed - indexed for MEDLINE]

25: Probl Tuberk. 1984 Feb;(2):44-7.

[Status of the hemostatic system in pulmonary tuberculosis patients during combined electroanesthesia]

[Article in Russian]

Kolesov SM, Stepanov KN, Nikiforova SP.

PMID: 6709621 [PubMed - indexed for MEDLINE]

26: Med Instrum. 1984 Jan-Feb;18(1):86-7.

The elusive search for electroanesthesia.

Senior JE.

A review of the search for a safe, effective, and inexpensive means of electrical anesthesia.

Publication Types:
Historical Article

PMID: 6369091 [PubMed - indexed for MEDLINE]

27: Probl Tuberk. 1983 Oct;(10):40-4.

[Comparative evaluation of neuroleptoanalgesia and electroanesthesia during phthisiosurgical procedures]

[Article in Russian]

Albegov EA, Smirnova NA.

Publication Types:
Review

PMID: 6359143 [PubMed - indexed for MEDLINE]

28: Anesteziol Reanimatol. 1983 Sep-Oct;(5):16-20.

[Combined electroanesthesia after heart surgery under general artificial circulation]

[Article in Russian]

Avrutskii MIa, Shloznikov BM, Polunin BA, Tverskoi AL, Nabi M.

PMID: 6660569 [PubMed - indexed for MEDLINE]

29: Inf Dent. 1982 Nov 18;64(40):3919-24.

[History of electroanesthesia]

[Article in French]

Kunegel JM, Limoge A, Debras C.

Publication Types:
Historical Article

PMID: 6762999 [PubMed - indexed for MEDLINE]

30: Vestn Khir Im I I Grek. 1982 Nov;129(11):126-9.

[Combined general electroanesthesia with peridural block]

[Article in Russian]

Kuzin MI, Sachkov VI, Abramov IuB, Vakhrameev DA, Buniatian AF.

PMID: 7157585 [PubMed - indexed for MEDLINE]

31: Med Tekh. 1982 May-Jun;(3):52-3.

[INAAN-3 automatic dental electroanesthesia device]

[Article in Russian]

Nesmeianov NA, Nesmeianov IA, Nesmeianov AA.

PMID: 7109876 [PubMed - indexed for MEDLINE]

32: Isr J Med Sci. 1982 Jan;18(1):99-103.

Electroanesthesia in the cat: standardization of electric current parameters and anesthetic criteria.

Papir-Kricheli D, Magnes J.

This study was an attempt to apply to electroanesthesia (EA) the accepted criteria for surgical anesthesia brought about by chemical agents, namely, analgesia, muscle relaxation and the abolition of such reflexes as the corneal, pinnal and light reflexes. In the cat, with extracranial, bilateral, temporally placed electrodes, anesthesia was best achieved by a sine wave of 3,500 to 4,500 Hz with a low-frequency component of 100 Hz (15% of the applied current). The appropriate current intensity differed for each cat, ranging from 45 to 55 mA, peak to peak. Special attention was paid to smooth and rapid induction of the anesthetic state. Pupil diameter (greater than or equal to 12 mm) was used as an indication of the establishment of EA. Application of the current at lower frequencies (100 to 2,500 Hz) produced analgesia only, whereas higher current intensities at the same frequencies caused respiratory paralysis and muscular rigidity. Stimulation through electrodes placed at various locations in the brain stem resulted in analgesia only.

PMID: 7068348 [PubMed - indexed for MEDLINE]

33: Isr J Med Sci. 1982 Jan;18(1):51-7.

Effect of electroanesthesia on local cerebral glucose utilization in the cat.

Arinos-Shehori M, Magnes J.

An autoradiographic method using tracer amounts of [14C]2-deoxy-D-glucose was used to detect areas of the brain in which glucose consumption was altered under extracranial electroanesthesia, as compared with ether-anesthetized cats. All brain structures studied exhibited higher glucose consumption rates than the homologous controls, by amounts varying from 14 to 174%. In 20 out of 31 structures, the increase was statistically significant. Brain structures were heterogeneous regarding the magnitude of their glucose metabolism and could be scaled accordingly; EA changed the scaling hierarchy. The periaqueductal gray (ventral part) and the red nucleus changed from moderately to highly active structures, and the cerebellar cortex became the most active of all.

PMID: 7068344 [PubMed - indexed for MEDLINE]

34: Rozhl Chir. 1981 Jan;60(1):1-9.

[General electroanesthesia in clinical practice]

[Article in Czech]

Pokorny J, Lebl M.

PMID: 7209700 [PubMed - indexed for MEDLINE]

35: Vestn Akad Med Nauk SSSR. 1981;(8):45-50.

[Experimental clinical study of the analgesic action of various components of general electroanesthesia without pharmacologic anesthetics and analgesics]

[Article in Russian]

Sachkov VI, Abramov IuB, Vakhrameev LA, Fedotov AIu, Kutyrov OD.

PMID: 7303854 [PubMed - indexed for MEDLINE]

36: Vestn Khir Im I I Grek. 1980 Apr;124(4):135-8.

[Evaluation of the adequacy of general electroanesthesia based on data from studies of the hormonal profile of patients during surgery]

[Article in Russian]

Kuzin MI, Morenkova SA, Shloznikov BM.

PMID: 6247807 [PubMed - indexed for MEDLINE]

37: Voen Med Zh. 1979 Oct;(10):22-4.

[Electroanesthesia in therapeutic stomatology]

[Article in Russian]

Kabakov BD, Nesmeianov AA.

Publication Types:
Clinical Trial

PMID: 388847 [PubMed - indexed for MEDLINE]

38: Czas Stomatol. 1979 Apr;32(4):331-8.

[Trial use of a device of the author's own construction for electroanesthesia in conservatice dental care]

[Article in Polish]

Alwas-Danowska H, Jatczak J, Kurnatowska A, Skalska J.

PMID: 287597 [PubMed - indexed for MEDLINE]

39: Anesteziol Reanimatol. 1979 Jan-Feb;(1):51-4.

[Changes in several biochemical indices of blood serum with different methods of general combined electroanesthesia]

[Article in Russian]

Tsibuliak VN, Rasstrigin NN, Sysoev AB, Petrenko IuA, Piastunovich KA.

PMID: 434559 [PubMed - indexed for MEDLINE]

40: Vopr Okhr Materin Det. 1978 Oct;23(10):65-6.

[Acid-base balance of the maternal, fetal, and neonatal blood in electroanesthesia during labor]

[Article in Russian]

Utkina LA.

PMID: 706277 [PubMed - indexed for MEDLINE]

41: Anesteziol Reanimatol. 1978 Jul-Aug;(4):3-9.

[Central and peripheral hemodynamic indices as criteria of the adequacy of the analgetic component of general electroanesthesia]

[Article in Russian]

Darbinian TM, Kuzin MI, Shloznikov BM.

PMID: 697100 [PubMed - indexed for MEDLINE]

42: Anesteziol Reanimatol. 1978 Jan-Feb;(1):26-8.

[Combined electroanesthesia in conjunction with anticonvulsive agents]

[Article in Russian]

Smirnov IuA.

Publication Types:
Case Reports

PMID: 637348 [PubMed - indexed for MEDLINE]

43: Ann Anesthesiol Fr. 1978;19(5):337-40.

[Bibliographic review and critique on the phenomena of electroanalgesia and electroanesthesia]

[Article in French]

Gogan P.

PMID: 29529 [PubMed - indexed for MEDLINE]

44: Mil Med. 1977 Dec;142(12):929-31.

Electroanesthesia for military application.

Hertert RS, Cutright DE.

PMID: 414157 [PubMed - indexed for MEDLINE]

45: Anesth Analg. 1977 Sep-Oct;56(5):678-85.

Electroanesthesia (EA) studies: current applications to human volunteers to produce general and local anesthesia.

Smith RH, Kano T, Cowan GS, Barber RE.

Electrical currents found to be of sufficient intensity to produce EA in animals were applied to human subjects several hundred times, to determine whether, and how, clinical general anesthesia, and local anesthesia in various parts of the body, could be obtained. General anesthesia was not produced in any subject in any test, the obstacle in every instance being pain. Local analgesia of the arm was obtained in one subject, but in all other subjects muscle spasm and vibration pain prevented application of enough current to produce analgesia or anesthesia in the arm. Anesthesia of the hand was produced several times in all subjects, with a total loss of pain sensation.

PMID: 562093 [PubMed - indexed for MEDLINE]

46: Am J Vet Res. 1977 Mar;38(3):403-6.

Effects of electroanesthesia and a phenothiazine tranquilizer on thermoregulation in the sheep.

Hofman WF, Riegle GD.

The effects of giving propiopromazine alone and of electroanesthesia-propiopromazine treatment on thermoregulation (body temperature regulation) were studied in 3 sheep at ambient temperatures of 5, 25, and 35 C. Measures of thermoregulation during a 120-minute treatment and 120-treatment recovery period included rectal temperature, respiratory frequency, respiratory evaporative heat loss, metabolic heat production,

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