Title: MOTOR EVOKED POTENTIAL (MEP) FOLLOWING TRANSCRANIAL MAGNETIC STIMULATION IN MONKEY ANESTHETIZED WITH NITROUS OXIDE, KETAMINE, AND THIAMYLAL SODIUM

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Introduction: Magnetic stimulation has shown to have certain advantages over electrical stimulation in that: (a) the magnetic fields are not attenuated by biological structures, i.e. the skull (b) there is no need to reduce scalp impedance; (c) there is minimal discomfort, if any in awake subjects; (d) simplicity; (e) there is no need to have either electrodes or trephine and (f) the stimulating coil can be readily moved over the head to stimulate different regions (1). The present study assessed the reliability of motor evoked potential (MEP) recording following nonivasive, transcranial magnetic stimulation (TMS) of the motor area of primates, anesthetized with N_2O and ketamine (KT) or thiamylal Na (THY).

Methods: Sixteen normal cynomolgus monkeys (Macaca Fuscata), weighing 5.5 to 6.5 kg, were subjected to nonivasive TMG using a magnetic stimulator (Novametric Magstim 200) producing maximum power of 1.5T. (100%). The animals were anesthetized initially with KT (10 mg/kg IM) and maintained under anesthesia with different N_2O:O_2 mixture ratios. Supplemental THY, (5 mg/kg IV bolus) or KT (5 mg/kg IV bolus) were repeatedly given to maintain a deeper anesthetic level. The magnetic coil was positioned over the animal head and the area of optimal response (a potential of maximal amplitude) was defined. Contralateral (to the site of stimulation) and ipsilateral, median, and posterior tibial nerve MEP responses were recorded with Grass EEG needle electrodes. The Nicolet Pathfinder II device was used for recording the MEP following a stepwise increase in magnetic intensity of 10% increments. The depth of anesthesia was regularity assessed during the stimulation and recording periods by testing the righting reflex, clamp tail test, and subcutanous electrical stimulation.

Results: The peripheral MEP response was found to be consistent, as recorded, and reproducible in all anesthetized animals following TMG. Maximal MEP responses were obtained when the animal was lightly anesthetized, as evidenced by spontaneous eye opening, brisk blink reflex, response to clamp tail test and subcutanous electrical stimulation. No MEP response was noted when using magnetic intensity 50%. The scalp zone of optimal response (in relation to the center of coil) was a rectangular like area extending 5 cm sagittally; from the midline and 2 cm laterally. The MEP response was well maintained during Kt (total dose 50 mg/kg IV) and/or nitrous oxide (25-75% concentrations) anesthesia. The zone of optimal response was unaffected during KT and N_2O anesthesia. On the other hand, the MEP response, was attenuted after 15 mg/kg of THY but was not abolished even after a total dose of 50 mg/kg. The zone of optimal response was reduced to 25% of the original area after THY injection.

Discussion: Intraoperative MEP monitoring has been advocated as a sensitive monitor of the spinal cord motor function (1,2). The motor pathways need to be closely monitored during spinal cord and vascular surgical procedures, if motor tract integrity is at risk. In this case, TMS-MEP may prove to be a useful replacement for the intra-operative "waking-up test", minimizing the known hazards of the latter. Limited, but promising results have been reported utilizing TMS in humans (1). Epileptogenic activity has not been reported. In this study, TMS was reliable in eleciting MEP in primates. The threshold for magnetic intensity was 50%. Potentiation of the MEP response was noted when the animal was lightly anesthetized, as noted in humans during voluntary muscle contraction (1,2). The MEP response was reproducible and well preserved during KT and/or N_2O anesthesia. THY, however, had a depressant effect on MEP. Barbiturates are known to depress the CNS and skeletal muscle while, KT and nitrous oxide appear to induce varying degrees of excitatory effects on the same tissues (3). Interestingly enough muscle action potentials were frequently noted in the MEP recording tracings during N_2O and KT anesthesia. Further investigations are needed on MEP produced by magnetism to define the use of TMS intraoperatively in man.

References:

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