Motor threshold-tracking transcranial electrical stimulation with double and single train stimulation under sevoflurane anesthesia

Evgeny Gulaev, MD; Sergey Kolesov prof., PhD, MD
FSBI MH RF National Medical Research Center for Traumatology and Orthopedics named after N.N. Priorova.

ABSTRACT

Inhaled anesthetics cause significant depression of the MEP, especially in the presence of an initial neurological deficit. The search for optimal stimulation parameters to reduce this problem is an important issue. The aim of the study was to compare the effectiveness and the threshold of the TcMEP obtained by automatic tracking with single and double train stimulation.

In 25 patients undergoing anterior idiopathic scoliosis correction, we compared MEP threshold with automatic tracking induced by stimulation with single and double trains. Electrodes were placed in the muscles abductor hallucis (AH), abductor pollicis brevis (APB), bilaterally. Inhalation anesthesia with sevoflurane was used, without muscle relaxants.

Successful MEP monitoring with double train stimulation performed in all patients, 1 patient had no unilateral MEP APB response. MEPs were absent bilaterally with a single train stimulation in 4 (AH) and 10 (APB) patients, unilaterally in 4 and 3 additionally at maximum intensity of stimulation. The median threshold MEP AH was 216 and 259 μv for a single and double train, respectively, for APB - 183 and 224 μv,

The use of double train stimulation which has greater efficiency and a lower MEP threshold is recommended when performing intraoperative monitoring of MEP under inhalation anesthesia.

CONTACT

Evgeny Gulaev
National Medical Research Center for Traumatology and Orthopedics named after N.N. Priorova.
Email: evlgul@mail.ru
Phone: +79611183575

INTRODUCTION

- Intraoperative motor evoked potentials (MEPs) are commonly used in spinal surgery, including scoliosis correction. Inhaled anesthetics cause significant depression of the MEPs, especially in the presence of an initial neurological deficit, because of that the search for optimal stimulation parameters to reduce this problem is an important issue.
- The aim of the study was to compare the effectiveness and the threshold of the transcranial electrical MEP obtained by automatic tracking with single and double train stimulation.

METHODS AND MATERIALS

- Prospective study of 25 consecutive patients undergoing anterior idiopathic scoliosis correction.
- The operations were performed under conditions of inhalation anesthesia (0.8 to 1.2 MAC) with sevoflurane (with fentanyl), without muscle relaxants at the main stage of the operation The MEP threshold was analyzed with tracking for 4 limb muscles (7 consecutive stimulations for each muscle). Monitoring was carried out using the Neuro-IOM device (Neurosoft). MEP induced by stimulation C1-C2/C2-C1 with single and double trains of 5 pulses, 0,2 ms duration, 3 ms interpulse interval, inter-train intervals were 12 ms. Stimulation was performed every 20 seconds.
- Needle recording electrodes were placed in the muscles abductor hallucis (AH), abductor pollicis brevis (APB), bilaterally. The maximum stimulation level was 500 V, the minimum response amplitude was considered as 50 μv.

RESULTS

- Successful monitoring of MEP performed in all patients. There were no signal criteria for reduction or disappearance MEPs during the operations.
- All patients had a lower MEPs threshold in response to double train stimulation, compared to single train.
- The median threshold MEPs AH was 216 and 259 μv ($p<0.05$) for a single and double train stimulation , respectively, for APB - 183 and 224 μv ($p<0.05$).

RESULTS

- Successful MEP with double train stimulation were obtained in all patients, only 1 patient had no reliable unilateral MEP APB response.
- When stimulated with a single train, even when the maximum intensity of stimulation used (500 V) was reached with the same parameters, it was not possible to obtain MEPs in a significant number of patients.
- MEPs were absent bilaterally with a single train stimulation in 4 (AH) and 10 (APB) patients, unilaterally in 4 and 3 additionally at maximum intensity of stimulation.

DISCUSSION

- Motor threshold-tracking transcranial electrical stimulation makes it much more reliable to determine the threshold of the MEP response at any given time, which can be used both in scientific research and scientific work.
- The study made it possible to determine the level and effectiveness of the facilitation of MEPs responses in the case of stimulation with a double train in comparison with a single one under the conditions of inhalation anesthesia with sevoflurane.

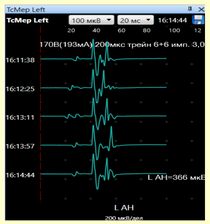

Figure 1. The amplitude of double train stimulation in response to the first and second series of stimuli

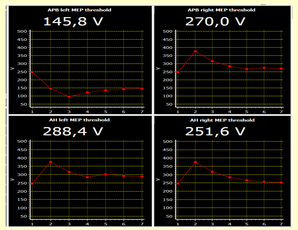

Figure 2. TcMEP tracking threshold with double train stimulation

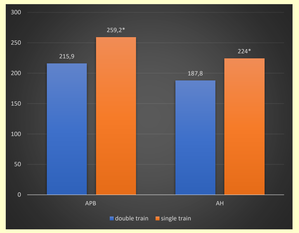

Figure 4. TcMEP threshold with double and single train stimulation

	Idiopathic scoliosis group (n=25)
Age, years	25,8 ± 12,0
Gender, n (%) women	21 (84)
Height, cm	168,1± 10,7
Weight, kg	60,9 ± 9,5

Table 1. Anthropometric data

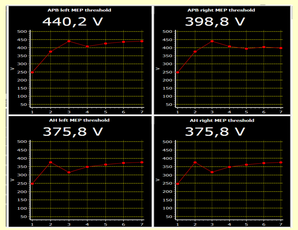

Figure 3. TcMEP tracking threshold with single train stimulation

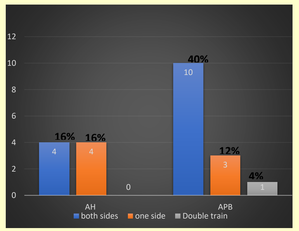

Figure 5. Absence of MEP with single train stimulation

CONCLUSIONS

- The use of double train stimulation has a lower MEP threshold.
- Double train stimulation under inhalation anesthesia allows obtaining reliable MEPs in the overwhelming number of patients, in comparison with single train stimulation
- Double train stimulation is highly recommended when performing intraoperative monitoring of TcMEPs under inhalation anesthesia.

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