Total i.v. anaesthesia for transcranial magnetic evoked potential spinal cord monitoring


Summary
Continuous intraoperative monitoring of transcranial magnetic motor evoked potentials (TcMMEP) can warn the surgeon of motor tract damage more effectively than somatosensory evoked potentials. As a non-invasive technique it is especially useful during post-traumatic internal fixation and is applicable whatever the level of the spinal cord at risk. Inhalation and many i.v. anaesthetics block the single pulse TcMMEP but a total i.v. anaesthetic regimen based on methohexitone, alfentanil and ketamine was effective in seven patients undergoing post-traumatic internal fixation. Consistent TcMMEP of 100–1000 mcV were obtained in all patients, with a latency change of only 2 ms above preoperative values. Good cardiovascular stability was maintained during operation. (Br. J. Anaesth. 1996; 76: 870–871).

Key words
Anaesthetics, i.v. monitoring, evoked potentials. Spinal cord, evoked potentials.

Spinal column surgery is associated with a risk of permanent neurological damage and it is imperative to monitor reliably and repetitively the integrity of the long motor tracts throughout surgery and before operation. Dependence on the use of somatosensory evoked potentials may give a false sense of security [1]. Currently, difficulties in obtaining responses in anaesthetized patients [2, 3], even in the absence of neuromuscular block, are impeding wider adoption of transcranial magnetic motor evoked potential (TcMMEP) monitoring. Previous unpublished work at this centre established that a combination of ketamine, alfentanil and etomidate permitted TcMMEP monitoring. A recent publication of experimental work in dogs demonstrated that methohexitone also had a permissive effect in this situation [4], despite contrary effects with thiobarbiturates.

The aim of this study, therefore, was to use a reliable total anaesthesia (TIVA) regimen for spinal surgery with intraoperative TcMMEP monitoring.

Method and results
In seven adult patients undergoing internal fixation of the spinal cord after spinal column trauma, we recorded continuous intraoperative TcMMEP from a suitable muscle. Selection of the latter depended on the level of neurological injury and was either below the fracture in patients in whom the muscle was neurologically intact or incomplete (n = 3), or on the last intact myotome of neurologically complete lesions (n = 4). Two patients had cervical injuries and the remainder thoracolumbar. The stimulus was provided by a Magstim model 200 single pulse machine using a double 70-m cone coil which produces a peak magnetic field strength of 2.0 T.a. Recordings were made using a Medelec MS 91a machine. Peak-to-peak voltage and latencies were assessed continuously and compared with preoperative values. As voltage responses are always less during anaesthesia, the Magstim output of 100 % was usually used in the intraoperative period.

Patients were premedicated with either promethazine or morphine, deliberately avoiding benzodiazepines [3]. The anaesthesia regimen comprised a bolus dose of methohexitone 2 mg kg⁻¹ for hypnosis, followed by 100 µg kg⁻¹ for 30 min and then 75–50 µg kg⁻¹ min⁻¹. Analgesia was provided by a bolus dose of alfentanil 50 µg kg⁻¹ followed by 5 µg kg⁻¹ min⁻¹ for 15 min and 1 µg kg⁻¹ min⁻¹ thereafter. Ketamine was used in a low dose of 20 µg kg⁻¹ min⁻¹ decreasing to 14 µg kg⁻¹ min⁻¹ after 1 h, to augment anaesthesia and improve TcMMEP amplitude responses [5]. One bolus of a neuromuscular blocking agent was used in most instances at induction of anaesthesia for initial airway control, but before recording TcMMEP, subsequent recovery of neuromuscular function was confirmed using a conveniently located peripheral motor nerve. The adequacy of the TIVA-based anaesthesia was assessed with familiarity according to cardiovascular stability with the aid of invasive arterial pressure monitoring, and by the absence of reflex body movements in response to surgical stimuli. All patients were awakened within 30 min of discontinuation of the TIVA, albeit with the aid of doxapram or naloxone, and none had psychomimetic side effects from ketamine.

Reliable TcMMEP were obtained in all patients using this TIVA regimen, latenecies being within 2 ms of preoperative values. When anaesthesia in an individual patient was optimized, if necessary even by elimination of 25 % nitrous oxide from the air and

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oxygen mixture, voltage was at least 100 mcV in all patients. It was noticeable in many cases that TcMMEP increased permanently after surgical decompression of the compromised spinal cord (Fig. 1). There was a temporary loss of TcMMEP in two patients after passage of sublaminar wires but no patient sustained neurological deterioration after operation. Two factors affecting TcMMEP amplitude during surgery were variation in the intensity of the surgical stimulus and changes in the position of the hand-held stimulation coil. However, rogue weak TcMMEPs were discounted by repeating stimuli every 2–5 min and examining the stability of the latency.

Comment

Before this series in which methohexitone proved successful, etomidate was the principal hypnotic, used after consultation with the Medicines Control Agency and after local Ethics Research Committee approval. A direct comparison was made between etomidate and methohexitone in patient No. 1 in this series and as there were comparable TcMMEP with both agents (fig. 1), etomidate was abandoned thereafter, although 24-h tetracosactrin responses had recovered in seven patients with an etomidate-based regimen.

Propofol and inhalation agents are powerful suppressants of both magnetic and electrical transcranial evoked potentials, as confirmed in patient No. 1 (fig. 1). The evidence suggests that this effect takes place at the spinal motoneurone or interneurone [2]. While the next generation of magnetic stimulators use the summation effect from double or quadruple pulsing and are better able to overcome anaesthetic-induced TcMMEP depression [6], our experience indicates that the methohexitone-based TIVA regimen provides the greatest potential for non-invasive monitoring of spinal motor tract integrity and would cause less hypotension than propofol. The exact role of ketamine has yet to be clarified.

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References