Intraoperative Transcranial Electrical Motor Evoked Potential Monitoring During Spinal Surgery Under Intravenous Ketamine or Etomidate Anaesthesia

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Summary

Motor evoked potentials (MEPs), monitoring the motor function directly, are superior to somatosensory evoked potentials (SSEPs) in monitoring the motor system during spinal surgery. Reliable MEPs are difficult to elicit under normal anaesthesia. Using intravenous anaesthesia with either ketamine or etomidate infusion, we performed intraoperative MEP monitoring in 12 spinal operations for 11 cases from February 1992 to May 1992. For anaesthesia, ketamine was used in 5, etomidate in 7, fentanyl was supplemented in all, muscle relaxation at 30% to 50% of pre-anaesthetic muscle power was maintained with atracurium or vecuronium infusion. Transcranial bipolar electrical stimulation was used to induce MEPs. Concomitant SSEP monitoring was performed in 3. No significant anaesthesia related side effects were noted except one episode of unpleasant dream occurred in the ketamine anaesthesia group.

Successful monitoring was achieved in 10 sessions. In 5 of which warning to the surgeons was made due to sudden MEP deterioration, which recovered followed by definite management in four and persisted in one. In the other 5 sessions, no warning was made due to stationary or gradual change in MEPs. Bilateral two-channel recordings were used in 3 sessions. In 2 of which unilateral transient change was noted. Loss of SSEPs was noted in one despite unchanged MEPs, in whom only new sensory deficits occurred postoperatively.

In our small series, the intraoperative MEP monitoring showed neither false negative nor false positive result. It is concluded that the intraoperative MEP monitoring is feasible under intravenous ketamine or etomidate anaesthesia and valuable in spinal surgery.

Methods and Material

Patients

From February 1992 to May 1992, a total of 11 cases underwent 12 sessions of intraoperative MEP monitoring during spinal surgery, of whom 7 were male and 4 female with their age ranging from 30 to 73 years. The clinical summary is listed in Table 1. Case 5 un-
of the hand or at the tibialis anterior (AT) of the lower leg in belly/ tendon fashion. Only one channel was used for recording MEPs of the upper extremity, one or two channels were used for recording MEPs of the lower legs, as both sides of the motor cortices for lower leg could be excited simultaneously by stimulating electrodes placed in the midline. Cadwell spectrum 32 (Cadwell Laboratory, Kennewick, Washington, USA) was used for recording and triggering at the rate of 0.1 to 0.3 per second. The gain was set between 100 μV to 1000 μV, the bandpass 30 to 3 kHz, and the sweep 50 ms or 100 ms, the post-stimulus delay for 10 to 15 ms was used in case of large stimulating artifact. The latency was measured from the stimulus to the take-off point of the evoked EMG, the amplitude was measured from the peak to the following trough. A baseline tracing was obtained immediately after anaesthesia. During operation, warning to the surgeons was made if sudden reduction of amplitude more than 50% of baseline and/or latency prolongation for more than 3 ms, the possible offending surgical manoeuvres were recorded. Whether the waves would return to the baseline thereafter was correlated with the following surgical procedures and the postoperative motor status. Without the above changes, the MEPs were classified as stationary. The final MEPs compared to the baseline in terms of amplitude and latency were correlated with the immediate postoperative motor status.

Scalp SSEP

Sequential bilateral posterior tibial nerve stimulation or median nerve stimulation was used at the rate of 5.11 Hz with 15 per cent randomization. The stimulus intensity was supramaximal with 100 μs pulse duration, the interstimulus delay was 40 ms for median nerve stimulation and 100 ms for posterior tibial nerve stimulation. Cadwell spectrum 32 was used for recording and data storage. Scalp recordings were taken according to the international 10~20 system, active leads were placed at 2 cm behind Cz, C3, and C4, the reference lead was placed at Fpz. Gain was set 4–10 μV, bandpass 30 to 3 kHz, sweep 100 to 150 ms with a post stimulus delay for 10 to 20 ms. Averaging of 250 sweeps was used for each recording. The monitoring procedures are similar to that of MEP.

Results

All patients recovered soon from anaesthesia with either ketamine or etomidate infusion. Anaesthesia-related side effects were noted only in case 5 receiving ketamine infusion throughout his first operation, who suffered from unpleasant dreams. No adrenal insufficiency or myoclonic movements occurred clinically in the group receiving etomidate anaesthesia postoperatively. No stimulation related side effects such as headache or seizures were observed in any patients. Intraoperative MEP monitoring was successful in 10 sessions, failed in two due to technical problems. A maximal response could be obtained with 35% to 50% of the maximal output. If the stimulus exceeded 55% of the maximal output, contraction of trapezius and pericranial muscles was large enough to disturb the operation. The intraoperative MEP findings and its clinical correlation are summarized in Table 2.