THE WAKE-UP TEST AND SSEP MONITORING DURING SPINAL SURGERY

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ABSTRACT :

During spinal surgery assessing the integrity of the spinal cord can be difficult. To avoid complications like compression, stretching and derangement in circulation it is important to be able to evaluate the neurologic status during surgery. The Wake-Up test is still performed for this reason.

24 patients undergoing elective spinal ALICI instrumentation were assessed by preoperative physical examination to be neurologically normal. They were premedicated with diazepam 0.2 mg/kg orally. TİVA was performed with 40-60 µg/kg/h alfentanil and 2-3 mg/kg/h propofol. In all patients under TİVA, intraoperative Wake-Up test was performed and the neurologic examination was carried out when cooperation to verbal commands occured.

In two patients who showed changes in amplitude, both showed motor deficit during the Wake-Up test. In one of two patients who showed prolongation in latency there was minimal motor deficit postoperatively. The other 20 patients with normal SSEPs remained neurologically normal.

Especially in patients in whom cooperation is poor or neurologic examination is difficult SSEP monitoring hasbeen found to be valuable.

Key Words: *Monitoring, SSEPs, Spinal surgery.*

INTRODUCTION:

During spine surgery assessing the integrity of the spinal cord can be difficult. To avoid complications like compression, stretching and derangement in circulation it is important to be able to evaluate the neurologic status during surgery (3, 4, 9). The Wake-Up test is still performed for this reason (18).

To complete a successful neurologic examination with the Wake-Up test, we have to considerate several factors influencing it. These are the anesthesia method, biometric properties, behavioural properties and the cortical functions. In elderly or high risk patients, and patients who have difficulty in cooperation it is not possible to perform the Wake-Up test or to evaluate it correctly. In those clinical conditions somatosensory evoked potentials (SSEPs) have been extensively used as a noninvasive monitoring of spinal cord functions.

Intraoperative somatosensory evoked potentials with or without the Wake-Up test can accurately predict the electrophysiologic state of the spinal cord (1, 5, 6, 8, 15).

In 24 patients undergoing posterior spinal surgery under total intravenous anesthesia (TİVA), the relationship between the Wake-Up tests results, SSEPs recording and perioperative neurologic defects were studied.

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METHODS:

24 patients undergoing elective spinal ALICI instrumentation were assessed by preoperative physical examination to be neurologically normal (2). They were premedicated with diazepam 0.2 mg/kg orally prior to surgery. After precurarisation with vecuronium 0.01 mg/kg, anesthesia was maintained with 67% nitrous oxide in oxygen whereas TİVA was performed with 40-60 µg/kg/h alfentanil and 2-3 mg/kg/h propofol. To begin the Wake-Up test propofol infusion and nitrous oxide were stopped 100% oxygen was continued with mechanical ventilation. The neurologic examination was performed when cooperation to verbal commands occured. Then TİVA was restarted with a 1 mg/kg bolus dose of propofol.

After the patients had been placed in the prone position, baseline SSEPs recordins were made from the left posterior tibial nerve area. The Medelec (Mistral) computer was used with band pass filtration of 30-3000 Hz and an analysis window of 100 msec. Mean values of 256 potentials were taken into account. Stimulus strength was 1.5 times motor treshold and was recorded at the Cz' point (5, 13, 14, 16). P 32 wave

forms, amplitudes and latency changes were taken as the baseline values. Recordins were repeated every 5 minutes during surgery. SSEP changes were considered significant and the surgeon was informed, when latency changed more than 3 msec and amplitude changed more than 50% (8).

Abnormal amplitude and latency changes were compared with the results of the Wake-Up test and postoperative neurologic status. Statistical analysis was carried out using students t-test.

RESULTS:

24 patient (eleven women and thirteen men) with mean age of 37.43 (±16.6) were studied.

The indications for posterior spinal instrumentation were scoliosis for 11 patients, spondylolysthesis for 11 patients and vertebra fracture for two patients.

In all patients under TİVA, intraoperative Wake-Up test was performed, in three patients the Wake-Up test had to be repeated (Table I-II).

Table I. Results of the Wake-Up test (n = 24)

Opening the eyes in	6.46 ± 4.13 min.
Voluntary motor movements in	8.32 ± 5.24 min.

Table II. Quality of cooperation during the Wake-Up test (n = 24)

Good	11 patients
Adequate	9 patients
Bad	4 patients

During the whole intraoperative period, especially when the instrument was beeing distracted, there were minimal changes in SSEPs latency and amplitude in all patients. In two, significant increases in amplitudes were observed during distraction and two other patients showed a significant prolongation in latency. In the two patients with significant increases in SSEPs amplitudes, no important findings occured during the first Wake-Up test. But in the second Wake-Up test one of the patients showed motor movement only to pain. The patient with minimal motor deficit developed paraplegia 12 hours postoperatively and in spite of surgical decompression total spinal block occured. The other patient showed recovery to normal SSEPs amplitudes and neurologic findings after intraoperative decompression. One of the patients who showed prolongation in latency showed motor movement in the left foot only to painful stimulus and after immediate decompression, his SSEPs recordings and motor functions returned to normal. The other patient had no significant finding during the Wake-Up test and no neurologic deficit was found in the postoperative period (Table III).

Table III. SSEPs and Wake-Up test results (n = 24)

	Wake-Up Test	
SSEPs	Normal	Motor deficit
Normal	20	-
Changes in amplitude	-	2
Prolongation in latency	1	1

DISCUSSION:

The advantages of TIVA in allowing for intraoperative Wake-Up testing and SSEP monitoring are well known (3, 4, 10, 12, 17).

Ideal intraoperative spinal monitoring should give the possibility to warn the surgeon of potential irreversible hazards. It is important to keep in mind that unnecessary warnings prolong and may negatively effect the outcome of surgery.

In patients who underwent surgical decompression before permanent changes developed, intraoperative SSEPs also improved immediately (11). Intraoperative deterioration in SSEPs is not always reversible. McCallum and Bennet recorded decreasing amplitudes in eight patients with SSEP monitoring, although seven of them didn't show any neurologic deficit in the postoperative period. In another patient who showed increase in SSEP amplitudes during exploration of the spinal cord no deficit was found postoperatively. In one patient with syringomyleia who showed intraoperative depression of SSEP they also observed a postoperative neurologic deficit (6). Seven patients from the Neuroanesthesiology Department in the University of Pittsburgh in fifteen patients with SSEP monitoring showed significant depression in SSEPs. In one patient with a spinal cord AVM in the thoracolumbar region depression in SSEP occured a few hours postoperatively and evolved into a total spinal block (13). Spielholz et al. showed improvement whereas in one patient

no clinical improvement occured in spite of positive development in electrophysiologic properties (11).

Engler et al. monitored 54 scoliosis patients undergoing operation and found minimal latency and amplitude changes. No depression in SSEP was seen (9).

According to another study in patients undergoing spinal fusion surgery because of scoliosis, the Wake-Up test was performed when there was a 50% or more decrease in SSEP amplitudes and prolongation in latencies for more than 3 msec. The Wake-Up test was performed in 5 of 24 monitorized patients. In these patients voluntary motor movements were found to be normal. Changes in SSEPs returned to normal in the intraoperative period and there was no neurologic deficit in any patient in the postoperative period. This study showed that the Wake-Up test is unnecessary in patients whose SSEP recordings can be carried out properly and whose SSEP wave forms remain stable (6). However several authors report that instable lesions in the anterior cord can result in complete motor block without having shown any changes in SSEP recordings.

In our study SSEP monitoring was performed in 24 patients who underwent posterior spinal instrumentation (ALICI). In two patients we observed more than 50% increase in SSEP amplitudes and in two other patients prolongation in latencies for more than 3 msec. In all patients who showed an increase in SSEP amplitude there was also a motor deficit in the Wake-Up test. In one of the two patients with prolongation in latency, there was no neurologic deficit. Two patients with significant SSEPs and Wake-Up tests recovered completely after intraoperative decompression. Changes in SSEP and motor functions returned to normal values. One patient who undervent late decompression showed no recovery in motor function and remained paraplegic.

In conclusion, the Wake-Up test and the SSEP monitoring are methods which complement each other. Especially in patients in whom cooperation is poor or neurologic examination is difficult, SSEP monitoring should be preferred.

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