

WAKE - UP TEST FOR RECOGNITION OF POSSIBLE NEUROLOGIC DAMAGE DURING SCOLIOSIS SURGERY

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To permit early recognition of possible spinal cord trauma due to spinal distraction with Harrington rod instrumentation, 20 patients were awakened intraoperatively in Hacettepe University Medical Faculty.

Droperidol and Fentanyl were used for anesthesia for all patients. The reliance of this procedure was investigated by noting the time between spinal distraction and obtaining motor response and by comparing with the post-operative neurologic condition.

One patient with an unusual complication-transient cortical blindness (Anton Syndrome), was also discussed.

Key Words : Harrington instrumentation, spinal monitoring, wake - up test.

Surgical intervention and internal fixation with distraction for correction of spinal deformities has come much added risk of neurologic injury.

The incidence of neurologic injuries associated with posterior spine fusion and Harrington instrumentation is 1.2 %, with the incidence of paraplegia or partial impairment being 0.5 % to 0.7 %. There are numerous risk factors that make neurologic injury more likely;

1. Pathophysiologic factors-Rigid curves, congenital scoliosis, kyphosis, postradiation curves, pre-existing neurologic deficits, neurofibromatosis,

2. Surgical factors-sublaminar wiring, spinal distraction, spinal osteotomy, skeletal traction, and

3. Anaesthetic factors-hemodilution and induced hypotension.

The mechanism underlying spinal cord damage may vary from compression to blunt trauma, to stretching or disruption of neural elements to ischemia. The majority are believed due to distraction of the spinal cord by the Harrington system, causing either vascular spasm or neuropraxia directly by traction. Only a small number of spinal cord injuries are secondary to direct surgical trauma.

Intraoperative awakening to test motor function has been a commonly used method of monitoring spinal cord function in order to avoid nerve damage during

Harrington rod distraction. It is originally reported by Vauzelle et al., involves muscle relaxation and narcotics at the beginning of the surgical procedure only. Other methods of intraoperative awakening have been described by Sudhir et al. and Hall et al., in which muscle relaxation is reversed at the time of wake-up.

It is anticipated by use of this technique that there can be early recognition, permitting rod removal thus avoiding permanent neurologic injury.

MATERIAL AND METHODS :

Since 1988, in Hacettepe University Medical Faculty we have used intraoperative awakening routinely in patients undergoing surgery involving distraction of the spinal column 16 consecutive patients were included in this study.

Patients had chosen for intraoperative awakening among others to be at a cooperative age (above 7 yrs), without psychiatric problems or mental retardation.

The day before the operation they were informed about the procedure.

Premedication includes peldin 1 mg per kg., and Atropine SO₄ 0.50 mg. per kg. of body weight, intramuscularly, 45 minutes before the surgical intervention. In the operating room a route for iv. therapy is established and the monitoring of BP, ECG, and precordial heart sounds is started before the anaesthesia is induced. Urine output is monitored by Foley Catheter.

Intravenous thiopental 5 mg. per kg. is used for induction. Succinylcholine 2 mg. per kg. is used for muscle relaxation and tracheal intubation.

Respiration is controlled with 65 percent nitrous oxide, 35 percent oxygen, and 0.5 percent Halothane.

Anaesthesia is maintained by fentanyl and droperidol in small fractional doses.

Halothane is discontinued 10 minutes after neuro-

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leptic medication. Muscle relaxant is given 1 mg. per kg. and anaesthesia is continued by controlled respiration.

Prior to testing, patients is controlled for regain of muscle activity and spontaneous respiration. When spontaneous respiration is achieved the nitrous oxide is discontinued and 100 % oxygen is given. After waiting 2 or 3 minutes at this mode patients were asked by name to open their eyes. Subsequently to move their hands and feet.

After completion of the test 2 mg. per kg. Thio-pental Na is given for amnesia. Then, through the surgical intervention, muscle relaxant, oxygen, nitrous oxide and halothane are given.

By this technique 16 patients with idiopathic or neuromuscular scoliosis or vertebral fractures undergoing spinal fusion with Harrington rod instrumentation were monitored intraoperatively. (Table -1)

wake-up time were changed between 1 to 10 minutes, average being 3.87 minutes. One 9 year old boy couldn't be woken.

Cardiac pulse rates and blood pressure were not significantly altered during the test.

After the operation only one of our patients remember that he is awakened and asked to move his parts. He did not recall any sense of fear.

One patient had to be woken twice, each successful.

RESULTS :

There was no difficulty carrying out the wake-up test in all but one patient.

The patient who not able to woke was a 9 year old boy with poliomyelitis scoliosis. This was his second operation for redistrac tion of a subcutaneous Hairing-

Case	Age	Sex	Body weight	Recovery time	Cooperation	Pulse Rates		Blood Pressure		Recall of intra-op events	Notes
						Before the test	During the test	Before the test	During the test		
1	14	F	40kg	3min.	+	90	110	100	100	-	Post-op. Anton Syn.
2	16	M	50kg	2min.	±	100	100	90	100	+	
3	30	M	70kg	4min.	+	70	75	110	110	-	
4	11	F	25kg	1min.	+	70	100	110	110	-	
5	9	F	20kg	2min.	+	80	90	90	100	-	
6	9	F	17kg	1min.	+	90	90	110	110	-	
7	15	M	40kg	4min.	+	90	100	110	110	-	Facet fracture
8	14	F	42kg	4min.	+	80	90	80	90	-	
9	9	F	24kg	10min.	+	80	80	100	110	-	
10	15	M	50kg	7min.	+	70	80	80	70	-	
11	15	M	30kg	3min.	+	80	90	80	80	-	
12	11	F	33kg	7min.	+	100	110	120	120	-	
13	11	F	30kg	5min.	+	60	75	120	120	-	
14	15	F	45kg	3min.	+	80	85	110	120	-	
15	11	M	23kg	1min.	+	90	90	100	120	-	Wake-up 2 times
16	9	M	20kg	-	-	90	95	100	110	-	

Table 1

The age of the patients vary from 9 to 30 years, 13 of them between 10-15 years.

There were 9 girls and 7 boys.

Wake-up tests were performed after the distraction applied, and patients cooperation, the time passed during movement, blood pressure and pulse rate changes before and during the test were noted.

Among 15 cases that the test is succesfully done,

ton rod. The distraction was completed at the 35th minute of induction. However, the anesthetist was not prepared himself for such a short time and all the medication had been given as the usuall sort. We think, because of that he was not able to woke after 15 minutes of trying.

One other patient, a 14 years old girl with Deje-rine-Sottas disease and thoracolumbal scoliosis is un-

dergone surgery with Harrington instrumentation. After insertion of Harrington rod and distraction force applied she was able to move both feet voluntarily on awakening. Then the operation continued to a totaly 5^{1/2} hours for compression rod and DDT placement. 5 units of blood were transfused. Vital functions went along between normal limits except a hypotension period of twenty minutes, BP being not much less than 80 mmHg.

At 6th hour postoperatively she had two subsequent generalized convulsions. Since all the biochemical studies and vital functions prior to these convulsions, their cause was not be able to explained. And at the 14th hour, doctors found that she had lost vision. After consulting Neurologists she was diagnosed as cortical blindness. With horizontal nystagmus and normal pupillary reactions to light but the loss of vision.

During the second and third days, CT scan, EEG and visual evoked potentials not able to show pathology. And by the 5th day she began to regain vision slowly, when externed being normal except some loss of visual field. However not explained she regarded as a possible complication of wake-up test.

Among other complications mentioned in the literature, we have seen only, one facet hook dislodgment due to patients sudden movement during the awakening period.

There were no false negative results. We have seen no postoperative neurologic damage.

DISCUSSION :

Intraoperative awakening to monitor spinal cord function during Harrington instrumentation is very effective means of detecting neurologic damage at the earliest possible moment. Early removal of the distraction force is known to result in a high rate of recovery of spinal cord function, recent advances in spinal cord monitoring may provide an answer but they require expensive equipment and, in most cases, specially trained technicians to use it.

Using the anesthetic technique described it was not found necessary to reverse either the relaxant or the narcotic.

The potential hazards of the wake-up test include accidental extubation, dislodgement of orthopaedic instrumentation, self injury, bronchospasm, recall of intraoperative events and psychological trauma, air embolism due to aspiration of air into the open vessels in the surgical wound, and cardiac ischemia.

Here, we describe transient cortical blindness as a

possible complication. In practice, the most frequent cause of cerebral blindness is occlusive vascular disease involving both occipital lobe, hence, hypoxemic insults. During scoliosis surgery, numbers of other factors can also cause hypoxemia. But air embolism or insufficient self-respiration when the wake-up test is performed may lead this type of impairment.

Wake-up testing has other shortcomings besides its possible complications. False negatives, through rare, have been reported. The test does not detect isolated posterior cord injury. It can not distinguish isolated nerve root injury, subtle changes, or perhaps even most degrees of subtotal cord injury. It is not applicable to certain patients and may be contraindicated in some others.

CONCLUSIONS :

In that study, we discussed 16 cases awakened intraoperatively without long-term complications.

The test is simple to perform and requires no additional equipment or personal, thereby making it inexpensive and widely applicable. It is, most importantly, a reliable test of motor function not subjected to sometimes frustrating vagaries of electrophysiologic testing.

In conclusion, other than those situations where it may not be appropriate, the wake-up test has benefits far outweigh its disadvantages. Therefore it is recommended routinely as at least a part of the spinal cord monitoring for scoliosis surgery.

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