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Correlation of Clinical Outcome with Intraoperative Neuro-monitoring of Spinal Tumours of Thoracic Region: Our Experience

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Abstract

Introduction: The goal of treatment for spinal tumours of thoracic region is complete removal with minimal postoperative neurological deficit. *Methods:* According to the extension of spinal tumour we divided patients into two groups-A-spinal tumours only. B- Spinal tumours with neuroforaminal and mediastinal extension. We reviewed clinical outcome with intraoperative neuro-monitoring of spinal tumours of thoracic region from 2012 to 2016. *Results:* Forty three patients were analyzed (group A and B- 93% and 6.97% cases respectively). In both groups spinal tumours were common in male (67.5% and 66.6% in group A & B respectively). Intraoperative neuromonitoring used in all cases and help in complete removal of tumour. The posterior midline approach of surgery were used in all cases (100%) in group A while in group B anterior (thoracotomy) and combined approach in 33.3% cases each. We find that the complete neurological recovery in 97.5% in group A and 100% in group B. *Conclusions:* Hinojosa et al. find that neuro-monitoring may help to minimize postoperative motor deficit by avoiding or correcting spinal cord tumour manipulation and modifying surgical technique during tumour resection. We concluded that the correlation of changes in transcranial motor evoked potential and electromyography on corresponding muscles help in nerve root identification and complete removal of spinal tumours without any postoperative neurological deficit. Spinal tumours having extension to neurofoamina/mediastinal are very rare and their complete removal needs correct preoperative diagnosis and single or two stage surgical approach.

Keywords: Neuromonitoring; Mediastinum; Tumour; Thoracotomy; Nerve Root.

Introduction

The goal of treatment for spinal tumoursof thoracic region is complete removal with minimal postoperative neurological deficit. The surgical management for spinal tumours needs a close collaboration of neurosurgeon, thoracic surgeon, neurologists trained in intraoperative neuro-monitoring and anaesthesiologist. The correlation of changes in transcranial motor evoked potential and electromyography on corresponding muscles during resection of spinal tumours with postopera-tive motor function has been documented. Thoracic dumb-bell tumours are relatively rare, usually arising from neurogenic elements in posterior mediastinum extending into spinal canal via the intervertbral fora-mina. Love and Dodge [1] in 1952, first coined the term dumb-bell tumour, reporting the ingrowths of a neurogenic tumour into the spinal canal. Methods for surgical removal there remain controversial.

Methods

Forty three cases of spinal tumours, surgically treated from January 2012 to December 2016, were analyzed. According to the extension of spinal tumour we divided patients into two groups-A-spinal tumours only (93% cases). B- Spinal tumours with neuroforaminal and mediastinal extension (6.97% cases). We reviewed clinical outcome with intraoperative neuro-monitoring of spinal tumours of thoracic region. Routine blood investigations and computer tomography/magnetic resonance imagingwere done for correct preoperative assessment of neuroforaminal extension to avoid spinal cord injury. The aesthetic issue of surgical procedure was also discussed. The surgical approaches in group A was posterior midline laminectomy along with transpedicular fixation after complete removal of tumour while in group B includes anterior approach (posterolateral thoracotomy) and combined approach in two-stages (first stage- Neurosurgeon did laminectomy with total excision of intraductal component with transpedicular fixation, in second stage, for intrathoracic removal of tumour via posterolateral thoracotomy.The placement of motor evovked potential electrodes (cork screw electrodes) subcutaneously in scalp and EMG electrodes (dual needle) on corresponding muscles - Rectus abdominis near sternum for T6-T7 nerve segment, between sternum & umblicus forT8-9 nerve segment, at umblicus for T10-11 nerve segment) and on pelvis for T12-L1) and vastus lateralis for L2-4 and abductor lateralis for S1-2 intraoperative neuro-monitoring. Nerve root identification and predicted neurological function of the spinal cord were monitored by progressively increasing the transcranial stimulation (starting with 200 V) until a response or to a predicted level, and observing changes in the spontaneous EMG tracing if activation was present during dissection of the tumour (Figure 1). Histopathology revealed benign etiology of tumour. (Figure 2)

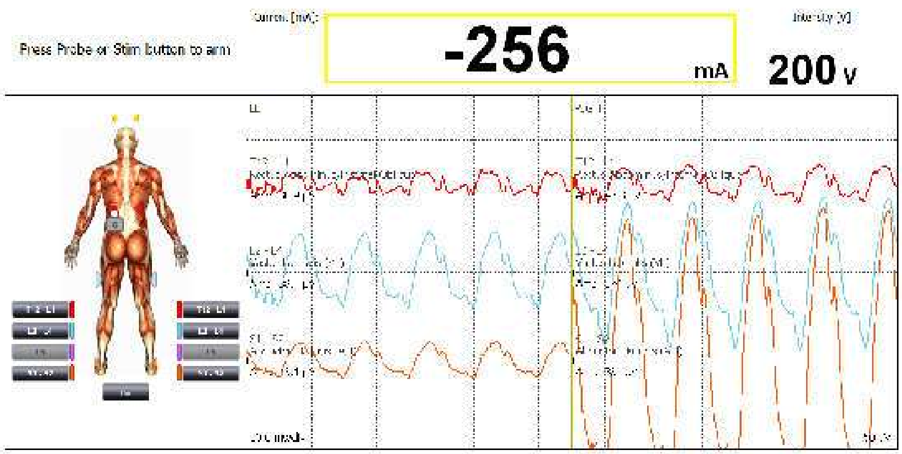

Fig. 1: Intraoperative neuromonitoring transcranial motor evoked potential and electromyography on corresponding muscles during resection of spinal tumours A- baseline EMG monitoring of T12-L1, L2-L4 and S1-S2 myotomes before surgical intervention. B- Transcranial stimulation after surgical intervention revealed increased amplitude, preserved shape without delay in latency.

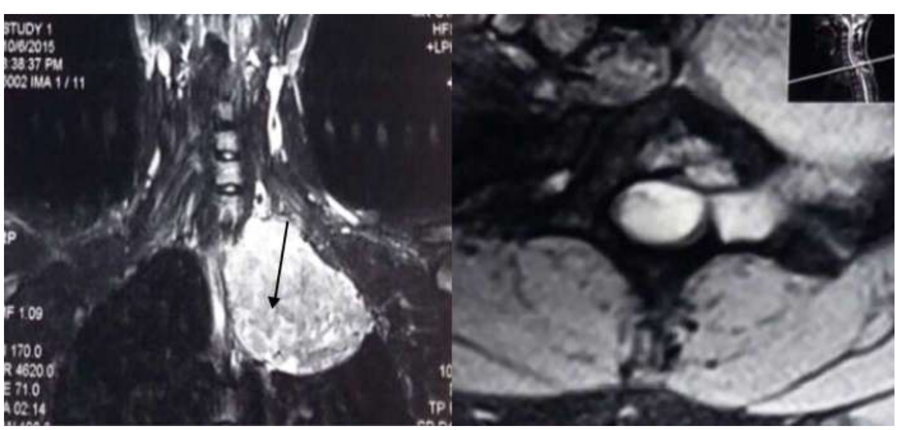

Fig. 2: Contrast-enhanced computed tomography of the thorax revealed a welldefined heterogeneouslyenhancing density soft tissue mass (76*69*68 mm, marked as arrow) in relation to D1-D2 neural formina causing its widening on the left side extending into the superior mediastinum and upper left hemi thorax compressing left upper lung, left lobe thyroid, displacing the left common carotid artery anteriorly and lateral wall of oesophagus, left paratrachea region and arch of aorta.

Anaesthesia Protocol

Anaesthesiawas induced with intravenous midazolam 1 mg/kg, fentanyl 2-3 microgram/kg and suitable doses of propofol upto abolition of verbal communication and eye lash reflexes with maximum doses 1-2 mg/kg was given, intubation was facilitated after muscle relaxant vecuronium bromide (.08 to .1mg/kg). Anaesthesia was maintained with oxygen 35-40% in air with isoflurane up to 1% and intermittent doses of vecuronium 0.01mg/kg every 30 minutes and fentanyl 50 microgram hourly. After completion of surgery patient were extubated on table in standard manner and observed in post-operative area for 24Hr.

Results

A total of43 patients were analyzed. The patients were divided into two groups: Group A- with spinal tumours only (93% cases), Group B- spinal tumour having neuroforaminal and mediastinal extension (6.97% cases). In both groups spinal tumours were common in male (67.5% and 66.6% in group A & B respectively) and age group in less than 40 year of age (table 1). Intraoperative neuromonitoring used in all cases and help in complete removal of tumour. The posterior midline approach of surgery were used in all cases (100%) in group A while in group B anterior (thoracotomy) and combined approach in 33.3% case each (Figure 3). There was no significant difference in mode of presentation of spinal tumours and complications in both the groups. We find that the complete neurological recovery in 97.5 % in group A and 100% in group B while in rest of patients despite of neurological deficit they gained functional status. The onset of neurological improvement was faster within three month in both groups (80 % and 100% in group A and B respectively).

Fig. 3: Operative picture showing the mediastinal extension of spinal tumour.

Table 1: Patient's Profile.

Serial No.	Variables	Group A (=93% cases)	Group B (=6.97% cases)
1.	Age (in years)		
	-<20	10	66.6
	-20-40	65	33.3
	->40	25	00
2.	Sex-male	67.5	66.6
	-female	32.5	33.3
3.	Symptoms		
	-pain/ radicular pain	100	100
	-numbness	77.5	100
	-hemi paresis / paraparesis	47.5	33.3
	-bladder and or bowel involvement	2.5	00
4.	Approach of surgery		
	-posterior mid line (laminectomy)	100	33.3
	-anterior (thoracotomy)	00	33.3
	-combined (laminectomy and thoracotomy)	00	33.3
5.	Intraoperative neuromonitoring used (%)	100	100
6.	Complications		
	-re-exploration	2.5	00
	-wound infection (superficial)	5	33.3
	-respiratory infections	10	00
	-CSF leak	2.5	00
	-neuroparaxia	10	00
	-mortality	00	00
7.	Neurological recovery		
	-complete	97.5	100
	-neurological deficit persist	2.5	00
8	Onset of improvement		
	-within 3 month	80	100
	-after 3 month	17.5	00
	-no improvement	2.5	00

CSF= cerebrospinal fluid

Discussion

In the surgical treatment of spinal tumours, preoperative functional status and the extent of removal were the significant prognostic factors influencing postoperative outcome. Early diagnosis is vital and complete removal of the tumour should be attempted in all surgical treatment of spinal tumours [2]. Although intraoperative neuromonitoring have often been employed in spinal surgery to limit the risk of iatrogenic neurologic injury, the literature on its use for posterior mediastinal tumours is very rare. Hinojosa et al. [3] find that quantitative intraoperative neuro-monitoring data may help to minimize postoperative motor deficit by avoiding or correcting spinal cord tumour manipulation and modifying sur-gical technique during tumour resection. Eggspuehler et al. [4] studied 246 patients who received multimodal intraoperative monitoring MIOM (somatosensory spinal and cerebral evoked potentials combined with continuous EMG and motor-evoked potentials of the spinal cord and muscles) during cervical spine surgery between March 2000 and December 2005 and found that the sensitivity of MIOM was 83.3% and specificity of 99.2%. They concluded that MIOM is an effective method of monitoring the spinal cord functional integrity during cervical spine surgery and can help to reduce the risk of neurological deficit by alerting the surgeon when monitoring changes are observed.Peeling and his associates [5] surveyed members of the Canadian spine society regarding the availability and use of intraoperative modalities to identify an insult to the neural elements, with the goal of preventing injury, and found that most surgeons believe that it is an important adjuvant to improve patient safety. S Mohd Ariff and his collegues [6] chose a two-stage approach, the first stage to provide extensive intraspinal access posteriorly and a second procedure to complete resection of the large, extra spinal extension via the anterior exposure. In his case, prognosis was good despite the severity of preoperative neurological deficit. They observed that two-stage procedure with a longer interval between stages provides a safe surgery and decreases intraoperative morbidity to the patient, due to avoidance of prolonged operative time and massive blood loss. A longer interval also provides time for the initial surgical wound to heal and for oedema absorption around the spinal cord from the first surgery. In contrary to above literature, our patients were symptomatic and spinal thoracic tumour with neuroforaminal and mediastinal extension diagnosed preoperatively correctly by computed tomography imaging/ magnetic resonance imaging, assisted in selecting the appropriate surgical approaches (posterior midline, thoracotomy, combined) using intraoperative monitoring of spinal motor evoked potentials. The two- staged combined removal of complex thoracic large dumb-bell spinal tumour (mediastinal extension) in a symptomatic patient has many advantages including nerve root identification by using spinal evoked potentials and adequate exposure by laminectomy and thoracotomy to avoid further damage to spinal cord, transpedicular fixation of spinal cord, surgeon comfort and good predicted post –operative function.

Conclusions

The correlation of changes in transcranial motor evoked potential and electromyography on corresponding muscles help in nerve root identification and complete removal of spinal tumours without any postoperative neurological deficit. Spinal tumours having extension to neurofoamina/mediastinal are very rare and their complete removal needs correct preoperative diagnosis and single or two stage surgical approach.

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