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Neurological Outcome after Surgical Intervention in Lower Cervical Spine Trauma

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Abstract: Acute injuries of the cervical spine are among the most common causes of severe disability and death. There are several controversial issues with regard to surgical intervention in the management of trauma to the cervical spine. Most importantly, is the issue of the timing of surgical decompression. The purpose of the study is to evaluate the role of early surgery on the outcome of traumatic cervical cord injury. Sixty-seven patients with a single fracture (29 patients) or fracture-dislocation (38 patients) of the cervical spine were operated. Thirty-one patients had surgical intervention within 72 h of injury, whereas 36 patients were operated after 72 h of injury. The results were compared using Statistical Package for Social Sciences Release 11.5 software and the independent samples Student's t-test, the paired samples t-test and chi-square analysis as the statistical tests. Patients with complete tetraplegia had no neurological improvement postoperatively. All patients with incomplete spinal cord lesions showed improvement of their neurological status after the operation. No statistically significant difference was found between the times elapsed from the injury to the time of operation and to the final neurological outcome. Surgical decompression and stabilization of cervical fractures is a safe procedure and neurological recovery may be anticipated in patients with incomplete spinal cord lesions. This study does not support the role of earl surgery on the final outcome of patients with traumatic cervical cord injury.

Key words: Cervical spine, trauma, surgical decompression, outcome, fracture

INTRODUCTION

Cervical spine injuries represent one third of all spinal injuries (Korres, 1993). Management of spinal cord injuries remains controversial. Some authors recommend early operative intervention (Mirza *et al*., 1999); however the optimal timing of surgical intervention in cervical spinal cord injuries has yet to be defined.

It is also controversial whether early spinal stabilization decreases morbidity (Helden *et al*., 1982; Marshal *et al*., 1987; Wilmot and Hall, 1986).

The purpose of this study was to assess the outcome of the surgical treatment in patients with unstable lower cervical spine injuries and to determine if early surgical intervention and stabilization leads to an improvement of their neurological outcome.

MATERIALS AND METHODS

We retrospectively reviewed 67 patients who had sustained acute unstable injuries of the lower cervical spine (C3-C7). Forty-nine of patients were men (73%) and 18 were women (27%). The average age was 36 years (range: 16-72 years). The causes of the injury were road traffic accidents in 49 cases (73%), falls from a height in 12 cases (18%), diving in 5 cases (7.5%) and sports related injuries in 1 case (1.5%). Vertebral injury was classified as burst fracture or facet fracture-dislocations (Fig. 1).

Fifty-eight patients (86.5%) had a neurological deficit on admission. The preoperative neurological evaluation according to American Spinal Injury Association (ASIA) impairment scale showed 20 patients graded as Frankel A, 10 patients graded as Frankel B, 11 patients graded as Frankel C, 17 graded as Frankel D and 9 graded as Frankel E. Steroids were administrated preoperatively in the majority of the patients.

Concurrent injuries in other parts of the body included head injuries, abdominal injuries, femur fractures, clavicle fractures and rib fractures.

The main indications for surgical intervention included spinal instability, deformity and neurological compromise due to compression of the neural elements. Surgery was performed as soon as the medical condition allowed. Time from injury to surgery was recorded. Thirty-one patients who underwent surgery within 72 h of injury consisted the early surgical group whereas, 36 patients who underwent surgery more than 72 h after the injury were classified as the late surgical group.

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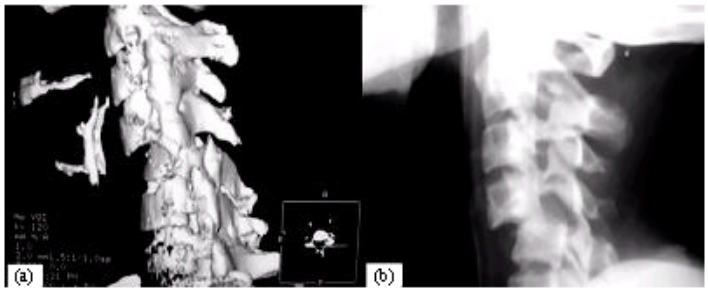

Fig. 1: Bilateral facet dislocations of C4-C5. (a) Three-dimensional spiral computed tomography. (b) Lateral cervical plain radiography

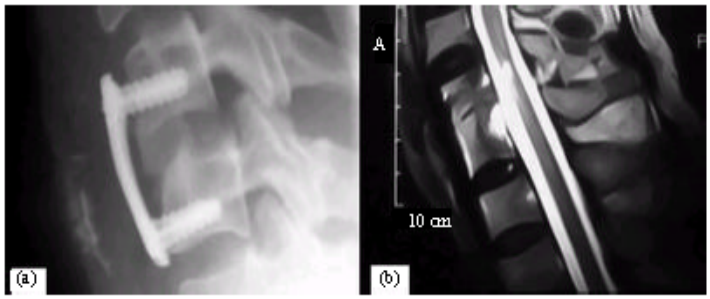

Fig. 2: Stabilization via an anterior cervical approach with diskectomy and fusion using autograft and plating. (a) Lateral cervical plain radiograph demonstrating anterior plate. (b) T2-weighted MRI shows fusion of C4-C5 and increased signal intensity of cervical cord consistent with myelopathy

Cervical traction was applied pre- and intra-operatively in all patients. Operation techniques included open reduction, decompression and spinal stabilization via posterior, anterior or combined approaches (Fig. 2).

Anatomical reduction was achieved in the majority of the cases. Autogenous bone grafting was used in all patients.

A Philadelphia type cervical collar was applied in all patients postoperatively for 6 weeks and a soft collar for other 6 weeks. The mean follow-up time of the patients was 4 years (range: 1-9 years). All Patients had a routine anterior-posterior, as well as flexion-extension lateral view of the neck at their last outpatient visit. Thorough clinical and neurological exams were performed for all patients.

The results of 2 groups were analyzed using Statistical Package for Social Sciences Release 11.5 software and the independent samples Student's t-test, the paired samples t-test and chi-square analysis as the statistical tests. Statistical significance was defined by $p<0.005$.

RESULTS

Fractures with unilateral facet dislocations were seen in the majority of the injured levels, apparently due to the injury's cause, which were mainly road traffic accidents. Anterior translation of the involved vertebrae was more than 25% below C5-C6 level, whereas above this level the anterior translation was less than 20% ($p<0.005$ by Chi-Square test).

The mean preoperative Frankel grade was 2.2 in the group of patients who underwent early surgery (<72 h) and 3.7 in the group of patients who underwent late surgery (>72 h).

No statistical significance difference was found between the ages, gender distribution and steroid administration in the early and late surgical groups.

The mean neurological improvement for patients undergoing posterior, anterior or combined approach was 1.1, 1.2 and 1.6%, respectively. These differences were not statistically significant (anterior vs. posterior vs. combined).

At the time of latest follow-up examination, using plain radiographs and computed tomography imaging, spinal arthrodesis was solid in all patients.

The mean postoperative neurological improvement was 2.8 Frankel grade for the group of patients who underwent early surgery (<72 h) and 4.1 for the group of patients who underwent late surgery (>72 h). This difference was not statistically significant.

DISCUSSION

Controversy still exists between operative versus non-operative treatment following acute cervical spine injuries. Also, the optimal timing of surgical intervention in cervical spinal cord injuries has not been defined yet. The majority of the published studies are based on a relatively small number of patients and different methods of management divide these groups into even smaller subgroups, making statistical analysis difficult (Beyer *et al*., 1996).

Wagner and Cherazi (1982), reported that time of surgery had no effect on neurological recovery (Wagner and Cherazi, 1982). On the other hand, Delamarter *et al*. (1995) showed in a laboratory study that early surgical intervention might be associated with improved results. It has been also supported that surgical treatment may be associated with higher complication rates, particularly if done within the first 5-7 days post-injury (Helden *et al*., 1982; Marshal *et al*., 1987; Wilmot and Hall, 1986). Marshall *et al*. (1987) in a multicenter study concluded that early surgery (within 5 days of injury) should be delayed as this can cause neurological deterioration (Marshal *et al*., 1987). However, that statement was set in doubt by Mirza *et al*. (1999) who stated that neurological deterioration was more likely in patients with unstable spinal injuries and less likely related to the timing of surgery.

The same authors supported that early surgery does not result in neurological deterioration and gives rise to improved results in patients with cervical spinal cord injury.

Although, it has been suggested that surgical treatment may not be necessary because of the tendency towards spontaneous fusion after trauma (Beatson, 1963), the balance of opinion at present suggests that anatomical reduction appears to be necessary to minimize the risk of dynamic cervical translation and decrease the late pain and stiffness or both (Beyer *et al*., 1996).

Therefore, internal fixation of the cervical spine is often required for immediate mechanical stabilization (Garvey *et al*., 1992) and also decreases post-traumatic complications due to patients' immobilization (Garvey *et al*., 1992; Heldon *et al*., 1982).

In this study, all the patients underwent decompression and spinal stabilization via posterior, anterior or combined approaches. Although the type of operation (anterior vs. posterior vs. combined) was not proved to result in improved neurological status, during the follow-up all the patients graded as Frankel B to C had improvement of their neurological status.

Surgery maintained a stable spine at the level of injury, succeeded better mobilization of patients with paraplegia and prevented late spinal deformity.

The percentage of improvement for the early surgery group (<72 h) was 50%, whereas for the late surgery group was 33%. Although, the rate of percentage for the early surgery group seems better than that of the late surgery group, the statistical difference was not significant ($p>0.005$).

CONCLUSION

The results of this study showed that surgical intervention of cervical spinal injuries constitutes a safe procedure. Neurological recovery may be anticipated in patients with incomplete paraplegia after surgical intervention. The results of our study does not support the efficacy of early surgery on the outcome of patients with cervical spinal cord injury ($p>0.005$).

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