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FACTORS AFFECTING LONG-TERM OUTCOME IN ACUTE CERVICAL CORD INJURY – A STUDY DONE IN TERTIARY CARE TEACHING HOSPITAL

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ABSTRACT

Introduction: Spinal trauma is relatively a more common injury nowadays. Although its mortality is becoming low due to utmost care in intensive care unit, it is an important cause of long term disability. Magnetic resonance imaging (MRI) can accurately depict the presence and extent of spinal cord injury (SCI) in these patients. Several clinical and physical factors affect the outcome of cervical cord injury particularly neurological outcome. Analysing these influencing factors is must and will help in predicting the outcome in such patients. **Methodology:** Fifty patients with acute cervical cord injury who were treated in past five years (2013-2018) were evaluated by the American Spinal Injury Association (ASIA) scoring and magnetic resonance imaging (MRI) of cervical spine. MR patterns of cord injury and length of damage were evaluated by radiologist. They were followed up with ASIA score at the end of one year. Four factors were investigated for their effect on outcome - age, initial neurological status, timing of surgery, MR findings. **Results:** All patients with ASIA Grade 'D' improved whereas none improved in ASIA grade 'A'. Patients with cord edema showed good recovery compared to patients with cord contusion. Among the patients with cord edema, improvement was better in three or less than three segments compared to more than three segments. There was no significant influence by age. The difference in improvements between early surgery and delayed surgery was also not significant. **Conclusion:** The prime factor which defines the outcome, is the initial neurological status following injury in the patients. The age of the patient and the timing of surgery do not seem to influence the outcome. MRI pattern of cord edema with less than three segments has best prognosis for recovery.

KEYWORDS: ASIA scoring; Magnetic Resonance Imaging features; neurological outcome.

INTRODUCTION

Spinal cord injury (SCI) is a medically complex and life-disrupting condition. Historically, it has been associated with very high mortality rates. Spinal cord injury (SCI) is a traumatic event that results in disturbances to normal sensory, motor, or autonomic function and ultimately the impact of cervical cord injury is enormous from the economic, psychological and social perspectives.[1] Approximately 8000 new cervical spinal cord injuries occur each year in our country with an estimated prevalence of 300,000 to 500,000 living victims.[2] The information on outcome helps in counselling the anxious relatives, Planning the length of stay and expenditure in the hospital.[3] The incidence of injury to the spinal cord is on the rise and its impact and the impact on the healthcare system is tremendous. Advances in emergency medical care have positively impacted outcomes in trauma; however, the situation for SCI still remains a cause of concern. There has been a major shift from conservative management for these injuries to decompression of cord, stabilization of the spine, early mobilization, and rehabilitation. Although there have been advances in achieving spinal stabilization and decompressions of the cord; functional outcomes are a matter of concern. Several factors influence the neurological outcome following cervical SCI. Age, mode and severity of injury, autonomic disturbances and pre-existing diseases are important among them. In the present study we made an attempt to analyse the influence of these factors.

MATERIALS AND METHODS

A prospective study was performed on 50 patients with acute cervical cord injury, who were admitted to the department of Neurosurgery, Kanyakumari medical college from 2013-2018. The following criteria were used for selection of patients. Cervical spinal injury patients with cord damage, those who underwent surgery and had a minimum follow-up of one year were included in study. While patients who were managed

conservatively, patients with penetrating cervical spine injuries, patients with autonomic disturbances and with associated thoraco-lumbar or head injuries were excluded. Each patient was evaluated clinically by using the American Spinal Injury Association (ASIA) standards for assessment of neurological injury.[4] Patients were graded into five groups from A to E according to the ASIA impairment scale. All these patients underwent Magnetic Resonance Imaging (MRI) of cervical spine either at our institute or outside. MRI was conducted on a 1.5-T superconducting unit. Imaging included three series in the sagittal plane. An additional STIR image sequence was performed. The field of view incorporated the lower brainstem, the entire cervical spinal cord, and the upper thoracic Region upto T3. The image patterns are identified as defined by Silberstein *et al.*[5] The length of the damage to the spinal cord was quantified by locating the longitudinal boundary of the spinal cord haemorrhage or oedema relative to the nearest adjacent spinal vertebral landmark on mid-sagittal MRI. The location of upper and lower limits of pathology was recorded to determine length of pathology. The number of segments between the upper and lower limits represented the length.

These patients were managed as per the guidelines given by the American Association of Spinal Cord injuries. All patients were immobilized with skull traction immediately. Patients were operated after the stabilization of cardiovascular and respiratory status at the earliest possible time. Surgical stabilization and decompression was performed according to the extent and nature of injury. All these patients were followed up in the outpatient department at regular intervals with ASIA scoring. Functional grading was done using functional independent measure at the time of admission and at the end of one year and the results were compared. More than or equal to one grade change as per ASIA impairment scale from admission to one year follow-up was taken as improvement.

Chi Square analysis was done to study the statistical association of each factor with outcome. Chi Square values were obtained from which *p* values were derived. $p<0.05$ was taken as statistically significant.

RESULTS

There were 35 males and 15 female in our study with a ratio of 2.33:1. The age ranged from 18 to 62 years. The mean age of patients was 41.52 years. The duration of follow-up ranged from one year to two years.

First we analysed the effect of initial neurological status on outcome, patients were classified into five grades as per ASIA impairment scale. We could get only four grades of patients, as none were present in Grade E. The distribution of patients in the ASIA grades is shown in Table 1. The maximum number of patients were present in ASIA D.

Table 1: Grading of injury based on ASIA scale.

Asia Grade	No of Patients	Improved	Percentage of Patients improved
A	10	0	0%
B	14	3	21%
C	11	7	63%
D	15	15	100%

In our study when we analysed the outcome based on ASIA grade none of the patients in Grade A improved. In Grade B, among 14 patients three patients improved to Grade C. In Grade C, out of eleven patients, five patients improved to Grade D two patients to Grade E and the remaining four did not improve. All the patients of Grade D (six) improved to Grade E. There is a significant statistical difference in improvement between the groups, which indicate that the initial neurological status is an important factor which determines the recovery.

Next we analysed the effect of age on the outcome. We divided the patients into two age groups, above and below 40 years. There were 33 patients in the age group of above 40 years of which 15 improved and 17 patients in age group of below 40 years of which ten patients improved. No statistical difference in improvement noted between the groups.

Table 2: Age in correlation with outcome.

Age Group	Improved	Percentage	Not Improved	Percentage
ABOVE 40 YRS	15	45%	18	55%
BELOW 40 YRS	10	59%	7	41%

Next we analysed the effect of MRI patterns on outcome: MRI patterns were classified according to the Silberstein *et al* definition. Three types of imageological patterns were observed. The distribution of patients among them is as follows: cord edema - 27, Cord contusion - 18, normal cord-5.

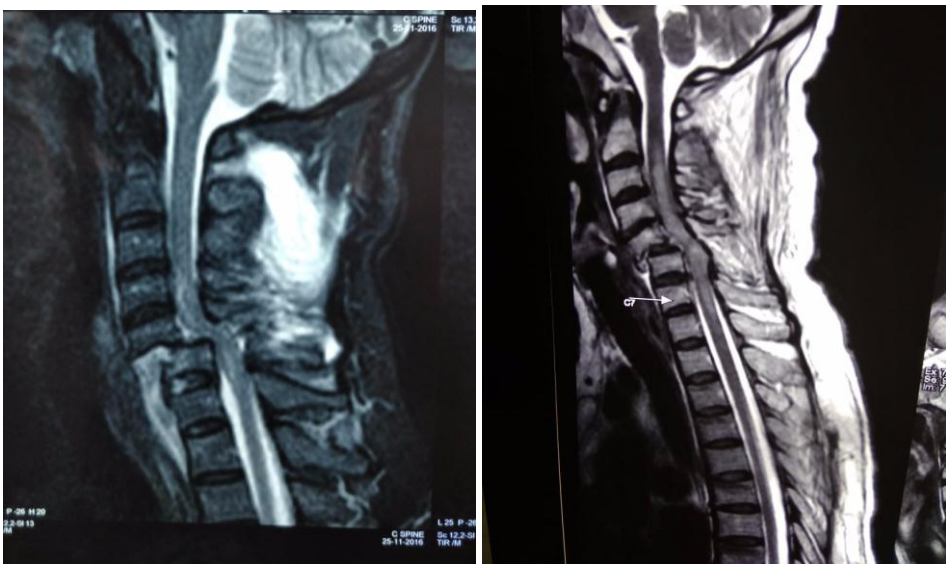

Fig. 1 & 2: Cervical cord injury and contusion.

When the improvements between the two image patterns were compared, 18 out of 27 patients with cord edema improved whereas only two improved with cord contusion showing good statistical difference (P<0.05). Further, among the patients with cord edema, based on the length of the edema, there were two groups i.e. more than and less than three segments. If the cord edema is involved in lesser segment segments there was a lesser improvement improvement if it involved in more than three segments there a lesser improvement.

Table 3: MRI pattern with improvement.

Mri Pattern	No of Patients	Improved	Percentage
CORD EDEMA	27	18	67%
CORD CONTUSION	18	2	11%
NORMAL	5	5	100%

Finally we analysed the timing of surgery on the outcome, in our Study, patients were divided into early (surgery done within two days) and late (surgery done between two to seven days) surgery groups. In the late surgery group, 5 out of 17 improved and in the early surgery group, 20 out of 33 patients improved which was not statistically significant.

DISCUSSION

In our study in our study similar to the previous works reported in the literature, a significant statistical association was observed between initial neurological status and improvement. Improvement was best in Grade "D" with 100% and worst in Grade "A" with 0%. Irrespective of grades, only 50% of patients showed the neurological recovery. This relative less improvement may be due to more number of patients in grade A&B (24/50). This is comparable to previous studies, in a study done by Burney *et al* reported a significant difference in the improvements between complete and incomplete injuries.[6] He reported 66% of recovery in incomplete and 14% in complete injuries. In one another study done by Ducker *et al* reported more mortality at the end of one year in patients with complete cord injuries.[7] Burns S.P Golding did a research on the effect of age and neurological status on the On the outcome and reported that the recovery in patients with ASIA D was independent of age whereas, in patients with Grade C, recovery was influenced by age.[8] A similar trend was observed in our series with 100% improvement in Grade D irrespective of age.

It is reported that in elderly patients, injuries are due to trivial falls, which result in incomplete injuries and in young patients, injuries are due to vehicular accidents, which result in complete injuries.[9] The improvement patterns between the age groups of less than 40 and more than 40 years were 59% and 45% respectively. This marginal difference in improvement was not statistically significant showing that the age per se does not influence neurological recovery.

Coming to the MR appearences there are many types of imaging patterns that have been put forward to associate the degree of neurological deficits and predict motor recovery.[10] Silberstein *et al* classified MR appearances into contusion and edema and compared them with the pathological findings.[5] We followed the classification given by Silberstein *et al*[5] in which they used the terms contusion and edema. The term contusion in our series is similar to that of hemorrhage pattern described by other authors. It is analogous to Type I and patterns of Kulkarni *et al*[10] and Ramon *et al.*[11] Analysis of the MR patterns revealed that there were 27 patients with cord

edema, 18 patients with contusion, and rest had normal cords. Edema was the most common imageological finding with an incidence of 54%. Kulkarni *et al* noted similar results in their studies.[10] MR appearance of cord edema has been associated with good recovery of neurological function, more so when it involves a small portion of the spinal cord In our study also maximum recovery of patients with cord edema less than three segments compared with other patterns of injury. Apart from neurological recovery most of the patients with cord edema presented with incomplete neurological deficits and hence there was a better improvement, outcome. The length of edema was significantly correlated with outcome. Most of the patients showed improvement in less than three segments of edema Compared to the patients with more than three segments. A similar results were seen in the study done by Selden *et al*.[12]

In similarity to other previous studies, We found that the neurological function at presentation is the single best predictor of long-term neurological outcome. However, a good number of our patients showed recovery despite complete motor injuries at presentation if they present with only cord edema instead of contusion. This indicates that MRI adds to the clinical examination in predicting the outcome. In concurrence with the contusion results of our study reconfirmed previous authors findings. Various studies showed that the identification of hemorrhage in MRI is associated with complete motor injuries (ASIA A and B) and the length of edema is inversely proportional to the motor function. In our study almost all the patients with complete cord injuries either had cord contusion or severe cord edema (>three segments) except in few cases. This shows that the presence of hemorrhage in MRI is not always associated with complete motor injury. A similar result was found by Flanders *et al*.[13] They attributed this finding to the improved spatial and contrast resolution in the imaging protocol. In our study only two patients with cord contusion showed recovery with significant statistical association. This indicates that the presence of hemorrhagic or contusion is associated with bad prognosis. A similar result was noted by Ramon *et al*[11] and Lucas and Duckers.[7]

Finally coming to timing of surgery, its highly controversial. There is strong evidence from the animal models to indicate that decompression of spinal cord improves the recovery after spinal cord injury. However, it is difficult to determine a "time window" for effective application of surgical decompression in the clinical settings. The definitions for early and late surgeries are variable in several studies. We chose the norm as before two and after two to seven days. The reasons For the postponement of surgery for more than two days are variable in each case. The most common reason was the presence of autonomic disturbances, which required stabilization. When the neurological outcome was compared in these two groups, improvement was better in the early surgery group when compared to delayed surgery group. The autonomic disturbances might have contributed for less improvement in the delayed surgery group.

CONCLUSION

The prime factor which defines the outcome, is the initial neurological status following injury in the patients. The age of the patient and the timing of surgery do not seem to influence the outcome. MRI pattern of cord edema with less than three segments has best prognosis for recovery.

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