

IMPROVEMENT IN ASIA GRADES AT 6 MONTHS FOLLOW-UP OF ACUTE THORACOLUMBAR JUNCTION (TLJ) SPINAL INJURY

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Conflict of interest: Nil

Abstract

Background: The incidences of injuries to spinal cord are on a rise and the impact on the health care system and economy is tremendous. Epidemiological research has demonstrated that SCI affects 10 to 40 persons per million populations per annum in developed countries. **Objective:** To study and evaluate the Improvement In ASIA Grades At 6 Months Follow-Up Of Acute Thoracolumbar Junction (TLJ) Spinal Injury. **Materials and Methods:** A prospective observational study at Department of Orthopedic surgery, Mymensingh Medical College Hospital, Mymensingh, Bangladesh with all patients with thoracolumbar junction (TLJ) spine injury, attending our hospital within a week of injury during a period of November 2018 to August 2020 were included for analysis. ASIA grade, thoraco lumbar injury classification and severity score (TLICS), imageological factors on MRI and timing of intervention were studied. Change in neurological status by one or more ASIA grade from the date of admission to 6months follow up was taken as improvement. Functional grading was assessed using functional independence measure (FIM) scale at 6months follow up. **Results:** A total of 25 patients with acute thoracolumbar junction (TLJ) spine injury, managed surgically were included in this study. Follow up was available for all patients at 6months. No improvement was noted in patients with ASIA grade A. Maximum improvement was noted in ASIA D group (83.3%). Patient with cord contusion showed mild improvement as opposed to those with just oedema wherein the improvement was seen in 75% patients. Maximum improvement in FIM score was noted in ASIA grade D and patients who had oedema in MRI TLJ spine. **Conclusions:** Incomplete spinal cord injury, patients showing MRI oedema have good improvement in neurological status at 6months follow up.

Keywords: Thoracolumbar junction (TLJ), Magnetic resonance imaging, Outcome.

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I. Introduction

The incidences of injuries to spinal cord are on a rise and the impact on the health care system and economy is tremendous. Epidemiological research has demonstrated

that SCI affects 10 to 40 persons per million populations per annum in developed countries like USA¹. Among which >1/2 corresponds to cervical, >1/3 corresponds to thoraco lumbar

injuries. Thoracolumbar junction comprised of D11, D12 & L1. Suspicion, early diagnosis of injury, preservation of spinal cord function and maintenance or restoration of spinal alignment and stability are the keys to successful management². The advantages of surgery include better correction of kyphotic deformity, greater initial stability, an opportunity to perform direct or indirect decompression of neural elements, decreased requirements for external immobilization, and an earlier return to work. In the body of literature concerning the degree of kyphosis that can be accepted or required, surgical correction continues to be questioned. To address the questions that surround the treatment of acute thoracolumbar fractures, it is important to elucidate the correlation between residual kyphotic deformity and patient's functional outcome. Several factors influence the neurological outcome following thoracolumbar junction (TLJ) spine injury. This study main aim is to analyse the factors like demography, aetiology of injury, pre op ASIA grade, Thoracolumbar injury classification and severity score(TLICS), imageological factors on MRI and timing of

intervention for their influence on outcome, and to formulate guidelines for the management of patients with spinal cord injury.

II Materials & Methods

A prospective observational study at Department of Orthopedic surgery, Mymensingh Medical College Hospital, Mymensingh, Bangladesh with all patients with thoracolumbar junction (TLJ) spine injury, attending our hospital within a week of injury during a period of November 2018 to August 2020 were included for analysis. Demographic factors like age, gender, aetiology of injury, preop ASIA grade, thoraco lumbar injury classification and severity score (TLICS), imageological factors on MRI and timing of intervention were studied. Change in neurological status by one or more ASIA grade from the date of admission to 6 months follow up was taken as improvement. Functional grading was assessed using functional independence measure (FIM) scale at 6months follow up. The inclusion and exclusion criteria are listed in (Table 1).

Table 1: Inclusion and exclusion criteria.

| Inclusion criteria | Exclusion criteria |
|--|--|
| 1. Spinal injuries from T11—L1. 2. Patients presented within a week following injury. 3. Patients who were managed surgically. | 1. Associated Cervical, T1-T10, L2-S1 spine injuries & head injuries. 2. Patients with penetrating injuries. 3. Patients who were managed conservatively. 4. Arrival at institute after 7 days of injury. |

All patients were assessed clinically by using the American Spinal Injury Association (ASIA) scoring and grading system. Apart from clinical parameters, the demographic parameters like age, gender, mechanism of injury, and timing of injury were also

included in the study. Radiological evaluation for stability was assessed by using TLISC scoring system (Image 1& 2). All these patients had MR imaging done either at institute (1.5 Tesla) or at the referral center (0.3 to 1.5 Tesla). MRI findings were

analysed into two groups a) contusion and b) oedema on the backdrop of time of injury and timing of MRI. The patients who presented within 8hrs of injury were treated with Inj. Methyl prednisolone (n=4) in accordance with NASCIS -2 recommendations. The patients were further divided arbitrarily into two groups as per the timing of surgery following the injury into early (\leq 1week) and late ($>$ 1week). The preoperative plan was decided by a collegium of neurosurgeons of the department in the preoperative period. Surgical decompression was performed based on TLISC Score $>$ 3 patients (Image 3). All these patients were followed up in outpatient department at regular intervals. More than or equal to 1 grade change in ASIA grade from the date of admission to 6months follow up was taken as improvement. Functional grading was done by using functional

independent measure (FIM) scale at admission and 6 months follow up.

III Results

Total of 25 patients were enrolled during the study period (Nov 2018 to Aug 2020). The descriptive analysis is provided in Table 2. Maximum number of patients in present study corresponds to below 30yrs (60%). Mean age for all patients in the present study 39.13 yrs (ranging from 0-60yrs). Age groups were divided in to 2 categories, \leq 30yrs and $>$ 30 yrs for analysis. Among the patients 88% were males. Most common mode of injury was road traffic accidents (56%) followed by falls (40%). Patients with ASIA grade D (40%) were the commonest to present to our institute, followed by grade A (32%). The percentage of improvement in \leq 30yrs group was 40% when compared to $>$ 30yrs group where it was 60%.

Table 2: Descriptive analysis of study participants (N=25).

| Parameter | Frequency | Percent |
|---------------------------------|-----------|---------|
| I. Age group | | |
| 30 and below | 15 | 60 |
| Above 30 | 10 | 40 |
| II. Gender | | |
| Female | 3 | 12 |
| Male | 22 | 88 |
| III. Mechanism of injury | | |
| RTA | 14 | 56 |
| Fall | 10 | 40 |
| Others | 1 | 4 |
| IV. ASIA GRADE | | |
| A | 8 | 32 |
| B | 1 | 4 |
| C | 4 | 16 |
| D | 10 | 40 |
| E | 2 | 8 |
| V. MRI | | |
| Edema | 16 | 64 |
| Contusion | 7 | 28 |
| Normal | 2 | 8 |

Table 3: Improvement in ASIA grades at 6 months follow-up.

| Follow up 6months | ASIA grades | | | | | Total after 6 months |
|-------------------|-------------|---|---|----|---|----------------------|
| | A | B | C | D | E | |
| A | 8 | 0 | 0 | 0 | 0 | 8 |
| C | 0 | 1 | 1 | 0 | 0 | 2 |
| D | 0 | 0 | 2 | 1 | 0 | 3 |
| E | 0 | 0 | 1 | 9 | 2 | 12 |
| Mortality | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 8 | 1 | 4 | 10 | 2 | 25 |

Note: No patient improved or deteriorated to group B and hence grade B has not been charged.

Table 4: Outcome in relation to MRI findings.

| MRI | Edema | Outcome | | Total |
|-----|-----------|-----------------|--------------------|----------|
| | | Static 4-25% | Improved 12-75% | |
| | Contusion | 6-85.71% | 1-14.29% | 7-100.0% |

Table 5: FIM scores in pre- and at 6 months follow-up.

| ASIA Grade | Average Pre op FIM score | Average follow up FIM score |
|------------|--------------------------|-----------------------------|
| A | 72 | 81 |
| B | 74 | 81 |
| C | 89 | 114 |
| D | 92 | 124 |

Clinical parameters: The initial neurological grade and follow up grade at 6 months labelled in Table 3. More than equal to 1 ASIA grade change in neurological status from date of admission to 6months follow up was taken as improvement. No patient died post operatively at 6month follow up. The improvement in ASIA grade D was 90% followed by grade C which is around 75%. Two grade improvement noted in 1patient of ASIA grade C who improved to grade E at 6 months follow up. Imageology: Based on MRI findings, the percentage of improvement in oedema group was 75%, whereas 14% in the contusion group improved (Table 4).

Timing of surgery: Percentage of improvement in ≤ 7 days surgery group was

48% as compared to 42% in >7 days surgery group. FIM score improvement: Maximum improvement in average FIM score at 6months follow up noted in ASIA grade D, with improvement in average score from 92/126 to 142/126(Table 5). Post-operative complications: Maximum follow-up was available for 18 months, with minimum follow up of 6months (average- 12.3 months). Post operatively 1 patients had chest infection, 1 patient had wound collection, 2 patients had bedsores, and 3 patients had UTI. No patient was died at 6 months follow up.

IV Discussion

Numerous studies in the literature had shown how various factors like age, gender, etiology,

ASIA grades, level of injury, timing of surgery etc. had influence on the outcomes. Demography & outcome: According to National Spinal Cord Injury Statistical Center (NSCISC, Birmingham, Alabama, 2012)¹ the average age at injury is 41yrs with 80% of SCI reported in males. In present study average age was 39.13 yrs with 85% cases being males. Most common etiology, according to NSCISC, motor vehicular accidents corresponds to 39%. In the present study, RTA contributed to 56% of cases. Clinical parameters: Several studies have focused on initial neurological grade, level of injury affecting outcome. Coleman et al., (2004)² opined that the severity of the injury was the primary predictor of outcome in acute SCI, reported that ASIA C&D had marked recovery as compared to ASIA B which did better than group A. Burns et al, (1997)³ studied the effect of age and initial neurologic status on recovery of ambulation in patients with incomplete injuries. They concluded that in patients with ASIA grade D, prognosis for recovery to independent ambulation was excellent irrespective of age. In present study no patients in ASIA grade A improved at 6months, Improvement was noted in 75% and 90% of patients with grade C and D respectively. No patient had neurological grade deterioration. MR imaging & outcome: Number of studies proved that MRI had been gold standard in prognostication of spinal cord injury. Kulkarni et al, (1988)⁴ were first to characterize three MRI signal patterns for the prognostication of acute spinal cord injury (SCI): (1) haemorrhage in the cord (2) oedema of the cord and (3) a combination of haemorrhage and oedema. Prognostication patterns used today are variations of these original patterns. Silberstein et al, (1992)⁵ described the following MRI patterns, describing the four pathologies of acute spinal cord injuries 1.Haemorrhage pattern 2.Edema

pattern 3.Contusion pattern 4.Transaction pattern. Ramon et al, (1997)⁶ described 6 patterns of MRI in acute spinal cord injury. In present study MR Imageology of TLJ spinecategorised into 2 groups, named as oedema and contusion groups. Out of 25 patients 16 patients had oedema, 7 patients had contusion and 2 patients had normal MRI. One patient in contusion group improved at 6 months follow up, whereas the percentage of improvement in oedema group was 75%. Timing of surgery & outcome: Controversy exists regarding timing of surgery in SCI. Proponents of both early and late surgery can be found in the literature. Till now 22 studies attempted to define optimal timing of surgery for acute traumatic SCI, 9 utilised the 24 hr limit to define an early decompression(Botel u et al,1997, Duh M et al 1994, Guest J et al,2002, Levi L et al.1991, Pollard M et al. 2003 etc⁷⁻¹⁴), 8 used 72 hrs (Vaccaro A et al, 1997, McKinley et al, 2004, Chipman J et al, 2004, Croce M et al, 2001, Kerwin A et al, 2005, Mirza S et al, 1999, Sapkas G et al, 2007, Schinkel et al, 2006⁽¹⁵⁻²³⁾) and 4 used other bench marks such as 8hrs, 48 hrs or 4 days(Cengiz S et al, 2008, Ng W. Fehling Mn et al, 1999, Clohisy J et al,1992, Chen L et al,1997²⁴⁻²⁷). Interestingly, none of the studies have reported adverse neurological outcomes with early surgical intervention. All these studies have brought a paradigm shift in favour of early surgical intervention. The rationale behind this is based on the pathophysiology of acute SCI indicate that there are both primary and secondary mechanisms that lead to neurological injury. Preventing and mitigating the secondary mechanisms is where opportunity for neuroprotection lies and where most attempts at therapeutic intervention staged. Fehlings et al, 2012 (STASCIS TRIAL)²⁸, in an multicenter, international, prospective study in adults aged 16–80 with cervical SCI,

concluded that decompression prior to 24 hrs after injury is significantly associated with improved neurological outcome at 6 months follow up. In present study, due to delay in referrals, poor respiratory status and/or time for traction, there was considerable delay prior to surgical decompression. Because of these reasons we categorized into two groups such as those operated within 7 days of injury considered as early surgical group, those were operated after 7 days considered as late surgical group. The percentage of improvement was 48% in early surgical group (≤ 7 days), whereas it was 42% in late surgical group (≥ 7 days). Inj. methylprednisolone as per NASCIS II trial was given to only 4 patients attended to emergency department within 8 hrs of injury. One patient belong to ASIA B who did not have improvement, the other 3 patients were ASIA D at admission improved to ASIA E at 6 months follow up. Functional outcome: Functional Independent Measure (FIM) scoring system is often used to assess the disability at admission and also to predict long term outcome. All the patients in present study were analyzed by measuring FIM at admission & at 6 months follow up. Overall improvement in average FIM Score for each grade was studied. Maximum functional improvement noted in ASIA D followed by C grade at 6 months follow-up.

V Conclusions And Limitations

ASIA grade D&C spinal injuries and patients having oedema in MR Imageology have better improvement when compared with ASIA Agrade& MRI contusion group. Significant improvement in average FIM score noted in incomplete cervical injury patients (ASIA grade D) at 6 months follow up. Present study has the following limitations. The major limitations of the present study were a small sample size, with

non-uniformity in imaging and timing of surgery.

References:

- 1** Spinal cord injury facts and figures at a glance. National Spinal Cord Injury Statistical Center. J Spinal Cord Med. 2013; 36:1-2.
- 2** Coleman WP, Geisler FH. Injury severity as primary predictor of outcome in acute spinal cord injury: retrospective results from a large multicenter clinical trial. Spine 2004; 4:373-8.
- 3** Burns SP, Golding DG, Rolle WA Jr., Graziani V, DitunnoJF Jr. Recovery of ambulation in motor-Incomplete tetraplegia: Archives of Physical Medicine Rehabilitation 1997; 78:1169-72.
- 4** Kulkarni MV, McArdle CB, Kopanicky D. Acute spinal cord injury: MR imaging at 1.5T. Radiology 1988; 164:837-43.
- 5** Morry Silberstein, Brian M, Tress, Oliver Hennessy. Prediction of Neurologic Outcome in Acute Spinal cord Injury: The role of CT and MR. AJNR 1992; 13:1597-1608.
- 6** Ramon S, Dominguez R, Ramirez L. Clinical and magnetic resonance imaging correlation in acute spinal cord injury. Spinal cord 1997; 35:664-73.
- 7** Botel U, Glaser E, Niedeggen A. The surgical treatment of acute spinal paralysed patients. Spinal Cord 1997; 35:420–28.
- 8** Campagnolo D, Esquieres R, Kopacz K. Effect of timing of stabilization on length of stay and medical complications following spinal cord injury. J Spinal Cord Med 1997; 20:331–34.

- 9** Duh M, Shepard M, Wilberger J, Bracken M. The effectiveness of surgery on the treatment of acute spinal cord injury and its relation to pharmacological treatment. *Neurosurgery* 1994; 35:240–48.
- 10** Guest J, Eleraky M, Apostolides P, Dickman C, Sonntag V. Traumatic central cord syndrome: results of surgical management. *J Neurosurgery* 2007; 97:25–32.
- 11** Krengel W, Anderson P, Henley M. Early stabilization and decompression for incomplete paraplegia due to a thoracic-level spinal cord injury. *Spine* 1993; 18:2080–87.
- 12** Levi L, Wolf A, Rigamonti D, Ragheb J, Mirvis S. Anterior decompression in cervical spine trauma: does the timing of surgery affect the outcome. *Neurosurgery* 1991; 29:216–22.
- 13** McLain R, Benson D. Urgent surgical stabilization of spinal fractures in polytrauma patients. *Spine* 1999; 24:1646–54.
- 14** Pollard M, Apple D. Factors associated with improved neurologic outcomes in patients with incomplete tetraplegia. *Spine* 2003; 28:33–39.
- 15** Tator C, Fehlings M, Thorpe K, Taylor W. Current use and timing of spinal surgery for management of acute spinal surgery for management of acute spinal cord injury in North America: results of a retrospective multicenter study. *J Neurosurgery* 1999; 91:12– 18.
- 16** Vaccaro A, Daugherty R, Sheehan T, Dante S, Cotler J. Neurologic outcome of early versus late surgery for cervical spinal cord injury. *Spine* 1997; 22:609–12.
- 17** McKinley W, Meade M, Kirshblum S, Barnard B. Outcomes of early surgical management versus late or no surgical intervention after acute spinal cord injury. *Arch Phys Med Rehabil* 2004; 85:1818–25.
- 18** Chipman J, Deuser W, Beilman G. Early surgery for thoracolumbar spine injuries decreases complications. *J Trauma* 2004; 56:52– 57.
- 19** Croce M, Bee T, Pritchard E, Miller P, Fabian T. Does optimal timing for spine fracture fixation exist. *Ann Surg* 2001; 233:851–58.
- 20** Kerwin A, Frykberg E, Schinco M, Griffen M, Murphy T. The effect of early spine fixation on non-neurologic outcome. *J Trauma* 2005; 58:15–21.
- 21** Mirza S, Krengel W, Chapman J, Anderson P, Bailey J. Early versus delayed surgery for acute cervical spinal cord injury. *ClinOrthopRelat Res* 1999; 359:104–14.
- 22** Sapkas G, Papadakis S. Neurological outcome following early versus delayed lower cervical spine surgery. *J OrthopSurg* 2007; 15:183–86.
- 23** Schinkel C, Frangen T, Kmetic A, Andress H, Muhr G. Timing of thoracic spine stabilization in trauma patients: impact on clinical course and outcome. *J Trauma* 2006; 61: 156–60.
- 24** Cengiz S, Kalkan E, Bayir A, Ilik K, Basefer A. Timing of thoracolumbar spine stabilization in trauma patients; impact on neurological outcome and clinical course. A real prospective (rct) randomized controlled study. *Arch Orthop Trauma Surg* 2008; 128: 959–66.
- 25** Ng W, Fehlings M, Cuddy B, Dickman C, Fazl M. Surgical treatment for acute spinal cord injury pilot study #2: evaluation of protocol for decompressive surgery within 8 h

- of injury. *Neurosurg Focus* 1999; 6: e3.
- 26** Clohisy J, Akbarnia B, Bucholz R, Burkus J, Backer R. Neurologic recovery associated with anterior decompression of spine fractures at the thoracolumbar junction (T12-L1). *Spine* 1992; 17:325–30.
- 27** Chen L, Yang H, Yang T, Xu Y, Bao Z. Effectiveness of surgical treatment for traumatic central cord syndrome. *J Neurosurgery Spine* 1997; 10:3–8.
- 28** Fehlings MG, Vaccaro A, Wilson JR, Singh A, W Cadotte D, Harrop JS et al. Early versus delayed decompression for traumatic cervical spinal cord injury: results of the Surgical Timing in Acute Spinal Cord Injury Study (STASCIS). *PLoS One*. 2012; 7(2):e32037.