

Socioeconomic and Functional Outcomes after Severe Traumatic Cervical Spinal Cord Injuries: A Comparison of Surgical and Nonsurgical Patients

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ABSTRACT

Background Data: Management of cervical spine fractures has no individualized treatment protocol. Most guidelines are based on the fracture types; our study, being done in a developing nation, has taken into consideration the socioeconomic factors and their implication in making a final treatment plan.

Purpose: To compare socioeconomic and functional outcomes of surgical and nonsurgical management of acute cervical spine fractures with severe (ASIA-A and ASIA-B) neurological deficit at a minimum of 12 months postinjury.

Study Design: A retrospective observational study.

Patients and Methods: The study included a total of 42 patients: 22 were treated operatively (group A) and 20 treated conservatively (group B). Functional outcomes were assessed at a minimum of 12 months postinjury using the SCIM scoring scale. Other parameters, including the number of hospital days, total expenditure at discharge, ICU-related events, deaths within one year, and rehabilitation details, were analyzed.

Results: The mean hospital stay in group A was 26 days, with one patient requiring ICU admission with an expenditure of \$2707, whereas in group B, the mean days of hospital admission was 40 days with two patients requiring ICU admission incurring an expenditure of \$850. ICU-related comorbidities were high in group A. One patient in group A and five in group B died within the first 12 months. Overall mortality within the twelve months following ASIA-A and ASIA-B cervical spine injury was 16.6%, with higher mortality in group B during the early (0–3 months) period. The mean SCIM functional score at 12 months in group A and B was 36.5 and 41.6, respectively ($p = 0.2$). No statistically significant difference was found in the functional outcome between survivors in both groups at 12 months.

Conclusion: One-year survival was better in surgically treated patients with no difference ($p = 0.09$) in the functional outcome of both groups. Only an early and sustained rehabilitation in both groups help improving their quality of life. (2021ESJ247)

Keywords: cervical fracture, functional outcome, conservative therapy, cervical fixation

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INTRODUCTION

The true incidence of cervical spine trauma is still unknown; there are only a few reports from premier institutes. Cervical trauma causes a lot of disabilities ranging from minor neck pains to quadriplegia and possible death with serious consequences influencing patients, their families, and health professionals. Surgical management has become a popular procedure following advancement in imaging and a better understanding of these fracture patterns. The debate between operative and nonoperative treatment has been present since the early nineteenth century when the nonoperative treatment advocated by Sir Charles Bell was challenged by the surgical school led by Sir Ashley Cooper.²

In India, due to socioeconomic constraints, a few patients with all indications for surgery are managed nonsurgically. Surprisingly, we observed them doing well in the follow-up, and this raises the question of whether nonsurgical management can obtain similar results to surgical management. Additionally, it has the added benefit of decreasing the financial burden of the individual and to the government that pays for the treatment in developed nations. Unlike other developed countries, many of our patients do not have insurance coverage to take care of the expenditure incurred. Hence, the treatment must be individualized to decrease the additional economic burden on these families.^{5,11,17} With this hypothesis, our main aim was to assess the outcomes in surgically and nonsurgical treated patients with reporting any added economic benefit.

PATIENTS AND METHODS

After obtaining institutional review board (IRB) clearance from our hospital, CMC, Vellore, India, we proceeded with the study. It is a retrospective observational study based on hospital records of the patients admitted to a tertiary care hospital

in India between Jan 2014 and Dec 2018. Ninety patients admitted with a neurological deficit due to cervical spine fractures were found. The study patients were divided depending on the way of treatment into a surgical group (group A) and nonsurgical group (group B).

We applied the following inclusion criteria: patients having severe cervical spinal cord injury (ASIA-A and ASIA-B) with associated fractures and/or dislocation with complete clinical and radiological data. The exclusion criteria were as follows: associated long bone fractures/visceral trauma, central cord syndrome, and <12-month follow-up.

We included in this study 42 out of 90 patients who were eligible for this study, 22 in group A and 20 in group B, where the other 48 patients were excluded according to the criteria mentioned above. All patients were submitted to full general and neurological examination. The radiological valuation included an X-ray, CT scan, and MRI of the cervical spine. Follow-up included neurological evaluation and plain radiographs at the outpatient's clinic. Functional outcomes were measured using Spinal Cord Independence Measurement scoring scale (SCIM)³ at a minimum of 12 months postinjury. Type of fracture was classified based on nomenclature and both groups matched based on the fracture pattern.

Other reported parameters were the demographic pattern, insurance status, duration of hospital stay, total expenditure at discharge, ICU-related events, death within the first year, and rehabilitation.

All details were extracted from the hospital database. The patient was admitted and the management was decided by the attending surgeon. If surgery was planned, the patient gave their consent, and the procedure was carried out as soon as possible using either the anterior (Figures 1) or the posterior approach.

Nonsurgical management was based on the fracture pattern. A burst fracture was maintained in a halo vest and if it was inconvenient to the patient, he was immobilized with a Philadelphia collar. A fracture dislocation was reduced using skeletal

traction (Figure 2). When reduced or an acceptable level of reduction was obtained, the weights were decreased, and the patient was immobilized in a halo vest/Philadelphia collar for a period of 3 months. Patients visited the rehabilitation center once before discharge and were kept in regular follow-up. The mortality rate within the first year after injury was reported through data collected by the social workers during their regular field visits. The social workers could get an in-depth status of the socioeconomic condition of these patients during follow-up.

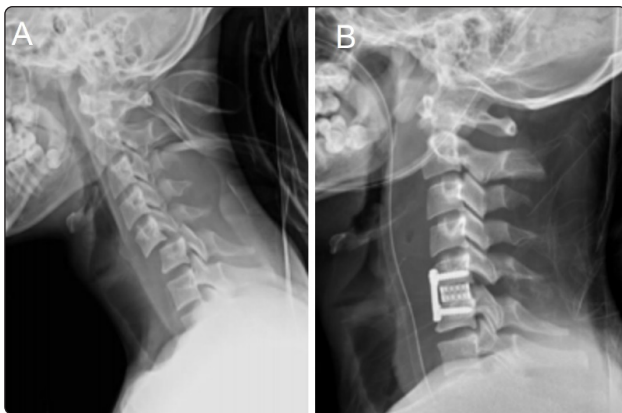


Figure 1. A 35-year-old male sustained RTA and C5-C6 fracture dislocation and presented with the neurological status of C5 ASIA-A. He underwent an anterior open reduction and stabilization and fusion using ACDF with an anterior cervical plate.

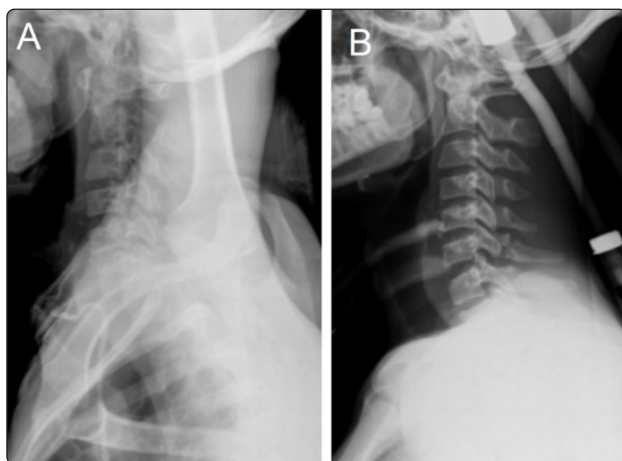


Figure 2. A 23-year-old male patient sustained RTA and C6-C7 dislocation with C6 ASIA-A neurological status. He was managed with closed reduction and stabilization with a Halo vest.

Statistical Analysis:

Data analysis was done using the IBM SSPS version 29. Descriptive analysis was used for demographic data. Mann-Whitney *t*-test was used for assessing the parametric data and *p* value of <0.05 was considered significant.

RESULTS

Demographically males were predominantly injured due to RTA involving motor vehicle accidents. Among them, ASIA-A and ASIA-B were almost equal in distribution. The most common fracture dislocation level was C5-C6 (Table 1).

The hospitalization details showed that group A had a marginally lower hospital stay and early rehabilitation than group B, but their expenses were three times higher than group B. The difference between the two groups was statistically significant (Table 2). Half of the patients in group A needed ICU admission, thus escalating the cost of treatment. Of these, 28% of them needed tracheostomy for prolonged ventilation; also, the mean duration of stay in group A patients was more than group B. Statistically, there was a significant difference in the duration of ICU stay and need for tracheostomy (Table 2).

Overall mortality was higher within the first 12 months of injury in group B, and the common causes were sepsis due to infected sacral sore and respiratory infections. There was no statistically significant difference between both groups. Overall, only 62% of the total patients had some form of insurance coverage for treatment; the others had to spend money out of their own pocket. The economic impact of the disease was found to be more in surgically treated patients. Further assessment of mortality showed that ASIA-A neurological patients had higher mortality within the first three months of injury, even with early rehabilitation. One patient from group A and six patients in group B died within the first year (Table 2).

A higher percentage (87%) of group A patients followed up better than group B (70%). Functional outcome using SCIM score at 12 months showed no statistical significance. SCIM score was assessed between both groups. In addition, subanalysis was done within ASIA-A and ASIA-B patients and showed that ASIA neurological status was not significantly different

at 12 months from the time of injury (Table 3). Reported complications among survival in this study were in general minor complications, including chest infections (n = 4), which settled with conservative measures and antibiotics, and superficial tracheotomy site infection (n = 3); no sacral sore was noted due to early vigorous physiotherapy.

Table 1. Demographic and preoperative data.

Parameters	Total (n = 42)	Group A (n = 22)	Group B (n = 20)	p value
Age	38.36	36.40	40.75	0.100
Sex(M/F)	37/5	19/3	18/2	1.000
RTA	26 (62%)	14 (64%)	12 (60%)	
ASIA-A	25 (59.5%)	12 (48 %)	13 (52%)	
ASIA-B	17 (41.5 %)	10 (58.8 %)	7 (51.2 %)	
SCIM (mean)	39.4	36.5	41.6	0.233
Fracture dislocation	36 (85.7%)	19(87%)	17 (85%)	
C5-C6 level	27 (64.3%)	14 (64%)	13 (63.5%)	
Highest cord level	C3	C3	C3	

M: male; F: female; RTA: road traffic accident.

Table 2. Hospitalization details, ICU-related events, and overall mortality.

Parameters	Group A	Group B	p value
Hospital stay/days	26	40	0.185
Hospital bill	\$2707	\$850	0.0057
Insurance coverage	12 (54%)	14 (70%)	0.352
Postoperative infection	1	-	
ICU stay	11 (50%)	2 (10%)	0.007
Tracheostomy	6 (27.7%)	-	0.021
ICU stay/ day	12	5.5	0.553
Early mortality (<3 months)	-	4 (20%)	
Late mortality (4–12 months)	1 (4.5%)	2 (10%)	
Total mortality	1 (4%)	6 (30%)	0.094

Table 3. SCIM functional score at 12 months between each group and subgroup scores between ASIA-A and ASIA-B.

Parameters	Group A	Group B	p value
ASIA-A	22.5	38.1	0.127
ASIA-B	50.5	45.1	0.303
SCIM	36.5	41.6	0.233

Expressed as a mean value.

DISCUSSION

The management of cervical spine fracture does not have a fixed protocol; there have been numerous debates about managing such patients surgically.¹⁰ Our aim was to obtain an anatomically stable cervical spine with management that best suited the patient's overall background. We considered the financial status of the family, the backup support from the family after discharge, accessibility to healthcare after discharge, and compliance to effective rehabilitation.

In this study, the mean age was 38 years and males were predominantly involved. A road traffic accident was the leading cause, followed by a fall from height at the workplace. These results are similar to other demographic studies by Chacko et al.,⁴ Agarwal et al.,¹ and Jackson et al.¹³ These indicators suggest that an essential government policy has to be taken to increase the safety at road and workplaces.

ASIA-A injury constituted 59% and ASIA-B 41% of the study group; our incidence was higher than the incidence reported in the studies by Agarwal et al.¹ The common level of vertebral injury in our study is C5/C6 compared to C6/C7 in a study by Goldberg et al.¹² The level of injury establishes the level of independence in functional activities during the rehabilitation. Patients with some preservation of hand functions were able to be functionally more independent.

Group A patients had decreased duration of stay in the hospital and early start of complete rehabilitation. The average days in hospital in group A were 26 days and in group B were 40 days, which is similar to the study by Sreshtha et al.²¹ who reported 149 Nepalese patients. In our study, 50% of group A patients required postoperative ICU care and 20% of those ICU admitted patients needed tracheostomy due to prolonged ventilation. These factors compounded the hospital bill of group A to thrice that of group B. In our study, the average expenditure was \$2707 in group A and \$850 in group B; this is a relatively negligible

amount compared with western literature where the average annual total costs were \$28,334 according to French et al.¹⁰ and others.^{8,15,20} In India, most of the patients do not have insurance coverage and pay out of their pocket compared to those in developed nations where the government/private insurance takes care of the injured.^{21,19,18} Our study can be an effective pilot data for developed countries to formulate a plan that can effectively influence these patients and also help cut down the government health expenditure.

The overall mortality rate in our series was 16.6% within the first 12 months of injury; 30% of group B patients died within the first 12 months compared to 4% in group A. This is similar to the American study by Miller et al.¹⁹ who reported 91 patients.

We further subdivided the mortality rates to early (within 3 months) and late (4–12 months) and found the mortality rates to be nil in group A and 20% in group B. Compared with other literature, a Norwegian study by Fred et al.⁹ who reported a 9% mortality rate after 3 months. Accurate mortality statistics are important for implementing appropriate health packages.

In our study, respiratory insufficiency accounted for 57.1% of the total deaths in the acute stage. These deaths were more in group B patients within the first three months, suggesting a possible lack of adequate acute stage rehabilitation; this matches with mortality studies done by Lalwani et al.¹⁶ and others.^{14,7} Two-thirds of rehabilitation defaulters died within the first 12 months. This involved predominantly nonsurgically managed (group B) patients, emphasizing that an early aggressive structured rehabilitation prevents early deaths in such patients. At 12 months after injury, we found no statistically significant difference between the two groups, similar to the study by Donovan et al.^{6,7}

The main limitation of the study was the number of study population, which is relatively low but gives us clear picture for future treatment strategies. Also, patients' allocation to either group was not at random.

CONCLUSION

The data of this study suggest that the management of such severe injuries should judiciously consider the socioeconomic background of the affected person. Radiological parameters alone should not be criteria for surgery as many families in developing countries cannot afford extensive rehabilitation after having spent a bulk of their resources on the cost of surgery. For lower socioeconomic countries, this study will be more useful as we can advise the family to channelize their limited resources for extensive rehabilitation than spend everything for surgery and hospitalization.

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LIST OF ABBREVIATIONS

- ASIA: American spinal injury association
ICU: Intensive care unit
IRB: Institutional review board
RTA: Road traffic accident
SCIM: Spinal Cord Independence Measurement.

الملخص العربي

النتائج الاجتماعية والاقتصادية والوظيفية بعد إصابات الحبل الشوكي العنقي الشديدة: مقارنة بين المرضى الجراحين وغير الجراحين.

البيانات الخلفية: إدارة كسور العمود الفقري العنقي ليس لها بروتوكول علاج فردي. تعتمد معظم الإرشادات على أنواع الكسر؛ دراستنا، التي أجريت في دولة نامية، أخذت في الاعتبار العوامل الاجتماعية والاقتصادية وآثارها في وضع خطة العلاج النهائية.

الغرض: مقارنة النتائج الاجتماعية والاقتصادية والوظيفية للتدبير الجراحي وغير الجراحي لكسور العمود الفقري العنقي الحادة مع عجز عصبي شديد (ASIA A و B) لمدة لا تقل عن 12 شهرًا بعد الإصابة.

تصميم الدراسة: دراسة قائمة على الملاحظة بأثر رجعي.

المرضى والطرق: شملت الدراسة ما مجموعه 42 مريضًا. 22 تمت معالجتها جراحياً (المجموعة أ) و 20 تمت معالجتها بشكل متحفظ (المجموعة ب). تم تقييم النتائج الوظيفية على الأقل 12 شهرًا بعد الإصابة باستخدام مقياس التهديد SCIM. تم تحليل المعلومات الأخرى بما في ذلك عدد أيام المستشفى، وإجمالي الإنفاق عند التخريج، والأحداث ذات الصلة بوحدة العناية المركزة، والوفيات في غضون سنة واحدة وتفصيل إعادة التأهيل.

النتائج: كان متوسط الإقامة في المستشفى في المجموعة (أ) 26 يومًا مع وجود مريض واحد يتطلب قبول وحدة العناية المركزة بنفقات قدرها 2707 دولارًا، بينما في المجموعة ب، كان متوسط أيام دخول المستشفى 40 يومًا مع وجود مريضين مطلوبين قبول وحدة العناية المركزة مع تكبد نفقات قدرها 850 دولارًا. كانت حالات الإصابة بالأمراض المشتركة المرتبطة بوحدة العناية المركزة عالية في المجموعة «أ»، وتوفي مريض واحد في المجموعة «أ» وخمسة مرضى في المجموعة «ب» خلال الـ 12 شهرًا الأولى. بلغ معدل الوفيات الإجمالي في غضون اثني عشر شهرًا بعد إصابة العمود الفقري العنقي ASIA-A و B 16.6% مع ارتفاع معدل الوفيات في المجموعة B خلال الفترة المبكرة (0-3 أشهر). كان متوسط الدرجة الوظيفية لـ SCIM عند 12 شهرًا في المجموعة A و B 36.5 و 41.6 على التوالي (ع = 0.2). لم يتم العثور على فرق معتد به إحصائياً في النتيجة الوظيفية بين الناجين في كلا المجموعتين في 12 شهراً.

الخلاصة: البقاء على قيد الحياة لمدة عام كان أفضل في المرضى الذين عولجوا جراحياً مع عدم وجود فرق (P = 0.09) في النتيجة الوظيفية لكلا المجموعتين. فقط إعادة التأهيل المبكرة والمستمرة في كلا المجموعتين تساعد على تحسين نوعية حياتهم.