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AN ANALYSIS OF CHANGING PATTERNS IN TRAUMATIC SPINAL CORD INJURIES IN A TERTIARY REFERRAL CENTRE IN SOUTHERN INDIA

Orthopaedics

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ABSTRACT

Study Design and Objective : A prospective study to analyze the changes in etiology, transfer patterns, time delay in transfers, levels of injury and type of traumatic Spinal Cord Injuries (SCI) was designed and comparative analysis with previous studies from the same tertiary centre was done.

Methods : This prospective study was done involving 313 patients at our institute. Personal information of patients and data were obtained from admission registers (records data) and patient proforma and analyzed and compared with the Paraplegia Analysis Report [11] of period 1987-98 and Paraplegia project, Madras[10] available in the institute.

Results : High falls (fall from height) remain the leading cause of SCI while an increase in SCI due to road traffic accidents is noted along with decreased time interval in inter facility transfers of patients.

KEYWORDS

Traumatic Spinal Cord Injuries (SCI), complete SCI, fall from height

INTRODUCTION

Spinal cord injury (SCI) is a traumatic event that can result in disturbances to sensory, motor, or autonomic function and can ultimately impact a patient's health.[1,2,3] The management of SCIs requires excess health care resources and usually places a substantial financial burden on patients, families, and society[4] . Expenditure is due to high level acute care in the short term and associated secondary complications that can occur in the long term[4]. There exists a high mortality rate at the scene of the accident and patient retrieval and transport is also of prime importance[12,16,21].

The incidence of spinal cord injury (SCI) is high in developing countries, and in developed countries the incidence appears to stabilize and shifting in etiology from traumatic to non-traumatic causes[6]. In developed countries four-wheeler motor vehicles accidents and falls on level ground (low falls) form the leading etiology. In comparison, two-wheeler motor vehicles accidents , falls from rooftops or buildings under construction and trees(high falls) are the most common injury etiology in Southern Asia[5].

MATERIALS AND METHODS

This study was conducted in the Institute of Orthopaedics and Traumatology at Rajiv Gandhi Government General Hospital, Madras Medical College, Chennai, South India. A total of 313 spinal cord injured patients who were admitted during the period September 2011 to December 2012 were included and patients suffering from other orthopaedic trauma were excluded. Analysis was done based on changes in various distributions like age, sex, injury mode, vertebral level of SCI, severity of SCI based on ASIA- American Spinal Injury Association-Impairment Scale (AIS) and this was compared with Paraplegia Analysis Report (PAR) [1] available in the Institute for the period 1987-1998.

RESULTS

In our study there were 276 male patients (88.17%) and 37 females (11.82%) and the PAR[1] too revealed a similar percentage in males and females who were injured (Table:01)

Table : 01(Sex distribution)

	2011-12		1987-98	
Gender	No. of patients	Percentage	No. of patients	Percentage
Male	276	88.17%	1467	88.8%
Female	37	11.82%	184	11.2%

The common age group (Table: 02) involved in SCI were the older adolescents (19-24 years) who form 23.3% and the young adults (25-50 years) 55.6%. In the PAR1 the age group commonly involved in SCI were between 20 to 50 years.

Table : 02 : Age wise distribution of SCI patients

	Age (years)	<18	19-24	25-50	51-70	>70
2011-12	No.of patients	15	73	174	45	6
	Percentage	4.8%	23.3%	55.6%	14.3%	1.9%
	Age	<19	20-29	30-49	50-59	>60
1987-98	No.of patients	122	474	617	162	92
	Percentage	8.31%	32.31%	42.05%	11.04%	6.27%

Duration between time of SCI and admission in Institute

The majority of SCI patients (64.22%) could reach our tertiary referral hospital within 24 hours and 28% of SCI patients could reach within 48 hours. Only 7.67 % reach after 48 hours (Table : 03). In the PAR1 study the patients admitted within 3 days or 72 hours of injury were called System cases or Early Entry patients as per MRSCICS criteria12 and SCI patients admitted after 72 hours were classified as Non-system cases. In the PAR1 study 1651 patients were system cases and 930 patients were non-system cases (Table:04).

Table 03 : Time interval between SCI and reaching Tertiary Hospital (2011-12)

Time interval between injury and admission	No. of patients	Percentage
<6 hours	76	24.28%
6-24 hours	123	39.94%
25 – 48 hours	88	28.11%
>48 hours	24	7.67%

Table: 04 : Time interval between SCI and reaching Tertiary Hospital (1987-98)

Time interval between injury and admission	No. of patients	Percentage
0-24 hours	556	33.67%
25-48 hours	532	32.22%
49-72 hours	407	24.65%
No information	156	

The 108 emergency ambulance service (EMRI) was begun on September 15, 2008 in Tamil Nadu19 and has helped transporting about 27% for trauma cases in 2012-13 and 2013-14 . Inter Facility Transfer (IFT) in Tamil Nadu increased to 37% in 2013-14 from 33% in 2012-13.(Table: 05)

Table:05: Number and percentage of trauma patients transferred (2012-14)-EMRI

	1 Apr 2012 to 31 Mar 2013		1 Apr 2013 to 31 Mar 2014	
Type of patient	No. of cases	%	No. of cases	%
Trauma (Vehicular)	147,290	23.22	174,248	22.03
Trauma (Non-vehicular)	24,883	3.92	35,466	4.48

However the number of transfers(Fig.01) of the SCI patient was found to be two transfers in 176 patients and three transfers in 67 patients. Only 58 patients reached the tertiary centre directly while 12 patients needed 4 transfers

Fig. 01 : No of SCI patient transfers to various hospitals before reaching Tertiary Centre

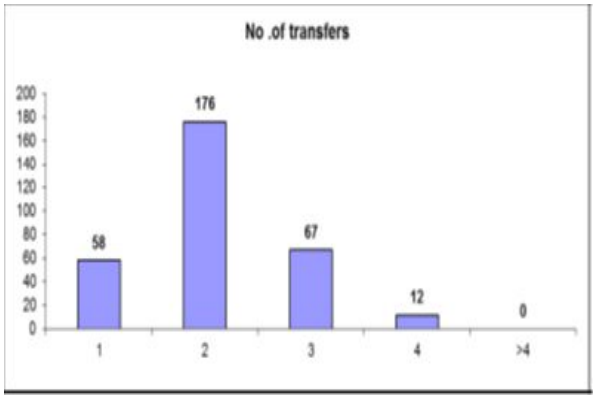

Table:06 : No. of transfer of SCI patients from site of accident to reach Tertiary centre

	2011-12 Study		PAR(1987-98) Study	
No. of transfers	No. of patients	Percentage	No. of patients	Percentage
1	58	18.53%	572	34.64%
2	176	56.23%	705	42.70%
3	67	21.40%	212	12.84%
4	12	3.83%	150	9.08%
5 &above	Nil	-	12	0.72%
Total	313		1651	

Mode of Injury

The most common mode of SCI was analyzed region wise (of the vertebral column). Shanmugasundaram TK[10] et al study (1978-86) of 844 patients in the same institute of the present study indicates that injuries were sustained mostly in villages ; manual and agricultural laborers were affected mostly. Falls from trees or falls into wells have been the commonest causes of injury(66%); road accidents have accounted in for fewer than 10 percent of cases. Annamalai[11] et al PAR study (Table:08) revealed that fall from height remained a major mode of SCI followed by Road traffic accidents (RTA) which had gone up to 12-18%. In our study RTA as a cause of SCI has increased to 25-30% while fall from height as a cause remained high.(Table 07)

Table 07 : Distribution of Modes of SCI in patients during 2011-12 , at various vertebral levels

	Cervical		Dorsal		Lumbar	
Mode of injury	No. of patients	Percent age	No. of patients	Percent age	No. of patients	Percentage
RTA	43	31.61%	14	15.38%	21	30%
Fall from height	58	42.64%	66	72.52%	40	57.14%
Fall of heavy weight over head.	13	9.55%	1	1.09%	2	2.85%
Sea diving	2	1.47%	0	0	1	1.42%
TTA	3	2.20%	0	0	1	1.42%
Fall on level ground.	6	4.41%	1	1.09%	0	0
Others	6	4.41%	9	9.89%	5	7.14%
History unknown	2	1.47%	0	0	0	0
Total	136		91		70	

Table :08 Mode of Injury (Paraplegia Analysis Report 1987-98-Study)

	Cervical		Dorsal And Lumbar	
Mode of injury	No. of patients	Percent age	No. of patients	Percentage
RTA	122	18.04%	130	12.56%
Fall from height	209	30.91%	190	18.35%
Fall of heavy weight over head.	99	14.64%	129	12.46%
TTA	8	1,18%	28	2.70%
Fall on level ground.	98	14.49%	73	7.05%
Others	19	2.81%	190	18.35%
Domestic	98	14.49%	73	7.05%
Occupational	23	3.40%	32	3.09%
Total	676		1035	

Level of SCI

The various levels of SCI (Table: 09)in the patients were analyzed ; in Cervical level spinal injuries were found to be in 43.45% (136 patients) while Dorso - Lumbar level injuries were found in 51.43% (161 patients). Sacral and mixed injuries formed 5.1% (16 patients). Lower cervical injuries like fractures and subluxations or dislocations were of significant numbers[9].

Table 09 : Level of SCI - Region wise distribution

	2011-12		1987-98	
Level of injury	**Number of patients**	**Percentage**	**Number of patients**	**Percentage**
Cervical	136	43.45%	538	46.33%
Dorsal.	91	29.07%	303	26.09%
Lumbar.	70	22.36%	221	19.03%
Sacral.	7	2.23%	0	0
Mixed.(Multiple/ DL etc,)	9	2.87%	99	8.52%
Total.	313		1161	

Neurological evaluation and severity of SCI was assessed by ASIA Impairment Scale (AIS) in 289 patients, while 24 severely injured patients could not be assessed . Analysis (Table : 10) revealed that ,of the 255 male patients evaluated 45.1% (115 patients) had complete SCI while 33.6% (86 patients) suffered from incomplete SCI. Among 34 female patients evaluated 26% (9 patients) had complete SCI and 25% (8 patients) suffered from incomplete injury.

Table : 10 :ASIA- Impairment Scale (AIS) Classification of SCI patients

	Complete SCI	Incomplete SCI			Normal Neurology	Total evaluated
	A	B	C	D	E	
MALES	115	31	27	28	54	255
Percentage	45.1%	12.2%	10.5%	10.9%	21.1%	
FEMALES	9	2	2	4	17	34
Percentage	26%	7%	6%	12%	49%	
TOTAL	124	33	29	32	71	289
Percentage	42.9%	11.4%	10%	11%	24.5%	
	24 severely and multiple injured patients not evaluated					

Table :11 Paraplegia Analysis Report 1987-98- Study

	Complete SCI	Incomplete SCI			Normal Neurology	Total evaluated
	A	**B**	**C**	**D**	**E**	
CERVICAL	355	97	51	51	59	613
Percentage	57.9%	15.8%	8.3%	8.3%	9.6%	
DORSO-LUMBAR	289	80	39	39	48	495
Percentage	54.4%	16.16%	7.87%	7.87%	9.69%	
TOTAL	**644**	**177**	**90**	**90**	**107**	**1108**
Percentage	**58.12%**	**15.97%**	**8.12%**	**8.12%**	**9.65%**	

The type of SCI of the patients in our study assessed by AIS (ASIA Impairment Scale) indicated complete SCI of 42.9% and incomplete SCI of 32.4%.The PAR[11] study showed 58.12% of complete SCI and 32.21% of incomplete SCI.Patients with Normal neurology were 24.5% in our study and 9.65% in PAR[11] study(Table:11).

DISCUSSION

Morbidity and mortality following SCI is a concern for patients ,relatives, the treating physician and society at large. The expenditure during treatment and recuperation period following the initial acute phase of SCI becomes a big burden on the patient and state exchequer[4]. SCI have a male preponderance globally[7] at a percentage of 82.8% whereas it was a little higher in our study(88.17%) probably indicating that in Southern India males travel more and may be involved in work at high rise buildings or climb trees more often[9]. An epidemiological study[9] was also carried out by a parallel team in our Institute for a period of 12months by Sridharan N et al[9], however our study period was 16 months and involved more on the orthopaedic aspects of SCI and an analysis of changing pattern in SCI over years was done.

Highest incidences of traumatic SCI in all countries were reported in age between 20 and 50 years by Ning et al[8] .Asian literature reported average ages that range from 26.8 to 56.6 years similar to our study where almost 55% were in this age group. This indicates that the majority of SCI occurs in this group of adults as they are the most active and socially productive members of society[8]. In our study older adolesc,ents (19-24 years) in their prime of life began showing an upward trend of increased trauma probably due to better economy and increased utility of motorcycles instead of bicycles and over speeding.

Optimal retrieval services and acute SCI care within first 72 h after SCI (system cases)[12] and expeditious and careful transport of patients with acute cervical spine or spinal cord injuries should be carried out from the site of injury by most appropriate mode of transportation available to the nearest capable definitive care medical facility[13,16,21] . In our study there was a vast improvement in early transfer to the tertiary centre due to the introduction and advent of the EMRI ambulance services[19]. The 108 Emergency Ambulance Services has contributed largely in reducing the time taken to reach our tertiary centre thereby resulting in improved care at the earliest.The total number of transfers or Inter Facility Transfers have all reduced with the advent of improved ambulance services in the state of Tamil Nadu, South India. Delayed admissions of over 1000 TSCI patients admitted to specialist centres in Italy and the United Kingdom resulted in more complications (pressure sores, heterotopic ossifications and urinary complications) and longer lengths of stay and such cases are dealt as non-system cases in our studies done earlier by Shanmugasundaram et al and in the PAR.[10,11,12,13,17,18]

With regard to mode of injuries of SCI demographic and economic differences between developed and developing countries affect the incidence of SCI from low and high falls. Low falls (1-metre or less or on the same level (slips and trips) in elderly (often resulting in tetraplegia) are on the increase in developed countries with ageing populations.[5,13,20]. High falls or fall from height may occur from tree tops in rural areas while in urban areas rapid infrastructure development and increased construction of high rise buildings remain a reason .Fall into wells in the rural areas has reduced to a great extent in our study. The proportion of SCI resulting from land transport (four-wheeled vehicles) is stable or decreasing in developed countries, but on the increase in developing countries[13]. This was observed in our study where there was a significant increase when compared to the PAR study. Developed countries have safer cars (energy absorbing body design, seat belt use and air bags), better road design, mandatory licensing and training as well as alternative transport implementation such as mass transit-rail whereas developing countries have poor infrastructure, many non-standard vehicles, less regulation and enforcement due to cost, lack of resources and a poor safety culture[13,14,15] which might be the reason for the increase .

The vertebral level (of SCI) analysis in our study showed cervical and dorso- lumbar injuries occurred in an almost equal incidence and it was comparable to studies by Movaghar[22] et al. In our study complete SCI was found to be more common and it was similar to our PAR[11] study and Movaghar[22,8] study. Similarly some studies[4,8,22] from developed countries mention a trend toward complete over incomplete SCIs over the last decade.

CONCLUSION

Traumatic spinal cord injury (SCI) is a devastating condition which occurs with an annual incidence of 12.1–57.8 cases per million.[23] In developing countries like India especially its southern part there is a shift towards road traffic accidents as a mode of SCI and improvement in transport (emergency ambulance) services combined with better roads has contributed to a significant change in early transport of SCI patients to tertiary referral centres. With better distribution of resources, better training of care givers in rural and urban centres, increase in more tertiary centres and institution of a SCI registry exemplary care for the SCI can be provided.

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