Management of Traumatic Spinal Column Injury: A Tertiary Hospital Experience

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Abstract:

Background: Trauma is the leading cause of disability in the first four decades of life and third most common cause of death. Spinal trauma poses considerable threats to survival and quality of life. **Objective:** Aims of this study is to assess the demographics, mode of trauma, hospital stay, complications, neurological improvement and mortality. **Methods:** Retrospective Cross sectional analysis of the records of spinal injury patients admitted in the Spine Unit of Bangabandhu Sheikh Mujib Medical University (BSMMU) Hospital from October 2003 to December 2013 was carried out. The demographics, mode of trauma, involved vertebral level, co-morbid factors; neurological status and its improvement by American Spinal Injury Association (ASIA) Score, duration of hospital stay and complications during hospital stay was assessed. Results were analyzed by SPSS. **Results:** Out of 1288 patients admitted, 192(14.90%) patients(range, 8-72 years) sustained spinal injuries and most (63.02%)of them were young (range, 21-40 years). Male to female ratio was 5:1. Cervical spine was most commonly (44.66%) affected followed by lumbar (35.41%), thoracic (13.54%), thoraco-lumbar (06.25%) and Cervico-thoracic (03.13%) region. Fracture through intervertebral disc was most common in cervical spine. Among the common causes were road traffic accidents (44.47%), fall from height (29.69%), heavy weight bearing (14.58%) and assault with gunshot (07.29%). Paraparesis was most frequent (51.05%) clinical presentation followed by quadriparesis (45.83%). Significant number of patients (83.33%) required operative treatment ($p<0.05$) and 09.89% were managed conservatively. Mortality rate (03.64%) was insignificant ($p>0.05$%) and 03.12% patient refused to take treatment. Of these patients, 77.01% had shown neurological improvement of at least one grade according to ASIA Score. **Conclusion:** Wide varieties of patients are encountered and managed varying from conservative to surgery. Carefully selected treatment provides the utmost outcome and reduces mortality.

Key words: Traumatic, Spinal Column injury, Management, Tertiary Hospital.

[BSMMU J 2015 ; 8 (2) : 95-104]

Introduction:

Trauma is the leading cause of disability in the first 4 decades of life and the 3rd most common cause of death[1]. The overall incidences varies from 25 to 59[2], [3]cases per million and has a huge physical, financial and emotional impact on the patients' family as well as the society in addition to their morbidity associated. In 1990, Stripling[4] estimated 4 billion dollars of annual cost to the United States for caring of these cases. The injuries are usually the result of high energy trauma, e.g. road traffic accidents (45%) and falls (20%) and need special care system for optimum clinical outcome.[5]

The beginning of effective Spinal Injury care can be dated back to the work of the American neurosurgeon Dr Donald Munro at Boston City Hospital in the 1930s[6] and later Sir Ludwig Guttmann at Stoke Mandeville Hospital in the United Kingdom in 1944, which revolutionized the

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Spinal Injury care system.[7]According to the researchers, approximately 10-30% of patients with spinal trauma will have associated spinal cord injury and 5% will have deterioration in their neurology.[8] Although the incidence and prevalence associated with the spinal column injury are very difficult to determine due to wide range of variations and very small number of documentations, a thorough diagnostic pathway guided by the standardized protocols, often including computed tomography with sagittal reconstructions are mandatory to evaluate the extent and consequences of spinal trauma.[9] Improved functional outcomes can be achieved with physical and occupational therapy, and holistic care corresponded to the socioeconomic needs of the patients.[10]

The corner stone of contemporary spinal column injury management are (i) rapid detection (ii) immobilization (iii) early reduction of the spinal deformity and (iv) pharmacological therapy to facilitate neuronal function[11]. The main focus of this study is to assess the demographics, mode of trauma, hospital stay and complications with spinal column injury patients attended in our institute.

Methods:

Bangabandhu Sheikh Mujib Medical University (BSMMU) is a major tertiary referral center and the only University teaching hospital in Bangladesh. It receives both direct trauma patients and inter-hospital trauma referrals. The hospital has an integrated Emergency Department (ED) with a resuscitation area and trauma theatre. The ED is manned by medical officers; residents from all specialties of surgery faculty and physical medicine are on-site on a 24 hour basis.

Our Study population comprised all the consecutive patients with Spinal injury (n=192, Male- 160, Female-32) either alive or dead attended, or admitted to the hospital in the study period (1st October 2003 –31st December 2013). We used a questionnaire based on World Health Organization (WHO) guide lines for essential trauma care, international guidelines of Advanced Trauma Life Support (ATLS) and similar previous study guidelines. It contained data on the demographics (Age, Sex, Co-morbid factors), of the victims, accidents and injuries data (Mode of injury, vertebral region involved, neurological injury and other associated injury), clinical outcomes and in hospital complications of victims recorded by trained doctors. Data were collected from the injured patient where possible, or from his (her) relatives or attending medical staff. All of the patients (and or caregivers or Consentees) were explained and offered management according to Guidelines for the Management of Acute Spinal Cord Injuries[12]. prepared and proposed by American Association of Neurosurgeons (AANS) and Congress of Neurosurgeons (CNS) accepted globally. Patients requiring conservative treatment had been managed by bracing, bed rest and physiotherapy [Fig.1] unless return to his previous level of activity as advised in the guideline. Surgical indication included i) Spinal instability, ii) Neurological deficit, and iii) Impending deformity. Data entry, verification and editing were done by investigators then analysis was performed by SPSS and $p<0.05$ value has been selected as the level of significance.

Prior to any interview, the participant and/or his or her care taker were given an explanation on the purpose, nature and benefits from the study and a written consent was taken upon their agreement. Confidentiality on data and privacy were rigorously protected and made accessible only to the researchers. The implants and additional materials used during surgery had no financial issues to be associated with any trade mark companies or institutes; neither this study was funded by any grant or financial support to any of its author and co-authors.

A detailed history and examination was carried out especially evaluating the mode of trauma, ASIA grading[13] [Table-1], sensory level and any spinal deformity. Plain x-rays, in antero-posterior and lateral views were obtained and the instability of the spine was confirmed using White and Panjabi criteria[14] of spinal instability [Table-I]. MRI or CT scan was done to further evaluate the important

relationships and instability of spine. Those patients with unstable spine (White and Punjabi scoring > 5), complete or incomplete neurological deficit (ASIA grade - A, B, C, D) and progressive neurological deficits were then explained pros and cons of the surgical treatment. Patients willing for surgery underwent open reduction and internal fixation by posterior approach. Laminectomy to decompress spinal cord was carried out at the involved level and bone was saved to be used as bone graft. Pedicles were localized using detailed anatomical landmarks and intraoperative imaging. Polyaxial screws were inserted through pedicles into vertebral bodies' one or two or level above and one or two level below fractured vertebra under fluoroscopic guidance according to site of involvement. Rod contouring using a French bender was employed in all the cases. The rod was coupled to Polyaxial screws. The cortical bone was roughened using high-speed drill or bone nibbler to make suitable for bone graft. The bone already saved while doing laminectomy was broken into small fragments free of soft tissue and was placed over roughened cortical bone. In cervical region anterior cervical decompression done by discectomy, fusion by tricortical bone graft and stabilized by plate and screw. The wound was then closed in layers after keeping a drain. The patients were kept on broad-spectrum antibiotics and analgesics for one week. The drain was removed on the next day of surgery. Check x-rays were done on the 3rd postoperative day. Support was given to the patients accordingly. Aggressive physiotherapy was started to mobilize patients. The neurological status of the patients and any other complications were noted up to one year. Those patients with stable spine (White and Punjabi scoring < 5) or neurologically intact (ASIA grade-E), only mild to moderate pain on mobilization, absence of mal-alignment and absence of gross bony destruction can be managed conservatively in the form of bed rest, traction, braces, molded orthosis and halo jackets. Skeletal skull traction for 4-6 weeks followed by Philadelphia brace or halo vest for another 6 weeks was used in conservative treatment of cervical spine injuries [Fig.-2]. In thoraco-lumbar compression fractures was treated conservatively by complete bed rest for 4-6 weeks followed by thoraco-lumbar orthosis for 6weeks [Fig.-3].

Results:

The follow up period varied from 12-45 months, the mean being 23.3±5.60 months. Out of 192 patients significant number of patients were male [n=160(83.33%)] as well as young of 21-40 years age group [n=121(63.02%)] (chi squared test, $p<0.05$), associated with co-morbidities e.g. Diabetes Mellitus (DM), Hypertension (HTN), Ischemic Heart Disease (IHD), Congestive Cardiac Failure (CCF), Chronic Kidney Disease (CKD) and bleeding diathesis as the following sequence [22(11.45%), 15(7.81%), 12(6.25%), 2(1.04%), 4(2.08%), 1(0.52%)] [Table-II]. We encountered almost all spine regions to be involved although none of them were statistically significant (chi squared test, $p>0.05$). Cervical spine involvement [n=80(41.66%)] was most commonly affected followed by lumbar [n=68(35.41%)], thoracic [n=26(13.54%)], thoraco-lumbar spine [n=12(6.25%)] and cervico-thoracic [n=6(3.13%)] region. Fractures through intervertebral disc were most common in cervical spine. Similar statistical analysis (chi squares test, $p>0.05$) was revealed regarding the causes of injury, which were Road Traffic Accidents (RTA) [n=86(44.47%)], Fall From Height (FFH) [n=57(29.69%)], Heavy Weight Bearing (HWB) [n=28(14.58%)], Gun Shot Injury (GSI) [n=14(7.29%)] and others. They were associated with other regional injuries (chi squares test, $p>0.05$), including Spinal cord injury, Head injury, Upper limb fracture, Lower limb fracture, Chest injury and pelvic fracture in the following order [184(95.83%), 33(17.18%), 8(4.16%), 11(5.72%), 5(2.60%), 5(2.60%)]. Patho-morphological characteristics of the injuries included 33(17.18 %) type-A injuries, 85(44.27%) type-B injuries and 74(38.55%) type-C injuries and none of them were statistically significant ($p>0.05$, chi-squared test) [Table-III].

Paraparesis [n=98(51.05%)] was the most frequent although insignificant (chi squares test, $p>0.05$) presentation followed by quadriparesis [n=98(45.83%)], paraplegia [n=14(7.29%)], quadriplegia [n=8(4.17%)]. The

neurological function assessed by ASIA scale at admission was as: ASIA grade-A [n=22(11.46%)], grade-B [n=40(20.83%)], grade-C [n=80(41.67%)], grade-D [n=42(21.87%)] and grade-E [n=08 (04.16%)]. At the end of 12 months it was, grade-A [n=16(8.34%)], grade-B [n=8(05.20%)], grade-C [n=30(16.67%)], grade-D [n=80(43.23%)] and grade-E [n=45(25.00%)]. Significant cases [n= 148(77.01%)] achieved at least 1 grade improvement (chi squared test, $p<0.05$) [Table-V]. Although surgery associated mortality [n=7(3.64%)] and morbidity [n=33(17.18%)] was insignificant (chi squared test, $p>0.05$). Few patients [n=6(3.12%)] refused to take treatment [Table-VI].

The major complications in this series encountered were dyspnoea [4(2.08%)] bedsore [n=12(6.25%)], GI tract bleeding [n=3(1.56%)], Urinary Tract Infections [n=10(5.20%)], and stricture urethrae [n=4(2.08%)]. There were Deaths [n=7(03.64%)] where 2(1.04%) patients died within 36 hours postoperative, 2(1.04%) patients within 1 and 3(1.56%) patients after 3 weeks.

Table -I

Assessment Criteria.

Neurological Assessment criteria of patients			
ASIA Grading			
Grade A	Absent motor and sensory function;		
Grade B	Sensory function present, motor function absent;		
Grade C	Sensory function present, motor function present; but not useful (MRC grade<3/5)		
Grade D	Sensory function present, motor function useful (MRC grade >3/5)		
Grade E	Normal function		
Radiological Classification System of spina	l column injuries proposed by AO (Magerl et al. 30)		
Type A	Vertebral body compression	A1	Impaction fractures
		A2	Split fractures
		A3	Burst fractures
Type B	Anterior and posterior element injury with distraction	B1	Posterior disruption predominantly l igamentous (Flexion - Distraction injuries)
		B2	Posterior disruption predominantly osseous (Flexion - Distraction injuries)
		B3	Anterior disruption through disc (hyperextension - Injuries)
Type C	Anterior and posterior element injury with rotation	C1	Type A (Compression) Injuries With Rotation
		C2	Type B Injuries With Rotation
		C3	Rotation - Shear Injuries
Diagnosis of clinical instability proposed by White and Panjabi			
Points			
2	Anterior element destroyed or unable to function		
2	Posterior elemen t destroyed or unable to function		
3	Cauada equina destroyed		
1	Dangerous loading anticipated		
	Flexion -extension radiology		
2		Sagittal Plane translation	
2		Sagittal Plane Rotation	
	Resting radiology		
2		Sagittal plane displacement	
2		Sagittal plane relative angulation	

Table-II

Demographic features of the patients. (n=192)

		No	%			No	%
Age	≤20	14	7.29	Co-Morbidity	Diabetes Mellitus	22	11.45
	21-40	121	63.02		Hypertension	15	7.81
	41-60	49	25.52		Ischemic Heart Disease	12	6.25
	61-80	8	4.16		Congestive Cardiac Failure	2	1.04
Sex	Male	160	83.33		Chronic Kidney Disease	4	2.08
	Female	32	16.67		Bleeding Diathesis	1	0.52

Table-III

Spinal column Injury characteristics

		No	%				No	%
Involved Region of Spinal Column	Cervical	80	41.66	Associated Injury	Spinal Cord Injury		184	95.83
	Lumbar	68	35.41		Head Injury		38	19.79
	Thoracic	26	13.54		Upper limb Fracture		8	4.16
	Thoraco-lumbar	12	6.25		Lower limb fracture		11	5.72
	Cervico-thoracic	6	3.13		Chest injury (Torso)		5	2.6
	Lumbo Sacral	0	0		Pelvic fracture		5	2.6
Cause of Injury	Road traffic accident (RTA)	86	44.79	Patho-Morphologic charecteristic of Injury	Type-A	A1	6	3.12
	Fall from height (FFH)	57	29.69			A2	4	2.08
	Heavy weight bearing (HWB)	28	14.58			A3	23	11.97
	Assault & Gunshot injury	14	7.29		Type-B	B1	58	30.2
	Machinery injury	5	2.6			B2	3	1.56
	Diving	2	1.04			B3	24	12.5
					Type-C	C1	0	0
						C2	70	36.45
						C3	4	2.08

Table-IV

Conservative treatment of Spinal Column injury.

		No	%			No	%
Age	≤20	2	10.53	Co-morbidity	Diabetes Mellitus	9	47.36
	21-40	9	47.36		Hypertension	7	36.84
	41-60	4	21.05		Ischemic Heart Disease	3	15.79
	61-80	5	26.31		Congestive Cardiac Failure	3	15.79
Sex	Male	16	84.21		Chronic Kidney Disease	2	10.53
	Female	3	15.79		Bleeding Diathesis	1	5.26
Region	Cervical	7	36.84	Outcome	Excellent	7	36.84
	Dorsal	6	31.58		Good	5	2.63
	Lumbar	5	2.63		Fair	5	2.63
	Sacral	1	5.26		Poor	2	10.53

Table-V

Clinical features of spinal injury patient (n-192)

		At presentation		At last follow up	
		No	%	No	%
Clinical Presentation	Quadriparesis	88	45.83	72	37.5
	Quadriplegia	8	4.17	7	3.64
	Paraparesis	98	51.05	46	23.95
	Paraplegia	14	7.29	9	4.68
	Neurogenic bladder	40	20.83	23	11.97
	Spinal shock	25	13.02	0	0
ASIA Scale	Grade -A	22	11.67	16	8.93
	Grade -B	40	20.83	8	4.47
	Grade -C	80	41.67	30	16.76
	Grade -D	42	21.87	80	44.69
	Grade -E	8	4.16	45	25.14
	Totel	192		179	

Table-VI

Treatment and complications of the patient (n-192)

Mode of treatment	No	%	Complications	No	%
Conservative	19	9.89	dyspnea	4	2.08
Operative	160	83.33	Bed sores	12	6.25
Refuse treatment	6	3.12	GIT Bleeding	3	1.56
Death	7	3.64	UTI	10	5.2
			Stricture urethra	4	2.08

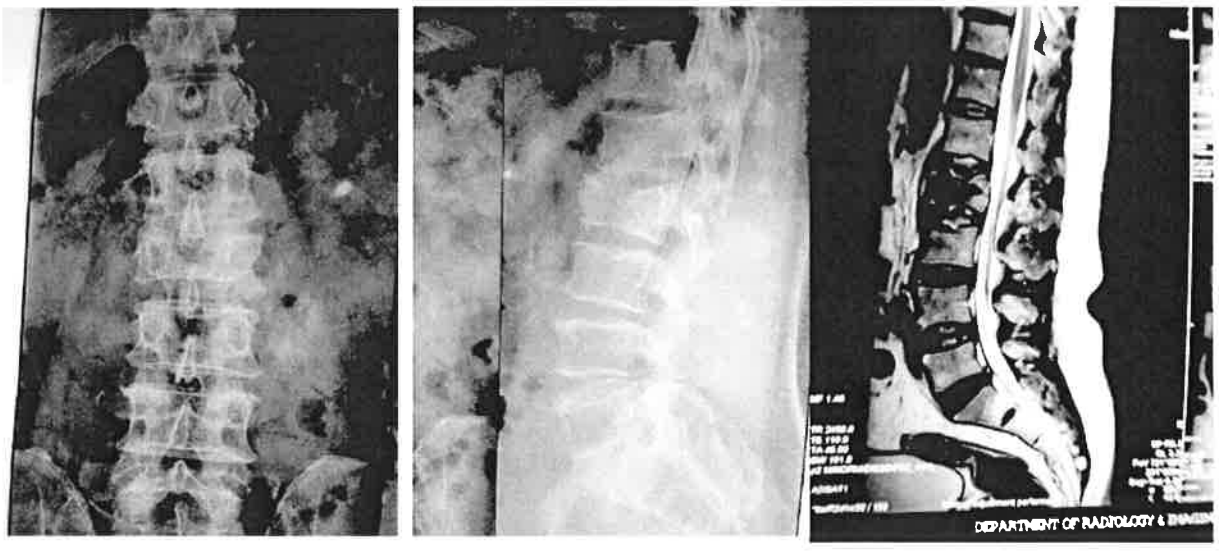


Fig.-1: *Conservative management of Spinal column injury patient.*

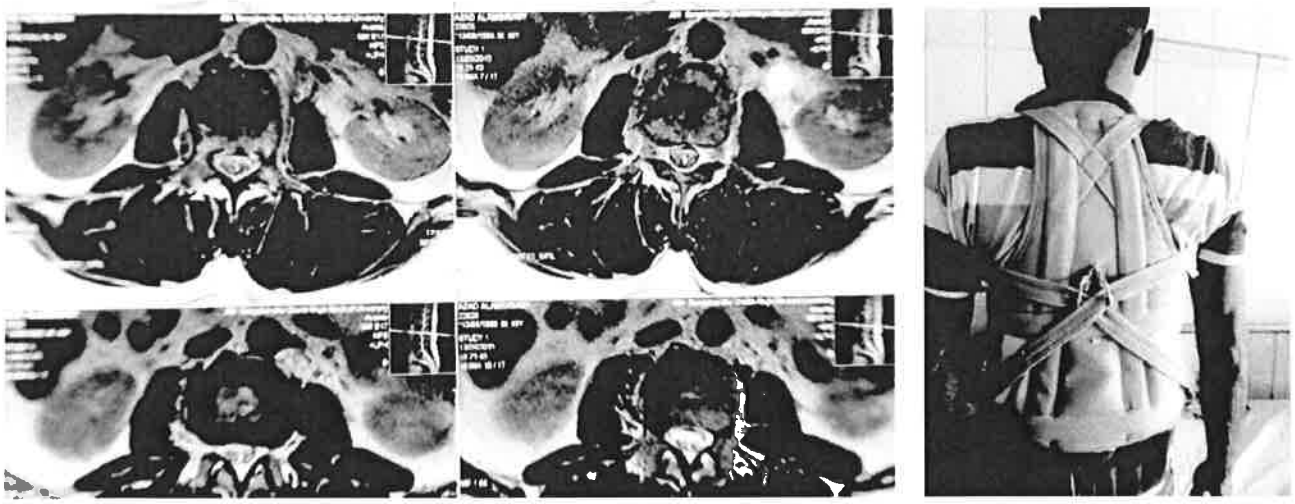
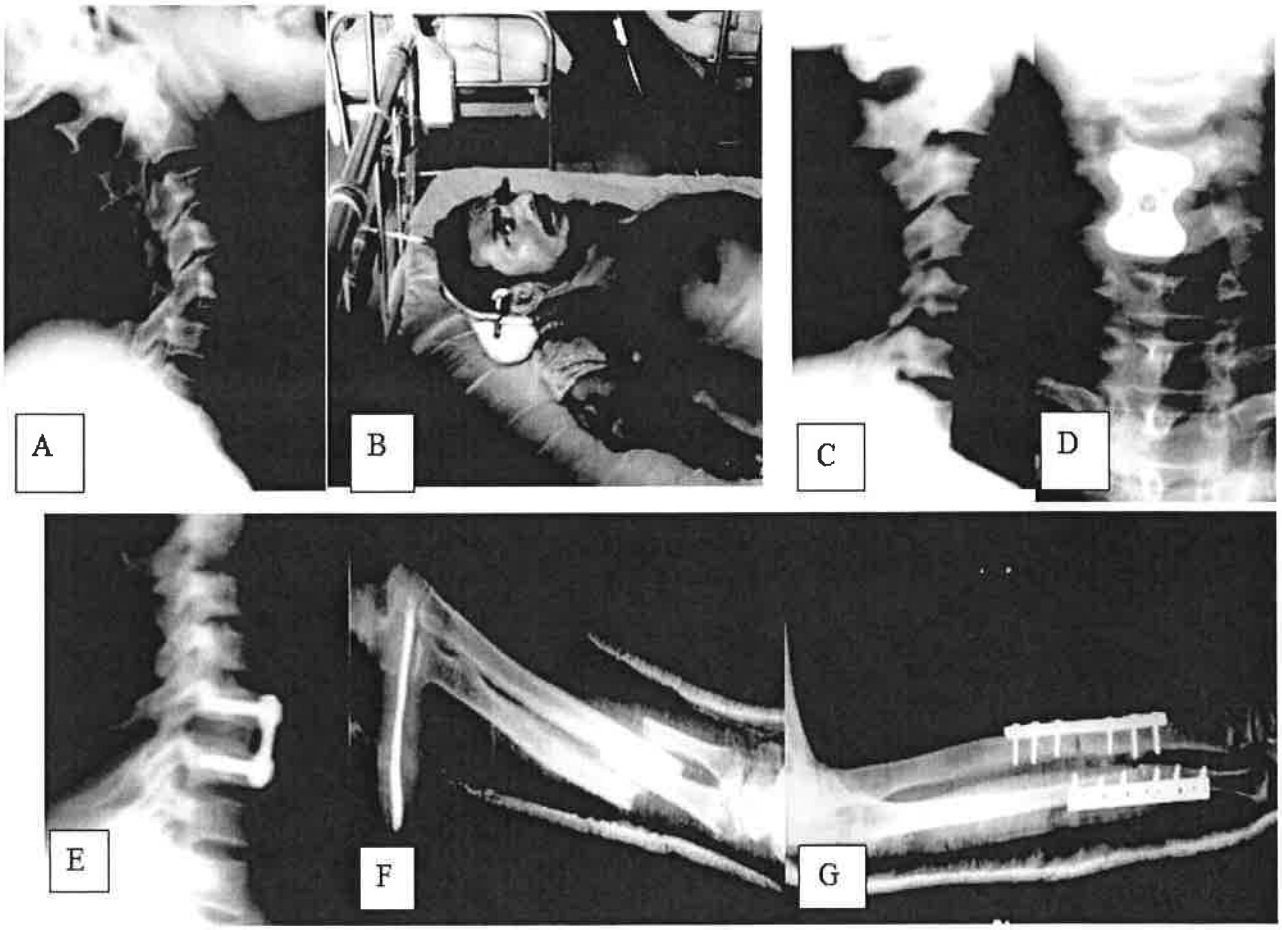
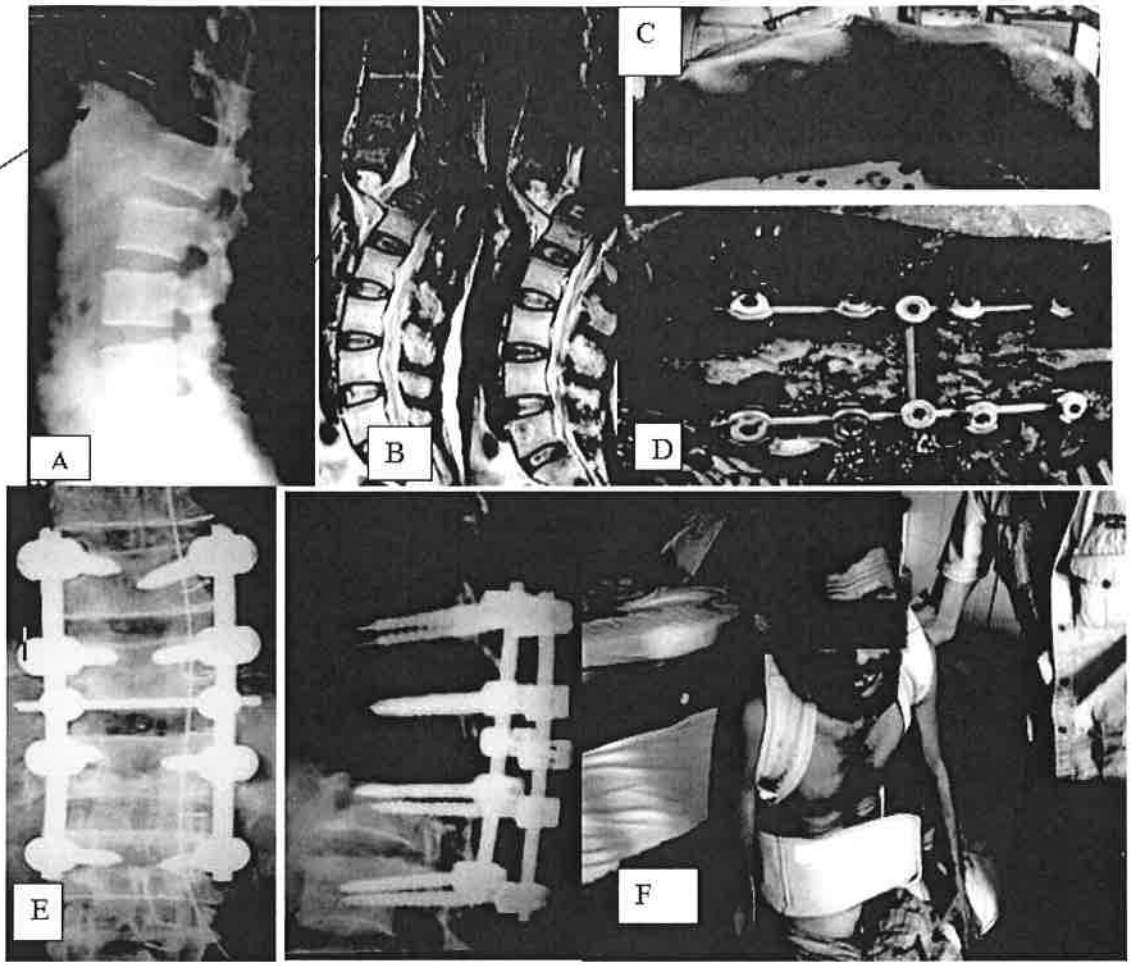


Fig.-2: *Operative management of Cervical injury patient.*



A. Traumatic facet dislocation at C5/6, B. Preoperative traction. C. Reduction of dislocation, D&E. Post operative X-ray. F. Associated fracture radius and ulna. G. Postoperative X-ray.



A. Plain X-ray shows Traumatic dislocation at D11/12, B. MRI shows cord transaction. C. Position for operation and showing dislocated area, D. per operative picture, E. Post operative X-ray, F. 3 wks after operation.

Fig. 3: *Operative management of thoraco-lumbar injury patient.*

Based on available evidence on the etiology of spinal injury across WHO regions, the three most common causes are transport (road traffic crashes in particular), falls and violence and the most common cause is due to falls in the developing countries.[5] Typically, these patients are immobilized with traction or an external orthosis and undergo MRI to assess the extent of their injury and the need for surgical intervention. The goal of management is restoration of normal pain free, static, dynamic and protective function of the spine with an aim to prevent or limit neurological deficit and promoting neurological recovery.[15-17] Stable healing of spine in its anatomical forms is a prerequisite in its management. Treatment of neurologic deficit in spinal injured patients is done with immobilization, medical stabilization, spinal alignments, and operative decompression and finally with spinal stabilization until osseous healing.[18] Decompression of the spinal cord as quickly as possible soon after injury has a definitive role in the management of spinal trauma.[19,20] Barring any medical or surgical contraindication, patients with an evidence of persistent spinal cord compression are considered absolute emergencies and are scheduled for immediate surgery.

Given the whole spine, because of its vulnerability, trauma to the cervical region of the spine occurs more

often than anywhere else.[21,22] These Injuries can be treated conservatively or operatively, depending on the degree of instability. In the lower cervical spine, most injuries require internal fixation.[9] Upper cervical region account for about 24% of acute cervical fractures and dislocations of the cervical spine.[23] Next common regions is the thoraco -lumbar spine. Compressions fractures usually can be treated successfully with conservative treatment, while burst fractures usually, and flexion/distraction injuries and fracture dislocation generally require internal stabilization. The treatment of unstable fractures and fracture dislocations of thoracolumbar spine remains controversial.[24] The goal of the treatment of unstable thoracolumbar injuries is optimizing neural decompression while providing stable internal fixation over the least number of spinal segments.[25] Either anterior, posterior or both approaches can be used to achieve fusion but the efficacy of either approach is the same.[26-28] Surgical stabilization of unstable thoraco-lumbar injuries with complete neurologic deficit or without deficit reduces hospital stay, improves spinal alignment, shortens rehabilitation and results in fewer medical complications.[29]

In an epidemiological study Prasad and his colleagues[30] had 52 cases of injury to cervical spine, 35 cases in the thoraco-lumbar region and 46 cases in lumbar region in a series of 133 cases in a rural and suburban setup in India. In our series the injury to the cervical spine occurred more frequently e.g. 80(41.66%) patients between the ages of 21-40 years followed by thoracic (13.54%), lumbar (35.41%), Cervico-thoracic (3.13%) and thoraco-lumbar (6.25%) region and association of head injury with cervical spine injuries are found in 38 patients (44.18%). Most of the studies found associations of significant head injury with cervical spine injuries resulting in >50% higher mortality and morbidity rate.[31,32] Patients with an acute thoracic and lumbar injury are often have other injuries related to their trauma, including pulmonary contusions, long bone fractures, and internal injuries. These patients receive the necessary medical treatment until surgery.

The injury to the spine tend to be more severe in RTA.[33,34] The dynamic energy is imparted in more than one direction with tortional element and this will explain the mechanism of more severe injuries in RTA. The neurological deficit is more common and more severe among road traffic vehicular accidents. FFH either causes axial load compression injuries or shear injuries. It is rare to find distraction injury with accidental fall. In accidental falls the impact most of the times is unidirectional[30] and the extent of injury depends on the magnitude of axial load. On the other hand, HWB causes flexion compression and distraction injury which is an unstable injury needing immediate orthosis followed by both anterior and posterior stabilization.[35] Fall from height usually causes dorso-lumbar injury and also associated with other injuries like fracture of ankle bone, fracture of forearm bones and visceral injuries.[36]

Among the complications encountered 01(0.52%) required emergency tracheostomy out of [04(02.08%)] dyspnoeic patients, 01(0.52%) patient required flap coverage for bedsore [n=12(06.25%)] and optical urethrotomy was done for stricture urethrae [n=04(02.08%)] by urologist. All the deaths [n=07(03.64%)] were associated with multiple injuries and causes revealed were respiratory insufficiency and florid infection which could not be controlled even after by intensive therapy. The average mortality figures are much higher in other studies.[32,37]

We did not collect information from the first hospital the patient attended, and possibly this would bias the interpretation of injuries sustained, hence we choose only to report the Glasgow comma scale (GCS) for those attending the hospital directly from the scene assessing the severity of injuries. The wide variability of the injury types, involved regions, associated trauma and mostly the variability of presentation of the patients are great drawbacks for a uniform outcome. A larger data and longer duration of study with long time follow up is essential to delineate more elaborate results.

Conclusion:

Spinal column injury has a wide variety of resentation but carefully planned surgery is effective and has few morbidity and mortality associated with.

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