Original Article

Distribution of Injury and Injury patterns in trauma victims admitted to the trauma centre of CSMMU, Lucknow

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Abstract

Introduction: Understanding the characteristics of injuries, injury patterns and trauma victims is absolutely essential in ascertaining the resources required for a trauma centre.

Methods: Age, sex, obesity, pre-existing chronic conditions, Injury Severity Score, Glasgow coma scale (GCS), injury type, and injury pattern were recorded. All patients admitted on all Mondays were consecutively recruited subject to informed consent. Abbreviated injury scale was used to record the type of injury. Extra burden of injury for referred patients was defined as patients who did not meet the Centre for disease control (CDC), USA criteria for admission to a trauma centre. Extra burden of injury for directly admitted patients was defined as patients that were discharged within 24 hours of admission without undergoing any operative procedure, admission to Trauma Ventilation Unit or any procedure requiring anaesthesia.

Results: Eight hundred and five injuries were recorded in five hundred seventy two patients. Patients admitted on different days of the week were found to be similar. Injuries to the lower extremity were the most frequent (29%). Fractures were the most common orthopaedic injuries. Exclusive treatment by an orthopaedic surgeon or a neurosurgeon was indicated in 46.68% and 31.99% cases. The overall Extra Burden of Injury (EBI) due to a lack of organized system of trauma care was 26.04%

Discussion: Majority of the EBI should have been taken care of at a district hospital as per the Indian Public Health Standard guidelines of the National rural health Mission. A vast majority of patients can be taken care of by a single specialist.

Conclusion: There is significant EBI on the CSMMU trauma centre which might be responsible for higher mortality reported by previous studies. There is a need to assess whether this higher mortality is an effect of EBI.

Keywords: Trauma, injury, patterns.

Introduction:

The resources required for managing trauma victims at a trauma centre are a concern for health planners, managers, administrators and doctors. In contrast to elective admissions, emergency and trauma related admissions place unpredictable demands on health providers and resources. Understanding the characteristics of injuries, injury patterns and trauma victims is absolutely essential in ascertaining the resources required for a trauma centre. A study was conducted to address this objective at the trauma centre of Chattrapati Sahuji Maharaj Medical University (CSMMU) which is the only trauma centre in Uttar Pradesh and serves the needs of Uttar Pradesh up to a radius of 100 miles. The objectives of this study were to identify the injuries, injury patterns, specialists required to treat trauma victims, determine extra burden of injury (EBI) at the CSMMU trauma centre due to lack of an organized system of trauma care and suggest methods to reduce EBI

The results of this study may be useful in identifying areas that require further research, education and allocation of resources, as well as making recommendations on reducing the EBI.

Material and Methods:

Age, sex, obesity, pre-existing chronic conditions, Injury Severity Score, Revised trauma score (RTS), Trauma Injury Severity Score, Glasgow coma scale (GCS), injury type, and injury pattern of the recruited patients was recorded. All patients admitted on all Mondays were consecutively recruited subject to informed consent for a period extending from 19/4/10 to 29/11/10. Patients

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admitted on Mondays (n=95), Wednesdays (n=99) and Saturdays (n=91) of eight randomly selected weeks were compared to determine the representativeness of our sample.

Abbreviated injury scale was used to record the type of injury. Since there is a lack of validated or consensus definition of polytrauma, we recorded two or more severe injuries in at least two areas of the body, and multiple injury (i.e. two or more severe injuries in one body area) in different categories. Injury patterns were defined as single injury to a body region, ≥ 2 injuries to a body region, injuries to two body regions, injuries to three body regions, injuries to four body region and injuries to five body regions. Combinations of regions were recorded for eg: - head and lower extremity, head lower extremity and upper extremity and so on. Extra burden of injury for referred patients was defined as patients who did not meet the criteria for admission to a trauma centre as defined by the Field triage decision scheme of Centre for Disease Control (CDC), USA. Extra burden of injury for directly admitted patients was defined as patients that were discharged within 24 hours of admission without undergoing any operative procedure, admission to Trauma Ventilation Unit or any procedure requiring anaesthesia.

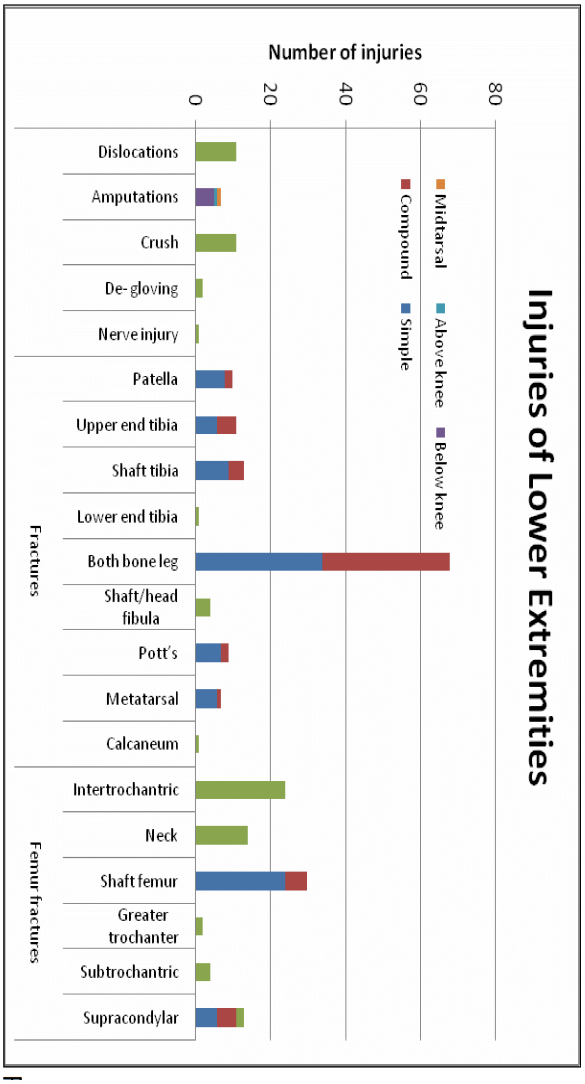
Results:

A total of Eight hundred and five injuries were recorded in five hundred seventy two patients. The mean age of the victims was 40.81±16.3 years, 83.60% were males and 16.40% were females. Mean ISS, RTS, and GCS were 12.56±7.3 (n=570), 7.07±1.2 (n=537) and 12.20±4.1 (n=537). Mean time to admission was 54.22±185.2 hours. One hundred fourty three patients (24.96%) died during one year follow up. Only one patient who did not meet the CDC criteria died. Surgery, treacheostomy, and blood transfusion was required in 210, 27, and 147 patients respectively. Mechanism of injury was known in 569 patients. Patients admitted on Mondays and other days (Wednesdays and Fridays) were compared for any difference in the demography and injury characteristics and it was observed that they were similar.

A) Injuries

Injuries to the lower extremity were the most frequent (n=248, 29.00%). As detailed in figure 1, 211 of these were fractures, 11 were dislocations, 11 were crush injuries, 7 were post traumatic amputations (5 below knee, 1 above knee and 1 mid tarsal), 2 were de-gloving injuries (and 1 was a common peroneal nerve injury. Common fractures were both bone leg, (34 simple and 34 compound), fracture shaft femur (24 simple and 6 compound) intertrochantric fracture (n=24), fracture neck of femur (n=14), fracture upper end of tibia (10 inter-condylar and 1 lateral condyle). Most common dislocations were central fracture dislocation of hip (n=5), and posterior dislocation of hip. Of the 211 fractures, sixty two were compound fractures. Of the twenty four pelvic injuries, 19 were stable and 5 unstable.

Cerebral contusions (n=112, single being 93 and multiple being 19), vault fractures (n=48, 26 simple and 22 compound), intracranial haematoma (extradural 31 and subdural 19) and cerebral edema (n=37) were the most common injuries to the head (n=246, 28.77%). Of the vault fractures 26 were simple and 22 were compound. There were 15 facial fractures (maxilla 7, zygoma 4, mandible 3 and nasal 1). Figure 2



1: Injuries to lower extremity injuries

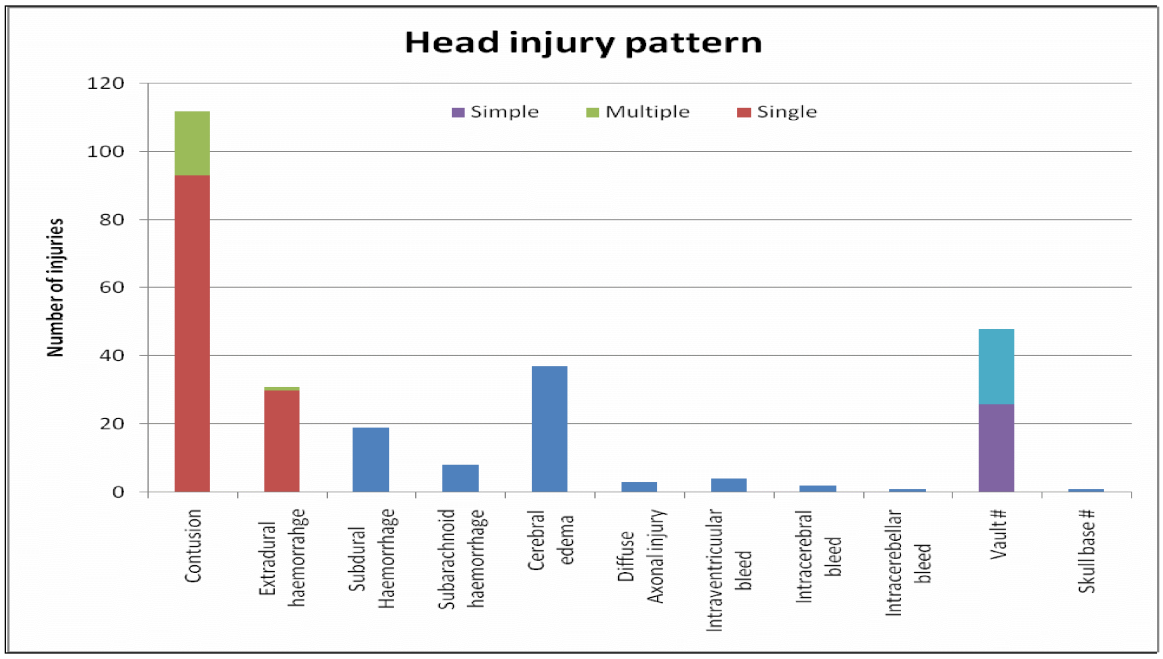


Figure 2 : Head injury types

Upper extremity injuries (n=95) constituted 11.11% of all injuries. Of these 82 were fractures, 5 crush injuries (hand 3, wrist 1 and forearm 1), 6 neurovascular injuries (4 brachial plexus, 1 posterior interosseous nerve and 1 radial artery) and 2 amputations/disarticulations (1 below elbow and 1 metatarsophallangeal). Figure 3

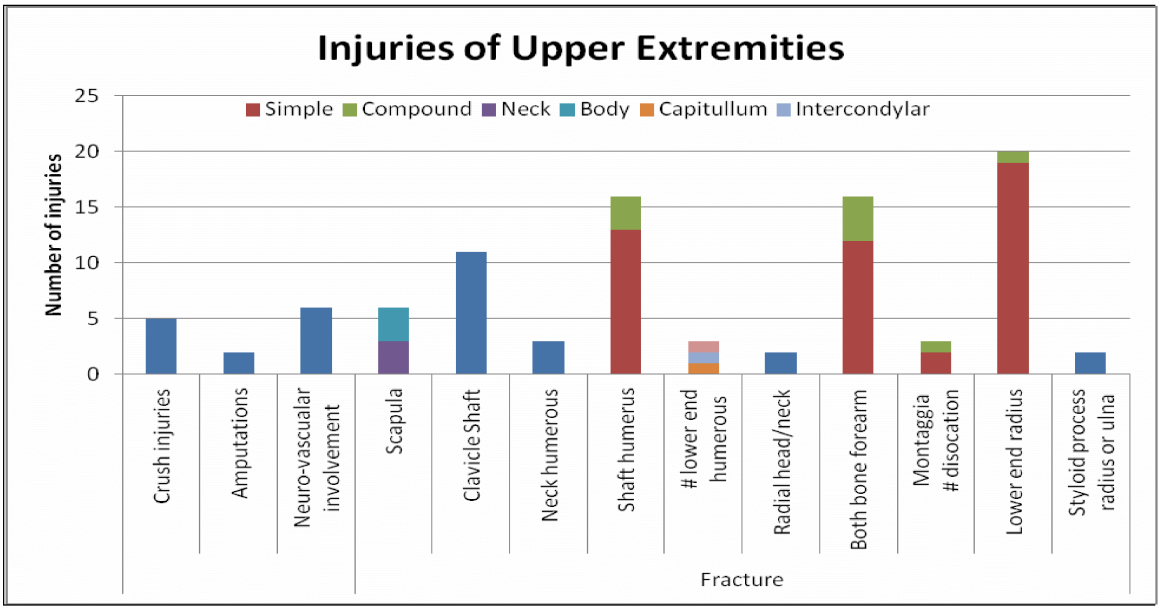


Figure 3 : Injuries to upper extremities

Spinal injuries constituted 6.1% (n=53) of all injuries. As shown in figure 4, 32 of these were cervical (26 with neurological deficit), 11were lumbar (9 with neurological deficit) and 10 were thoracic (9 with neurological deficit). Of the chest injuries (n=35, 4.09%), 16 were multiple rib fractures, 9 were haemothorax, 4 haemopneuomothorax, 1 pneumothorax, 3 flail chest and 2 lung contusions. Of the 14 (1.6%) abdominal injuries, 9 were perforations (jejunum 5, stomach 2, rectal 1 and urinary blader 1) and 3 were visceral lacerations (1 liver, 1 kidney and 1spleen), 1 mesentric tear and 1 urethral injury. Figure 4.

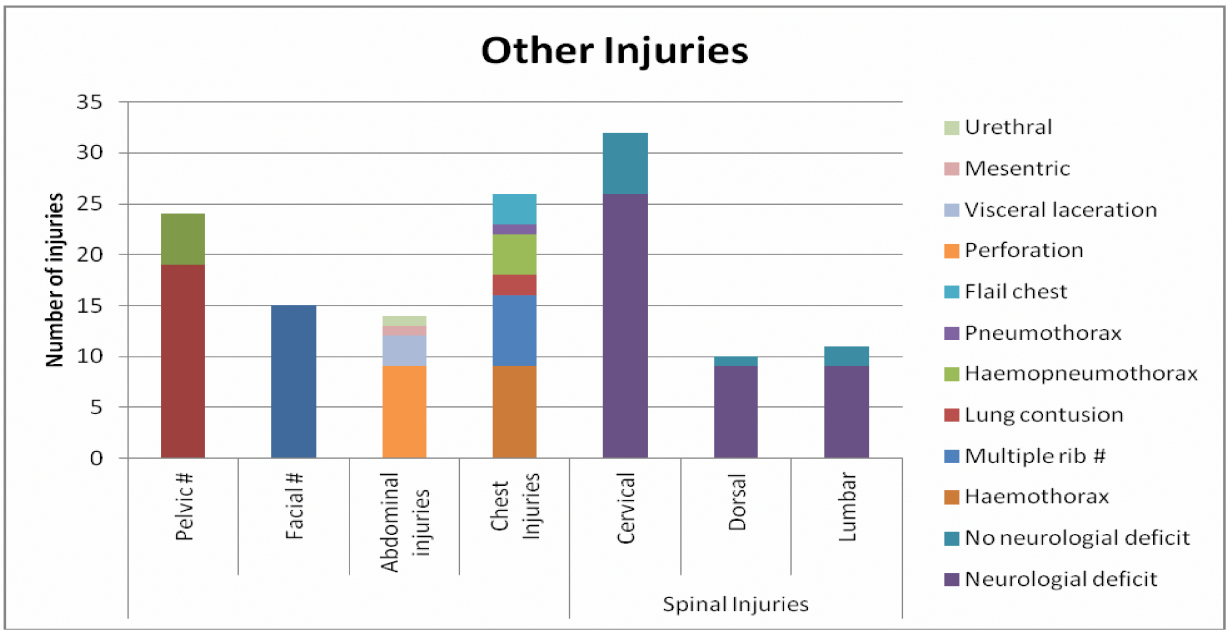


Figure 4 : Other injuries

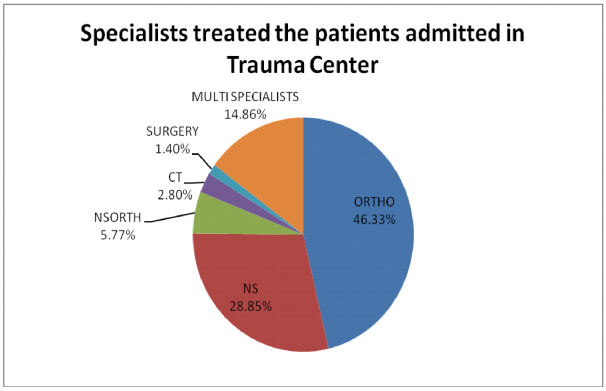


Figure 5: Specialists required for treating patients

B) Injury patterns and specialists required for treatment.

Single injury to a single body region, >1 injury to a single body region, injuries to 2 body regions, injuries to 3 body regions and 4 body regions was seen in 371 (64.86%), 75 (13.11%), 104 (18.18%) , 21(3.67%) and 1(0.001%) case respectively. In the single injury to a single body region there is a predominance of head (n=138, 24.12%), lower extremity injuries (n=124, 21.67%), spine (n=45, 7.86%) and upper extremity injuries (n=43, 7.51%). In the > 1 injury to single body region, head was the most frequently involved region (44, 7.69%). In the two body region group there is predominance of head and lower extremity (21, 3.67%) head and upper extremity (16, 2.7%), lower extremity and upper extremity (12, 2.09%) and head and face (12, 2.09%). In 21(3.67%) patients there were 13 different combinations of injuries involving three body regions. (Table 1).

83.39% of the patients required treatment by a single specialist. As shown in figure 5, exclusive treatment by an orthopaedic surgeon, neurosurgeon, general surgeon, cardiothoracic surgeon and maxillofacial surgeon was indicated in 46.68%, 31.99%, 1.57%, 2.80% and 0.35% cases. Thirty one cases i.e. 5.42% required admission to Trauma Ventilatory Unit. Some kind of treatment by an Orthopaedic surgeon, neurosurgeon, general surgeon, cardiothoracic surgeon and maxillofacial surgeon was indicated in 60.33%, 43.52%, 3.30%, 6.46% and 4.88% respectively. Treatment by a neurosurgeon and/or orthopaedic surgeon was required in 85.84% cases. Three female patients, who were pregnant, required an opinion from a gynaecologist.

Table 1: Injury pattern and extra burden of injury (EBI) in referred patients

		No. of patients	Number of Referred patients	Referred admitted patients EBI No.	(EBI%)	Number of direct patients	Direct admitted patients EBI No.	(EBI%)
Single Body region > 1 injury N=75	>1 segment LE	12	5	1	(20.00)	7	2	(28.57)
	Chest	7	6	0	(0.00)	1	0	(0.00)
	Head	44	23	6	(26.08)	21	1	(4.76)
	both LE	9	5	0	(0.00)	4	0	(0.00)
	UE	3	1	0	(0.00)	2	1	(50.00)
Single Body region one injury N=371	Abdomen	10	8	2	(25.00)	2	0	(0.00)
	Chest	9	3	0	(0.00)	6	1	(16.67)
	Face	2	1	0	(0.00)	1	0	(0.00)
	Head	138	91	9	(9.89)	47	11	(23.40)
	Lower Extremity	124	76	26	(39.39)	58	21	(36.21)
	Spine	45	24	3	(12.50)	21	1	(4.76)
	Upper extremity	43	23	17	(73.91)	20	15	(75.00)
Two Body regions N=104	Head and LE	21	13	2	(15.38)	29	0	(0.00)
	Head and UE	12	6	1	(16.67)	6	2	(33.33)
	Head and face	12	5	2	(40.00)	7	1	(14.29)
	LE UE Opp. Sides	4	2	2	(100.00)	2	1	(50.00)
	LE UE Same Side	16	9	3	(33.33)	7	2	(28.57)
	LE and Abdomen	3	2	2	(100.00)	1	0	(0.00)
	LE and Chest	3	2	0	(0.00)	1	0	(0.00)
	LE and Face	5	2	2	(100.00)	3	2	(66.67)
	UE and Chest	4	2	1	(50.00)	2	1	(50.00)
	Both LE and UE	4	2	1	(50.00)	2	0	(0.00)
	Face and UE	3	2	1	(50.00)	4	1	(100.00)
	Others	17	10	1	(10.00)	7	1	(14.29)
Three body regions		21	10	2	(23.08)	8	0	(0.00)
Four Body regions		1	1	0	(0.00)	0	0	(0.00)

C) Extra burden of injury

One hundred fourty eight patients i.e 26.04% did not meet the criteria for admission to a trauma centre. Of those, 79 patients were managed conservatively and 69 were managed operatively. A total of 72 surgeries were performed on these 69 patients; 60 surgeries were done at TC, 7 in elective OTs of CSMMU and 5 outside CSMMU on patients which left against medical advice. Eighty four of 327 referred admitted patients i.e. 25.68% did not meet the CDC criteria for admission to a trauma centre. 64.28% (n=54) of these 84 referred patients had been referred by a government hospital. Approximately 85% of referred EBI was from Lucknow, its adjoining districts and Sultanpur. Government hospital referred patients and private hospital referred patients from Lucknow, its adjoining districts and Sultanpur contributed to 44.04% and 23.80% of EBI. Table 2. Of these pure orthopaedic injuries accounted for 56.75%, pure head injuries accounted for 27.02% and a combination of head and orthopaedic injuries accounted

for 5.4% of EBI. Fourty one of eighty four required surgery while the rest were managed conservatively..

Sixty four of the 245 directly admitted patients, i.e 26.12% were discharged within 24 hours of admission, did not undergo any operative procedure or admission to Trauma Ventilation Unit or require anaesthesia for any proceedure. Approximately 94% of these directly admitted patients were provided Orthopaedic treatment (73.43%), or Neurosurgical treatment (17.18%) or a combination of both (3.12%). Approximately 87.5% of these were from Lucknow (70.31%), Seetapur (10.9%) and Hardoi (6.25%). Table 2

Approximately 85% of the referrals were for orthopaedic treatment (63.1%) or neurosurgical treatment (17.86%) or for both (3.57%). Two patients were referred for general surgery treatment and one was referred for treatment of chest injury. Rest of the referral (11.10%) was for varied polytrauma patients requiring multispeciality treatment. Approximately 85% of these referred patients were from Lucknow, its adjoining districts and Sultanpur. District wise and speciality wise contribution to extra burden of injury is shown in table 2. Twenty five (35.71 %,) of seventy patients (47.29% of the extra burden of injury) from Lucknow were referred. Twelve of twenty five were referred by government hospital in Lucknow. Thirteen patients who did not meet the CDC criteria were from Sultanpur, all of which had been referred (12 by government hospitals and 1 by a private hospital). Of the sixteen patients from Seetapur who did not meet the CDC criteria, eight had been referred (five by government hospitals and three by private hospitals). (Table 2).

Table 2 : District wise and speciality wise contribution to extra burden of injury N=572

	Speciality	EBI Direct %	EBI gov referral %	EBI pvt referral %
Ambedakar Nagaar	Neuro	0.68	0.68	0
	Ortho	0.68	0	0.68
Barabanki	Neuro,Maxillofacial	0	0.68	0
	Neuro,Ortho	0	0	0.68
	Ortho	0	0	0.68
	Neuro	0.68	0	0.68
Basti	Ortho	0	1.35	0
Gonda	Ortho	0.68	1.35	0.68
	Neuro	0	0.68	0
Hardoi	Chest, Ortho	0	0.68	0
	Ortho, Maxillofacial	0	0.68	0.68
	Neuro,Ortho	0	0.68	0
	Ortho	2.7	1.35	0.68
Lakhimpur	Neuro	0	0.68	0
	Ortho	0	0	0.68
Lucknow	Neuro	5.41	1.35	0.68
	Neuro,Maxillofacial	0.68	0.68	0
	Ortho	20.27	6.08	6.76
	Surgery	0	0	0.68
	Neuro,Ortho	1.35	0	0
	Chest, Ortho	1.35	0	0
	Ortho, Maxillofacial	1.35	0	0
Raebarely	Chest, Ortho	0	0.68	0
	Ortho	0.68	0	0
Seetapur	Chest	0.68	0	0
	Neuro	0.68	2.03	0
	Ortho	3.38	1.35	2.03
Sultanpur	Maxillofacial	0	0.68	0
	Neuro	0	1.35	0
	Neuro, Ortho	0	0.68	0
	Ortho	0	4.73	0.68
	Surgery	0	0.68	0
Unnao	Neuro	0	0.68	1.35
	Ortho	0	0.68	0

D) Mechanism of injury

Road traffic accidents (RTA) were the most important cause for injury. Three hundred sixty four patients (63.64%) sustained injuries due to an RTA. One hundred nineteen (20.80% of 569) patients sustained injury due to a fall, off which 68 (11.88% of 569) were from less than body height, 49 (8.87% of 569) were from more than body height and 2 (0.003% of 569) were from great height. Assault by hands or blunt objects was the cause of injury in 23 cases (4.02% of 569). Gunshot, struck by falling object, building collapse and machine injury was the cause in 14 (2.45% of 569), 14 (2.45% of 569), 12 (2.10% of 569) and 9 (1.57% of 569) cases respectively. Animal hit and fall/jump from a moving train was the cause of injury in 8 (1.39% of 569) and 6 cases (1.05% 0f 569) cases respectively. Table 3

Motorcycle collisions/skids/pillion slipping from the motorcycle, pedestrian hits, cycles collisions/skid, four wheelers collision/overturning, , six wheelers collisions and three wheelers collision/overturning were the cause of injury in 198 (34.62% of 569), 69 (12.06% of 569), 44 (7.69% of 569), 27 (4.72% of 569), 10 (1.75% of 569) and 9 (1.57% of 569) cases respectively. Tractors overturning and rickshaw four wheeler collisions was the cause of injury in 4 and 2 cases respectively. (Table 3).

Table 3: Frequency distribution of Mechanism of injury

Mechanism of Injury	Frequency	%
Road Traffic accident – 63.64%		
Motorcycle collisions/skids/pillion slipping from the motorcycle	198	34.62%
Pedestrian Hits	69	12.06%
Cycle collisions/Skid	44	7.69%
Three wheeler collision/Overturning	9	1.57%
Four wheeler collision/Skid	27	4.72%
Six wheeler collision	10	1.75%
Falls – 21.78%		
Less than body height	68	11.88%
More than body height	49	8.87%
Great height	2	0.003%
Assault by hands or blunt objects	23	4.02%
Gunshot	14	2.45%
Struck by falling object	14	2.45%
Building collapse	12	2.10%
Machine Injury	9	1.57%
Animal hit	8	1.39%
Fall/jump from a moving train	6	1.05%

Discussion:

Only one patient in our study who did not meet the CDC criteria for admission to trauma centre died and four patients required operative intervention by a neurosurgeon which could not have been performed at a district hospital. Majority of the EBI in our study should have been taken care of at a district hospital as per the Indian Public Health Standard (IPHS) guidelines of the National rural health Mission (NRHM). The cost of treatment in a trauma centre is almost twice that of treatment in a non-trauma centre[1]. EBI due to over triage results in an overuti-lization of financial and human resources[2], can contribute to trauma-centre overcrowding, and increases ambulance transport times and hospital turnaround times. EBI due to lack of a referral protocol resulted in fourty one extra surgeries in the trauma centre. In a disaster or a situation involving mass casualties, EBI could have an adverse impact on patient care[2]. A review of data concerning 10 terrorist bombings demonstrated a direct linear relationship between the rate of over-triage (and hence EBI) and the mortality rate of those critically injured[3].

Single injuries to single body regions are the most common injuries presenting to the trauma centre thereby implying that a vast majority of injuries can be taken care by a single specialist. Treatment by an orthopaedic surgeon or a neurosurgeon alone was indicated in 46.68% and 31.99% cases. Treatment by an orthopaedic surgeon or a neurosurgeon either alone or in combination with some other specialty was required in 60.33% and 43.52% cases. Initial treatment to patients who sustained head injury or chest injury was provided by general surgeons and patients being transferred to neurosurgery unit if an operative intervention was required. This practice is a relic from the past when there was a dearth of neurosurgeons and trauma was not a significant contributor to emergency admissions. Several studies have advocated direct admission of all head injury patients to a neurosurgical unit[4,5].

Motorcycle drivers sustained the majority of RTA injuries (54.93%). Pedestrians (18.94%) and cycle users (12.08%) were other groups that significantly sustained injuries in RTAs. High frequency of injuries in motorcycle users and pedestrians are consistent with the results of other studies[6]. This is expected as vast majority of road users in a semi-urbanized country like India use motorcycles, cycles and walking for transport as there is lack of public transport and only a minuscule minority can afford a car. According to Census 2011, 5% and 21% of Indian households own a four wheeler and a two wheeler respectively[7]. Surveys by the National Council of Applied Economic Research (NCAER) have shown that 5% households owned a car and 15% households owned a motorcycle in 2005-6[8]. Our results are consistent with complex traffic patterns in less motorized countries as compared to high income countries[9,10]. The vulnerable road users in our study were pedestrians (mortality 40.57%, victim in 18.94% of RTAs), cycle riders (mortality 24.74%, victim in 12.08% of RTAs). Pedestrians are most vulnerable to injury and death. This may be due to a number of factors, including lack of pedestrian facilities in road design, poor knowledge and practice of road safety measures by the general population, uncourteous behaviour of motorists, high speed driving, and low levels of vehicle ownership. Hospital studies in Bangalore during 1993, 1998 and 2005 have shown that pedestrians, occupants of Motorized Two Wheelers and bicyclists are injured and killed to the extent of 25%-35%, 30%-40% and 7%-10% respectively[11]. Corresponding rates in our study were 18.94%- 40.57%, 54.93%-24.74% and 12.08%-24.74%.The predominance of motorcycles riders sustaining injuries in RTAs could be due to increasing use of motorcycles.

Head injuries[12] and lower extremity injuries especially fractures tend to occur in motorcycle crashes[13]. Lower extremity osteoporotic fractures like those of neck of femur and upper extremity osteoporotic fractures are most commonly caused by low energy falls[14]. A high frequency of motorcycle crashes and low energy falls explains the preponderance of head injuries, lower extremity injuries and upper extremity injuries reported by us. Indian studies have reported polytrauma in a range of 20% to 40% of road traffic injuries[11]. Polytrauma i.e involvement of more than one body (22.02%) region or more than one injury to a body region (13.11%) was seen in 35.13 % cases.

Conclusion:

There is significant EBI on the CSMMU trauma centre which might be responsible for higher mortality reported by previous studies[15]. There is a need to assess whether this higher mortality is an effect of EBI. Overcrowding at trauma centre also puts an economic burden on the state as the cost of treatment at trauma centre is higher in a trauma centre than in a non trauma centre. This situation might be similar in other tertiary care centers of Uttar Pradesh which needs to be ascertained by conducting a multicentric study. In order to reduce the EBI of injury there is a need to improve the district hospital infrastructure, introduce a system of referral at hospitals and include referral decision making in the MBBS curriculum. Directly admitted patients who were discharged within 24 hours not requiring surgical intervention or admission to Trauma Ventilation Unit or any procedure requiring anaesthesia also tend to overload the trauma centre. Policy for such patients needs to be defined.

According to NRHM's IPHS guidelines[16], a vast majority of this EBI should have been managed at district hospitals. Strengthening these hospitals by ways of investing in infrastructure and human capital would certainly contribute to decreasing the extra burden of injury on trauma centre. Most of the district hospitals do not have an image intensifier which limits their ability to perform procedures requiring an image intensifier. There is a need to introduce a system of referral at community health centers and primary health centers in order to prevent overloading of tertiary care centres. We found the CDC referral protocol to be efficient in

identifying "at risk" patients and choosing the right hospital for treating an injured patient, since only 1 patient who did not meet the criteria died and only 4 who did not meet the CDC criteria required operative intervention. As mentioned in NRHM's IPHS guidelines for the facilities available at primary/secondary care hospitals, 97.3% of the patients (95%CI: 93%, 99%) who did not meet CDC referral criteria for admission to a trauma centre should have been treated in these hospitals.

Majority of injuries require treatment by an orthopaedic surgeon or a neurosurgeon (approximately 80%). This fact is worth considering while planning for the staffing requirements at the trauma centres that the government plans to establish. Since 16.61% of the patients required treatment by more than one specialist, it calls for starting a postgraduate specialization in trauma and emergency in India as these specialists can take care of diverse surgical and medical emergencies.

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