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Full Length Article

Epidemiologic characteristics and pre-hospital care of traumatic injuries during the COVID-19 pandemic in an emerging and developing country: A single tertiary centre experience

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ABSTRACT

Background: Pre-hospital care has been shown to reduce the mortality in trauma patients. The present study is an attempt to identify the status of pre-hospital orthopaedic trauma care in developing countries during COVID-19 pandemic.

Methods: This was a prospective observational study carried out in a tertiary care setup from March 25th, 2020 to January 31st, 2021. All the data pertaining to the traumatic injuries including demographic details and epidemiologic characteristics were recorded in an electronic database.

Results: A total of 1044 patients were included in the study for evaluation. The mean age was 35.24 ± 19.84 years. There were 873 males and 171 females. A total of 748 presented from nearby states, with 401 being the referrals and 347 cases coming directly to hospital. A total of 141 open fractures presented directly and 269 were referred from nearby states. Out of 269 cases of open fractures, only 67 and 139 were given intravenous antibiotics and had wound dressing done respectively at the periphery site. A total of 125, 112, 92 and 84 patients were received without traction/splintage, intravenous fluids, dose of analgesics and recording of vitals respectively. Delay from injury to presentation in emergency/administration of antibiotic (Hours) was 7.06. Road side accidents were main cause comprising of 52.58% cases. Gustilo Anderson classification grade-2 comprised of majority of the open fractures (51.63%). Lower limb fractures comprised of majority of the injuries (70.59%). Majority were adults and conservative management was the most common mode of treatment. A total of 197 and 265 patients had associated head injuries and blunt trauma chest/blunt trauma abdomen respectively.

Conclusion: Emphasizing on pre-hospital care measures, with special focus on co-ordination between primary, secondary and tertiary health care facilities is the need of the hour and can prevent additional morbidities, avoiding overburden of the already compromised healthcare centres.

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1. Introduction

Traumatic injuries have been a major cause of morbidity and mortality and accounts for more than 20% of total emergency cases.[1] Currently, more than 90% of the trauma related deaths is reported from the developing countries, posing a huge burden on the healthcare system of low and middle income countries.[2] An estimated 50% of total deaths occur within first hour of trauma and a further 30% of total deaths in next 23 h of trauma.[3] This latter part of mortalities can be prevented by properly implicating the basics of pre hospital trauma care.[4]

The pre hospital trauma care principles provide a basic framework for strengthening the already existing healthcare system and achieve health equity and helps in the development of emergency care capabilities in general healthcare systems.[4] Further, in order to respond to the ever increasing healthcare demand, strengthening pre hospital trauma care would help in strengthening the entire healthcare system and would be more cost-effective than operating

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separate systems.[5] Whereby the developed countries have a well-established pre-hospital trauma care management with all the sophisticated facilities at all times, rural and periphery areas in the developing countries like India have no access for the same.[5] Furthermore, the presence of social workers and non-specialists physicians adds to the woes, with no proper training being provided to them to handle these extreme emergencies.[6,7]

Integrating the pre hospital trauma care with the emergency medical services provided at the trauma care centres would help in efficiently managing the increased patient load and thereby reducing the mortality in the trauma patients.[4–6] Additionally, in low and middle income countries like India, this will help reduce the economic burden and help in optimal mobilising of the available funds and resources for better infrastructure development.[6] Also as has been reported in a previous study, neglect/delay in orthopaedic trauma during locked phase of COVID-19 time led to increased perioperative and postoperative complications in management of orthopaedic trauma during the unlocked phase, adding to the burden on already compromised healthcare resources.[8]

With unimaginable repercussions and challenges during COVID-19, the healthcare system worldwide has been affected in unprecedented way. The already compromised pre-hospital trauma care in developing countries has been further affected. Though several authors have discussed pre-hospital care during COVID-19 era, there is lack of literature regarding pre-hospital trauma care in developing countries. The present study makes an attempt to highlight the status of pre-hospital trauma care in orthopaedic patients during COVID-19 time in a developing country. By identifying the problems this study will further help in making strategies to improve the trauma patient care.

2. Materials and methods

This was a prospective observational study carried out in a tertiary care setup in northern part of India, catering patients from within as well as from outside the city. Since there is no established referral system in place, patients can come to this centre directly from any distant area. Even for referred patients from other centres, there are no standardised referral protocols. For current study all the patients coming to emergency department with traumatic orthopaedic injury were considered for inclusion. Patients without any fracture, received brought dead or unwilling to participate in study were excluded from the study. All the data pertaining to the traumatic injuries was recorded in electronic database from March 25th, 2020 to January 31st, 2021.

The data included demographic details, mode of injury, site of fracture, open/closed injury, management received from referral site, diagnosis, type of surgery, delay in injury and admission, delay in admission and surgery and associated injuries including head injuries and blunt trauma chest/blunt trauma abdomen injuries. Gustilo Anderson classification for open fractures was used to categorise the severity of the injury.[9]

ATLS guidelines were used to provide the emergent treatment and after stabilisation, a dedicated team of specialists managed these patients on a case to case basis, according to the evidence based medicine.[10] All patients went through compulsory temperature charting and screened for influenza like symptoms and travel history, followed by Reverse Transcriptase- Polymerase Chain Reaction (RT-PCR) Corona testing on admission. Patients requiring life or limb saving surgeries were operated on priority by a dedicated team of doctors in separate Covid operation theatres (OT) without waiting for the COVID-19 report.

2.1. Statistical analysis

For continuous variables, mean and standard deviation were used. For categorical data, percentage/frequency was used. Data was collected in the Microsoft excel sheet. SPSS22.0 was used to perform all the tests.

3. Results

A total of 1044 patients were included in the study for evaluation. The mean age of patients was 35.24 ± 19.84 years (range 3–82)[Table 1].There were a total of 873 males and 171 females [Table 1]. A total of 748 (71.64%) patients presented from nearby states, with a total of 401/748 patients being the referrals and 347 cases coming directly to our tertiary care hub [Table 1]. A total of 141 open fracture patients presented directly from nearby states and 269 open fractures were referred from nearby states [Table 1]. Out of 269 cases of open fractures, only 67 patients were given intravenous antibiotic dosage at the periphery site, 139 patients had wound dressing done [Table 2]. Further, a total of 125 patients were received without any traction/splintage, 112 without any intravenous fluids, 92 without any dose of analgesics and 84 without any recording of vitals status [Table 3]. Delay from injury to presentation in emergency/administration of antibiotic (Hours) was 7.06 (0.15–23)[Table 1]. Delay from injury to presentation in emergency/administration of antibiotic (Hours) was 7.06 (0.15–23) [Table 1]. Road side accidents were main cause comprising of 549 (52.58%) cases [Table 1]. Gustilo Anderson open grade 2 comprised of majority of the open fractures [n = 269 (51.63%)] [Table 1]. Lower limb fractures comprised of majority of the injuries [n = 737 (70.59%)], with fractures of the tibia being the most common fractures (n = 207) [Table 1]. Majority of the patients were adults [n = 887 (84.96%)] and conservative management was the most common mode of treatment [Table 1]. There was a total of 197 patients with associated head injuries and a total of 265 patients with associated blunt trauma chest/blunt trauma abdomen [Table 1].

4. Discussion

Coronavirus disease 2019 (COVID-19) was declared a public health emergency by the World Health Organisation (WHO) on January 20, 2020, and a pandemic on March 11, 2020. The skill to execute medical services in such exceptional situation remained a challenge. An effective work strategy needed to be executed at all healthcare centres, to prevent overburden of specialised healthcare centres and prevent inattentiveness in providing basic care treatment such as administration of antibiotic dose in open fracture, providing splintage in fractures and dislocations, etc. This study is an attempt to highlight some general deficiencies in the working of the healthcare system in providing optimum care in these unexpected pandemic scenario cases and subsequently providing a road map in formulating the future guidelines, if any such crises arise.

The most important finding of the present study was a high percentage of trauma patients reporting from nearby states (71.64%) to our tertiary care setup, with a substantial percentage of patients being the referral cases (38.40%). Further, direct admissions from outside Chandigarh comprised of 28.35% cases, indicating the absence of the necessary care in various healthcare centres in the nearby states. A possible reason for the same may be the conversion of various healthcare centres including Primary Health Centres (PHC) and Secondary Health Centres (SHC) into

Table 1
Demographic details and fracture distribution of Patients.

Category	n = 1044
Age (Years)	35.24 ± 19.84 (3–82)
Males: Females	873: 171
Outside Parent State (Chandigarh) admissions	748 (71.64%)
Delay from admission to surgery (Hours)	34 (12–96)
From Parent state (Chandigarh)[n = 296(28.35%)]	
Closed Fractures (n)	193
Open Fractures (n)	103
Delay from injury to presentation in emergency/administration of antibiotic (Hours)	**2.35 (0.10 to 28)**
Referral cases [n = 401(38.40%)]	
Closed Fractures (n)	132
Open Fractures (n)	269
Delay from injury to presentation in emergency/administration of antibiotic (Hours)	**7.06(0.45 to 72)**
Came directly from outside Chandigarh [n = 347(33.23%)]	
Open Fractures (n)	149
Closed Fractures (n)	198
Delay from injury to presentation in emergency/administration of antibiotic (Hours)	**5.06(0.30 to 48)**
Place of Fracture occurrence	
Road Side Accidents	549 (52.58%)
At Home	297 (28.44%)
At public places (parks, market, hospital, staircase, firearm injuries, railway track/crush injuries, etc.)	173 (9.86%)
Sports injuries	25 (2.39%)
Type of surgery	
Conservative Management (Splintage ± debridement)	701 (67.14%)
Operative Management (CRIF/ORIF)	343 (32.85%)
Fracture Location	
Upper limb fracture	234 (22.41%)
Humeral fractures	34
Elbow fractures	51
Forearm fractures	30
Wrist fractures	45
Hand fractures	74
Lower limb fractures	737 (70.59%)
Femur fractures	137
Knee fractures	131
Tibia fractures	207
Ankle fractures	85
Foot fractures	126
Pelvis and Acetabulum fractures	51
Axial Skeleton (Spine Injuries)	73 (6.99%)
Young Patients	744 (71.26%)
Elderly patients	143 (13.69%)
Paediatric Patients (≤14 years)	157 (15.03%)
Distribution according to Gustilo Anderson Classification for open Fractures (n = 521)	
Grade 1	71 (13.62%)
Grade 2	269 (51.63%)
Grade 3	181 (34.80%)
Grade 3A	143
Grade 3B	29
Grade 3C	9
Associated Injuries other than Orthopaedics (n = 462)	
Blunt Trauma Abdomen/Blunt Trauma Chest	265
Head Injuries	197

Table 2
Patients with open fractures who received basic trauma care before referral.

Patients referred from outside Chandigarh (open fractures) (n = 269)		
Wound dressing		**(n)**
Received with wound dressing		139
Without dressing		130
Antibiotics given before referring		**(n)**
	Yes	67
	No	202

dedicated COVID care centres as a result of exponential increase in the COVID-19 cases. Subsequently, specialised trauma hubs (tertiary care centres) had to cater to this additional trauma cases besides managing the COVID-19 case load, despite the prediction of less number of trauma as a result of lockdown.

Pre-hospital emergency services in developing countries like India are highly under-utilized.[11] Chandrashekhran et al. reported that inapt pre-hospital emergency care and first aid, led to augmented morbidity and mortality.[12] In the present study, a total of 125 patients were received without traction/splintage, 112 without any intravenous fluids, 92 without any dose of analgesic, 84 without any previous mention of vitals recording, 130 without

Table 3
Patients given basic trauma care before presentation to emergency department.

Total patients referred from outside Chandigarh (n = 401)	
Open fractures	(n = 269)
Intravenous fluids	194
Splintage/traction	185
Analgesics	203
Vitals checked	219
Antibiotics	67
Dressing of the wound	139
Closed fractures	(n = 132)
I/V fluid	91
Splintage/traction	91
Analgesics	106
Vitals checked	98

any wound dressing for open wounds and 202 without any dose of intravenous antibiotics for open wounds. There is an urgent need to upgrade the pre hospital care emergency services, besides maintaining well-planned referral service criteria, to prevent over burdening of the tertiary care setups, especially during the time of pandemic.[5,11,13] Whereas developed countries have a well organised setup for providing pre hospital emergency care services, developing countries have for long lingered on with the inadequate pre hospital care services for several decades and hence not able to reduce morbidity and mortality related to trauma by providing swift and apposite pre-hospital care.[4–6,11] The basic care of the trauma patients including traction/splintage, wound dressing, recording of vitals at presentation, giving of intravenous fluids, antibiotics and analgesics at periphery healthcare centres was not done in a substantial number of trauma cases, received at our tertiary care centre. A provision of education for social care workers/junior healthcare workers in managing the emergency cases and in providing basic pre hospital care should be emphasized.

As reported in the previous literature, delay in presentation/delay in administration of antibiotics may lead to increased infection rates, further adding stress to the already saturated capacity of the hospital.[14,15] Further, with a high percentage of open fractures being the Gustilo Anderson grade 3 (34.80%), possibility of patients getting infected remains quite high, if wound debridement and administration of intravenous antibiotics is delayed.[16,17] Ketonis et al. and Schenker et al. in their respective studies have stated that there exists a correspondence between early administrations of intravenous antibiotics with diminished infection rates.[14,15] Delay in presentation to the hospital along with the delay in the administration of the intravenous antibiotic was observed in the present study. The lack of public transportation services, strict enforcement of lockdown, economic implications associated with the lockdown and conversion of healthcare centres to dedicated COVID centres, may have led to the possible delay in the presentation to the hospital. In a previous study by Gupta et al. similar observations were reported during lockdown period compared to the pre lockdown period, simulating the results of the present study.[18]

Conservative management in form of traction/splintage for closed fractures and debridement with traction/splintage for open grade 1 and 2 fractures, constituted the major form of treatment wherever possible, according to the evidence based medicine guidelines.[19,20] Managing fracture in a conservative way as described by Sir John Charnley in his monograph in 1950 which relies on 3 basic principles; namely, reduction of the fracture, holding the fracture reduced and keeping it reduced in a supported environment (such as a cast or splint) till the fracture heals.[21] Most of the upper limb injuries and the lower limb injuries below-knee can be managed conservatively and has shown good results in literature.[21] Sarmiento functional bracing techniques conservatively managed tibial fractures, Thomas splint for managing femoral shaft fractures as propagated by Sir Robert Jones during the World War II are some of the few examples where the conservative manner has shown good to excellent results.[21] Further, BOA and NHS in their revised guidelines have stressed on the use of conservative way of fracture management where possible and this can be applied to the paediatric trauma cases also.[19,20] In addition with use of conservative management, less aerosol generation is present secondary to less use of diathermy, drilling procedures and pulse lavage and thus less chances of getting infected in the enclosed spaces such as emergency operation theatres.[22,23]

With the COVID-19 cases rising again with each passing day in our country and another peak cannot be ruled out, along with an unparalleled global crisis, there is a need to constantly assess the orthopaedic surgical conditions at all levels and upgrade the necessary trauma care at all local, regional and national centres following the necessary evidence based medicine guidelines, so that the basic care is not compromised during these unprecedented times and the tertiary care setups are not over-compromised.[24] There is a constant need to keep the pace with increasing COVID cases, besides taking care that, the non COVID cases (trauma cases) are not compromised, preventing morbidities and mortalities. Because the peak of COVID-19 cases presented at different times in various countries around the world, much has been stated about the global community response to the virus in a short period of 6–8 weeks with a small number of cases and only few studies present long term observational research, in identifying epidemiologic factors and challenges amid response to the COVID-19 pandemic.[18] The present study will not only summarize the deficiencies and better understanding of COVID-19, but will also cater to the future outbreaks and timely actions need to be taken, to tackle these extraordinary situations in a more optimal way.

5. Author's suggestions

- Streamlining transportation services and better coordination among adjacent states before referrals between healthcare centres.
- Diversifying the healthcare resources in all periphery setups would help in integrating the basic emergency care before referrals to the nearby trauma care setups.
- A formal training of healthcare workers in application of splintage, aseptic dressings, vitals recording, intravenous antibiotics and fluids at primary and secondary health centres can help in upgrading the pre-hospital services, preventing morbidities and mortalities in trauma patients and will reduce burden on tertiary healthcare facilities.

- Managing fractures in a conservative way, education of the healthcare workers pertaining how to wear and remove personal protective equipment (PPE), wherever time permits COVID testing for all patients before surgery, minimum staff in the theatre, avoidance of aerosol generating procedures and diversifying use of telemedicine and online out-patient services is the need of the hour.[25,26]

6. Conclusion

Since the COVID-19 situation seems far from over, the pre-hospital trauma care will continue to be a challenge. However certain things like co-ordination between primary, secondary and tertiary health care level can be improved. Community level participation can be an effective measure to improve trauma care. Further, educating and boosting people for community level contributions without breaking COVID-19 protocols should be encouraged.

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Ethical approval

Institutional ethical committee approval was taken before the start of research.

Ethical review committee statement

This study was conducted as per Ethical guidelines for biomedical research on human subject as given in "Declaration of Helsinki" and by Central Ethics Committee on Human Research of ICMR, New Delhi. A written and informed consent was taken from all. The interventions involved in this study were completely safe. Patients were given right to opt out of study at any time they want, without any impact on treatment being given to them.

A statement of the location

This study was conducted among the patients coming to Department of Orthopaedics of GMCH-32, Chandigarh.

CRediT authorship contribution statement

Ashwani Soni: was the conceptualized the study. **Sudhir Kumar Garg:** and. **Ravi Gupta:** MD did the review of literature. **Parmanand Gupta:** wrote the manuscript. **Rajeev Kansay:** did the proof reading. **Akash Singhal:** did the editing of the manuscript.

Declaration of competing interest

No conflict of interest for any author.

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