A descriptive study of hand injuries presenting to the adult emergency department of a tertiary care center in urban India

Murtuza N. Ghiya, Shakuntala Murty, Naren Shetty, Rodney D’Cunha

Departments of Emergency Medicine and Plastic Surgery, St. John’s Medical College, Bengaluru, Karnataka, India

ABSTRACT

Background: Despite having a dedicated Plastic Surgery Unit, emergency physicians (EPs) manage many of the acute, traumatic hand injuries. Further very minimal information exists about the extent to which tetanus recommendations as per Advisory Committee on Immunization Practices are followed in emergency departments (EDs). Furthermore, the management of pain is often neglected. Objectives: To provide a clinical description of hand injuries with etiology and mechanism; and describe the trends of ED management, including analgesia and tetanus prophylaxis. Methodology: Records of eighty patients with hand injuries were reviewed. SPSS version 18 was used for statistical analysis. Wilcoxon signed rank test, and Pearson Chi-square test were used to compare left with right-hand injuries and validate associations, respectively. Results: The mean age of the patients was 27.41 years and median delay in presentation was 2 h. Occupational injury was the predominant mode of injury (74%) most patients (59 of the 86) received intravenous analgesia; while very few (6) received local anesthesia and (24) received no analgesia at all. A majority of patients (56) received tetanus toxoid prophylaxis, while only four patients (4.6%) also received tetanus immunoglobulin intramuscular. Most patients (71%) were admitted, while only a small number of patients (14%) were discharged from the ED. Conclusion: Proper training and sensitization towards the need and technique of anesthesia (particularly local anesthesia) would improve the quality of patient care. Hand injuries could be managed better by the EP, with training through rotations to the Plastic Surgery Unit.

Key Words: Analgesia, emergency department, hand injuries, tetanus prophylaxis

INTRODUCTION

Studies in the emergency room showed that hand injuries comprise up to 10% of the visits and range from simple lacerations or finger sprains to mutilating injuries or amputations. The human hand is extremely complex and often difficult to understand.

Therefore, an entire subspecialty of training is dedicated to the hand. However, emergency physicians (EPs) and primary care providers manage most of the acute, traumatic hand injuries either for a brief period before the patient is taken over by the hand surgeon or the definitive treatment and discharge.

Managing emergent hand conditions encompasses correctly identifying and treating such injuries, which can be difficult
Many patients seeking wound care have not received adequate tetanus immunizations in the emergency. In this circumstance, tetanus can be potentially prevented by episodic administration of tetanus toxoid either alone or with tetanus immunoglobulin, as dictated by recommendations of the Advisory Committee on Immunization Practices (ACIP). However, very minimal information exists about the extent to which these recommendations are followed in ED practice.[8] Further, the management of pain is often neglected and overlooked. Even if analgesia is administered, it is unlikely to have been sufficient. It is, thus, the responsibility of the attending doctor to relieve patients of the pain, even before considering definitive management.[9]

Emergency medicine-based trials are sparse regarding the ED management of hand injuries. Hence, our over-reliance on the expert opinion. One must understand that specialty consultation may sometimes be delayed for days or weeks, more so in a resource-limited setting like ours. The EP must then take appropriate first aid measures and definitive plans awaiting consults.

Emergency medicine is a new field in our country, and every physician should be trained in the assessment and management of emergencies including trauma. The evaluation of hand injuries needs specialized training and practice. However, a study done to describe the diagnostic errors occurring in district general hospital accident and EDs in England over 4 years showed 953 diagnostic errors in 934 patients.[8] Very few Indian studies have described hand injuries, specifically in detail; one such is that by Mathur and Sharma.[9] Hence, this study would go hand in hand with the aforementioned study in building national data regarding hand injuries. Moreover, this would help create data regarding the ED presentation and management of hand injuries that is presently lacking in our country, which would further help improve ED first aid management including the often neglected analgesia for hand injuries. The stronger randomized, controlled studies that exist on hand injuries focus on their operative or rehabilitative aspects and are found in the hand surgery or occupational therapy literature. Very few studies describe the emergency presentation and management of these injuries, which includes early wound care, tetanus prophylaxis, and adequate analgesia.[9]

A systematic study of hand injuries presenting to the ED would be useful to know the extent of the presentation and the disposition of patients from the ED. Many minor hand injuries present to the ED, some of which can be assessed and treated by the EPs without the need for surgical specialist intervention. This study would help to know the presentation of such injuries.

Objectives of the study

a. To provide a clinical description of hand injuries presenting to the Emergency Medicine Department including the etiology and mechanism of injuries
b. To describe the trends of ED management, including analgesia, and tetanus prophylaxis.

METHODOLOGY

Source of data

This was a hospital based study done in the ED of a tertiary hospital in Bengaluru, India. The subjects who consented for the study were taken. The ED details were obtained from the medicolegal cases register, and the hand exam notes were recorded. This study was approved by the Institutional Ethical Review Board.

Duration of study

January 2013–April 2014.

Inclusion criteria

a. Age >15 years
b. Consenting adults
c. Hand injuries, i.e., injuries distal to the carpus.

Exclusion criteria

a. Preexisting deformity of the same hand
b. Fractures and neurovascular injuries involving any other parts of the upper or lower limb
c. Any other life-threatening injury
d. Thermal, chemical, or electrical burns to the hand
e. Injuries with surgical intervention already performed in another hospital before arriving at our ED
f. Pregnancy.

Study type

Descriptive study.

Sample size

To the best of our knowledge, no similar studies have been done in the ED in India and hence the incidence of hand injuries is not known: A pilot study of 37 hand injuries during 2 months showed that the major place of occurrence was workplace and this accounted for approximately 68% of the hand injuries. We chose to consider this parameter for sample size calculation as this was the most common place of occurrence. Hence, to estimate a similar proportion of workplace related hand injuries with 15% precision and 95% confidence interval (CI), eighty hand injury cases should be considered for the study [Table 1].

| Confidence level (%) | Sample size (n) |
|----------------------|----------------|
| 90                   | 56             |
| 95                   | 80             |
| 99                   | 339            |

Table 1: Sample size calculation
Sampling method used
Convenient sampling.

Statistical test
The characteristics of the injury will be described using proportions (for categorical variables) and using mean ± standard deviation (SD) (for continuous variables). 95% CI for all important characteristics will also be provided. SPSS version 18 was used for statistical analysis (SPSS Inc. Released 2009. PASW Statistics for Windows, Chicago). Wilcoxon signed rank test was used to compare left-hand and right-hand injuries. Pearson Chi-square test was used to validate associations between two independent variables. MS Excel was used to construct charts.

Method of collection of data
Consecutive eighty records of patients with hand injuries, satisfying the inclusion criteria (starting from January 2013), who presented to the ED were included in the study, till the required sample size was achieved. Their demographic data and details of injury along with the ED management with detailed clinical and radiological examination from plastic surgery resident’s notes of the same (documented during ED assessment) were noted. All data were recorded on a pro forma.

The pro forma was prepared borrowing key aspects from the EM practice guidelines. It was further modified after review from an expert hand surgeon [Annexure 1].

RESULTS

Age and gender distribution of patients studied
- The mean age of the patients studied was 27.41 years (SD - 9.163 years)
- The range of age of the patients was between 16 and 65 years
- While most patients were male (78), only eight were female.

Delay in presentation
The mean delay in presentation was 2.9 h (95% CI) = 2.9 (2.3, 2.5). The earliest presentation to the ED was at 15 min after injury, while the latest presentation was at 19 h postinjury.

Mode of occurrence of injury
Occupational injury was the predominant mode of injury (64 cases). The others included two cases of assault [Chart 1].

Mechanism of injury
The most common mechanism of injury was isolated crushing injury (51.44%), while the next most common injury was cutting-crushing (23.2%). The combination of crushing with avulsion; fall on outstretched hand with a cutting-crushing were seen in only singular cases. The remaining combination of mechanisms (other than those mentioned in the piechart) was not seen during the study [Chart 2].

Analgesia
Most patients (69%) received intravenous (IV) analgesia in some form either nonsteroidal anti-inflammatory drug (NSAIDs) or opioids percentage (95% CI) = 69 (59, 79). While most patients (72%) received analgesia in some form (95% CI) = 72 (62, 82). A significant percentage (27%) received no analgesia at all [Chart 3].

Tetanus prophylaxis
A majority of patients (65%) received tetanus toxoid prophylaxis (95% CI) = 65 (55, 75). In addition, only four patients (4.6%) also received tetanus immunoglobulin intramuscular. Further, 53.5% had both TT and analgesia. There is an association between TT and analgesia, \( P = 0.005 \).

Disposition
Most patients (71%) were admitted either in the plastic surgery ward or the day care facility. Only a small number of patients (14%) were discharged from the ED [Chart 4].

Hand examination
Of the total sample of 86 patients, the hand examination records of five patients were not traceable. Hence, the analysis of this section was done on only 81 patients.

Handedness - 61% of the patients were right-hand dominant, while in the remaining 39% dominance was not mentioned. There were no patients with left-hand dominance.

Calculations were done for the left and right hand separately and later a combined calculation for both hands was done.

Vascularity
Only 11 patients had doubtful or compromised vascularity. The remaining had adequate vascularity.

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![Chart 1: Mode/place of occurrence](image)
DISCUSSION

Demographics
In similar studies describing hand injuries, the mean age was 27–31 years.\textsuperscript{[7,8]} The male to female ratio was 2.2:1.\textsuperscript{[8,9]} Even in our study, we found a similar presentation as the mean age of the patients studied was 27.41 years. However, the ratio in our study was 9.75:1 this may be due to cultural and/or employment differences.

Nearly, half of the hand injury patients presented within 2 h of injury.\textsuperscript{[8]} In this study, the mean delay in presentation was 2.9 h. This could be attributed to the fact that our environmental management system is still in the early stages of development.

Mode/place of occurrence
The higher incidence of workplace injuries in our study is probably due to exclusion of sports related injuries (which contributed to 15% of cases of Hill \textit{et al}.\textsuperscript{[8]} Further, the location [Table 2] of our hospital, where small industries and hotels are abundant, may also have contributed to the above findings.

Mechanism of injury
Since Ozcelik \textit{et al.} focused only on occupational injuries, and our study included road traffic accidents in addition to occupational injuries, we mentioned an additional mechanism of injury as fall on an outstretched hand (17.5%) [Table 3].\textsuperscript{[10]}

Another study\textsuperscript{[9]} describing hand and wrist injuries reported fall on hand as 15%, cutting-penetrating 16%, and crushing 17%. However, they also reported 15% as sports related injury which was excluded from our study.

Tetanus
A study by Talan \textit{et al}.\textsuperscript{[3]} describing Physician Compliance with Tetanus Prophylaxis Practices showed that overall, 60.9% of patients required tetanus immunization, of which 57.6% did not receive indicated immunization. In our study, we found that the prior state of immunization and degree of contamination was not mentioned for any of our patients. However, 65% received tetanus toxoid prophylaxis while 4.6% received tetanus immunoglobulin. Since tetanus IG has a risk of anaphylaxis and serum sickness and is very expensive, we profiled the four patients who received it [Table 4].

- The points of concern with our limited information are
- One patient was administered IG despite having closed injuries
- Two patients did not receive concurrent tetanus toxoid
- The delay in presentation did not appear to be of any significance in making a decision for IG administration.

This is probably because the arbitrary time of significance
mentioned by ACIP is 6 h before surgical intervention. Most cases are likely to have this delay due to logistic reasons.

**Analgesia**

Goodacre and Roden[11] showed that 39% of admissions received no analgesia while in the A and E department; in contrast, our study showed 69% patients received some form of analgesia—IV diclofenac/opioids or local anesthesia.

In our study, we noticed that all of the 54% that received NSAIDs got diclofenac, despite ketorolac being the drug of choice, and being available in our ED. Further, only a small percentage of patients received narcotics (16.3%) and local anesthesia (4%) despite them being more effective than NSAIDs in traumatic pain.[11] While the reasons for the underutilization of local anesthesia may be due to lack of practice and possibility of altering sensory exam findings awaiting a plastic surgical consult, the reason for underutilization of narcotics was probably due to undue fear of adverse effects. Further, it was noticed that 53.5% patients had received both TT and analgesia and there was a positive association between the two, \( P = 0.005 \). Perhaps patients were being given either both these injections or neither, depending on whether they had open wounds or not. This probably means those having close wounds did not receive due analgesia apart from the TT which was anyway not indicated.

**Disposition**

As per Hill et al.[8] over half the patients needed only reassurance or a simple dressing but 5% had to be admitted for surgery. Fifty-three percent patients were intended for day-care surgery, which was comparable to a previously observed rate of 60% from another established unit.[9] In our study, the overall admission rate was 71%, of which day care admission rate was 38.40%. However, our discharge rate was a mere 14%. This is probably due to a preference for admissions even for smaller injuries for various logistic reasons and the lack of confidence on the plastic surgeon’s part to rely entirely on the EPs evaluation, since it is a budding specialty.

Of the discharged patients six had digital or palmar lacerations with no evidence of neurovascular deficit or tendon injuries.

Three had simple closed digital fractures while one had a simple closed metacarpal fracture.

One patient had a complete amputation at the proximal interphalangeal level (discharged at request), and one had hand exam records missing.

**Hand examination**

Right and left hands were injured with similar frequency, 51.8% and 45.4% respectively.[8] Even in our study, we obtained similar results, right hand - 39%, left hand - 36%, combined - 11%. The number of right and left side injuries were comparable, \( P = 0.892 \) [Table 5].

The aforementioned study had a lesser incidence of lacerations, amputations, and fractures probably because they also included wrist injuries which had a predominance for contusions more than penetrating or crushing injuries [Table 6].

A study by Tayal et al.[12] on hand fractures showed that 32% were phalangeal fractures and 68% were metacarpal fractures. Our study showed similar results, with 26% of the former and 74% of the latter.

The incidence of significant nerve or tendon injury is low, accounting for approximately 0.6%–6% of all hand wounds and nail injury 4.4%.[13] We, however, report a higher rate of

### Table 2: Comparison of mode/place of occurrence

|                | Hill et al.[8] | Our study |
|----------------|----------------|-----------|
| Work place (%) | 25             | 74        |
| Domestic (%)   | 15             | 7         |
| Road traffic accident/fall on hand (%) | 10 | 16 |

### Table 3: Comparison of mechanisms of injury

|                | Ozçelik et al.[14] | Our study |
|----------------|---------------------|-----------|
| Crushing       | 40.23               | 57.44     |
| Cutting-crushing | 23.49             | 23.2      |
| Cutting-penetrating | 21.52            | 20.7      |
| Avulsion       | 0.87                | 4         |

### Table 4: Profile of patients receiving tetanus Immunoglobulin

| Injury type        | Open injury | Tetanus toxoid co-administered | Delay in presentation (h) |
|--------------------|-------------|---------------------------------|--------------------------|
| Patient 1           | No          | Yes                             | 0.75                     |
| Digital fracture    |             |                                 |                          |
| Patient 2           | Yes         | Yes                             | 3                        |
| Multiple laceration, dislocations |             |                                 |                          |
| Patient 3           | Yes         | No                              | 3.5                      |
| Digital fracture    |             |                                 |                          |
| Patient 4           | Yes         | No                              | 1.5                      |
| Palmar laceration, metacarpal fracture |             |                                 |                          |

### Table 5: Incidence of injuries

|                | Right | Left | Both | None |
|----------------|-------|------|------|------|
| Amputation     | 11.6  | 11.6 | 0    | 76.7 |
| Laceration     | 20.9  | 22.1 | 1.2  | 55.8 |
| Fracture       | 15.1  | 12.8 | 2.3  | 69.8 |
| Dislocation    | 1.2   | 3.5  | 0    | 95.3 |
| Tendon         | 9.3   | 3.5  | 1.2  | 86   |
| Nerve          | 3.5   | 0    | 0    | 96.5 |
| Fingertip      | 11.6  | 8.1  | 1.2  | 79.1 |

### Table 6: Comparison of injuries

|                | Hill et al.[8] | Our study |
|----------------|----------------|-----------|
| Amputation (%) | 2              | 23.2      |
| Cut-lacerations (%) | 30      | 42        |
| Fractures (%)   | 14             | 24.2      |
14.5% for the former and 16% for the latter, possibly due to higher incidence of penetrating injuries at the workplace, and our exclusion of sports injuries which had lesser penetrating injuries and hence lesser nerve or tendon involvement.

**Limitations**
1. Inadequate details about tetanus prophylaxis and analgesia due to incomplete documentation
2. Convenience sampling was used as sports injuries were excluded (since they were excluded from the medicolegal register)
3. Follow-up of patients was not done. Hence, the outcome of the ED management and disposition decisions could not be measured.

**Scope for future research**
More robust, multicentric, prospective ED studies of hand injuries including sports injuries could help EPs manage hand injuries better.

**CONCLUSION**
1. The most common mechanism of injury was crush, and most common place of occurrence of hand injuries was found to be at the workplace (occupational injuries), implying greater need for more stringent safety measures for workers
2. The ED management of pain for hand trauma was found to be grossly inadequate, more so with respect to local anesthesia. Proper training and sensitization towards the need and technique of the same would help in reducing unnecessary suffering and promoting better examination and wound care
3. The ED documentation of tetanus prophylaxis was also found to be inadequate; while the adherence to the protocol (ACIP) was also found to be poor. Printed guidelines and periodic review of the charts would help to overcome these issues
4. Most patients were admitted for inpatient surgical management by the on-call plastic surgeon. Some of these injuries could be managed in the ED by the EP with or without the help of a plastic surgeon. This could be achieved by rotation of the emergency medicine residents to the Plastic Surgery Unit and improvement in training, particularly with regard to the specific hand injuries which could be managed in the ED and disposed of by the EP.

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**Conflicts of interest**
There are no conflicts of interest.

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ANNEXURE

Annexure 1: Proforma
MLC reg no - Sl. No -
Name - Age - Sex - M/F
Arrival date - Arrival time - am/pm
Date of accident - Time of accident - am/pm
Op/Ip number - Contact number -
Type of accident - road traffic related/domestic/sports related/occupational/others_____________
Specify_____________________
Any other injuries - Specify_____________________

Management in ED
Local Analgesia - yes/no Narcotic analgesia - yes/no
Tetanus toxoid given - yes/no Tetanus IG given - yes/no
Sutured in the ED - yes/no NSAIDs - yes/no

Description of hand injury
• Hand dominance- left/right
• Table – next page.

Disposition
Discharge/admission to short stay/admission to plastic surgery ward/DAMA/referred to another hospital.

| Type of injury                  | Right digits | Left digits |
|---------------------------------|--------------|-------------|
|                                 | 1 2 3 4 5    | 1 2 3 4 5   |
| Amputation                      |              |             |
| Partial                         |              |             |
| Complete                        |              |             |
| Level                           |              |             |
| Laceration                      |              |             |
| Palmar laceration               |              |             |
| Fracture                        |              |             |
| Open                            |              |             |
| Closed                          |              |             |
| Simple                          |              |             |
| Comminuted                      |              |             |
| MC/PP/MP/DP                     |              |             |
| Dislocation                     |              |             |
| Open/closed                     |              |             |
| MCP/PIP/DIP                     |              |             |
| Muscle/tendon                   |              |             |
| Extensor tendon                 |              |             |
| FDP                             |              |             |
| FDS                             |              |             |
| Thenar                          |              |             |
| Hypothenar                      |              |             |
| Ligament injury                 |              |             |
| Digital nerve injury            |              |             |
| Fingertip injury                |              |             |
| Nail damage                     |              |             |
| Bone injury                     |              |             |
| Pulp injury                     |              |             |
| Digital vascularity             |              |             |
| Adequate/doubtful/compromised   |              |             |