Original Article

Implementation of Upper Extremity Trauma Registry: A Pilot Study

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ABSTRACT

Background: Hand traumas are common in young men and their complications can have negative effects on their occupation and economic activities. On the other hand, most of the hand injuries are related to occupation accidents and thus necessitates preventive measures. The goal of a clinical registry is assisting epidemiologic surveys, quality improvement preventions.

Methods: This article explains the first phase of implementing a registry for upper extremity trauma. This phase includes recording of demographic data of patients. A questionnaire was designed. Contents include patients' characteristics, pattern of injury and past medical history in a minimal data set checklist. This questionnaire was filled in the emergency room by general practitioners. For 2 months the data were collected in paper based manner, then problems and obstacles were evaluated and corrected. During this period a web based software was designed. The registry was then ran for another 4 months using web based software.

Results: From 6.11.2019 to 5.3.2020, 1675 patients were recorded in the registry. Random check of recorded data suggests that accuracy of records was about 95.5%. Most of the missing data was related to associated injuries and job experience. Some mechanisms of injury seems to be related to Iran community and thus warrants special attention for preventive activities.

Conclusion: With a special registry personnel and supervision of plastic surgery faculties, an accurate record of data of upper extremity trauma is possible. The patterns of injury were remarkable and can be used for investigations and policy making for prevention.

KEYWORDS
Registries, Hand Trauma, Occupational accidents, Amputation

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INTRODUCTION

Clinical registry is defined as a data bank, recording patients' medical information based on previously defined checklists which recruits all defined population in a census. Nowadays, registries form the fundamental basis of clinical research [1]. Web-based registry facilitates quick and reliable access with minimal error. Due to high prevalence of trauma patients managed at tertiary hospitals, implementing a trauma

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registry is recognized as an important health policy, particularly in developing countries [2,3].

Although trauma registry systems may seem expensive, if the information input stays sustainable, these can revolutionise healthcare management and resources allocations. Therefore, it would ultimately result in cost-effective outcomes within the organisation as well as the society[2]. Establishing trauma registry systems would result in improvements in healthcare provision as well as healthcare policy making and preventive measures. An important example of trauma registry systems in developing countries was developed in a large teaching hospital in Nigeria. The registry system was designed relatively inexpensively and reorganised the trauma management systems[3,4,5]. Upper limb trauma is among the most common injuries encountered in emergency departments which is managed at a limited number of specialist centers. It is more prevalent amongst young men and its disabling complications may lead to detrimental personal and social impacts on occupational performance of the individuals affected[4,5]. There is an excessive need to perform multiple reconstructions in non-acute stages which may result in significant financial burden on the health system. It is notable that occupational injuries account for the majority of upper limb injuries which necessitates preventive measures. Lack of adherence to safety advice is a major cause of trauma. Being aware of the local patterns of injuries would highlight the deficiencies in the workplace safety regulations[6,7].

Despite admission and treatment of a varied group of patients with upper limb trauma in our center, research studies focusing on hand injuries were faced with challenges in recruiting the target study population and attaining their basic information and medical background such as the need to extract the data manually from hospital archives which is both time consuming and prone to errors.

It is essential to record patients' information accurately in order to investigate mechanisms, patterns and causes of injuries as well as identify high risk machines and at-risk population. Collecting data on anatomical features of the injuries and history of patients may be helpful in designing preventive strategies and facilitating qualitative assessments. For example, medications, addictions and occupational characteristics should be recorded. Although there are some limited trauma data banks existing in Iran, there is no exclusive registry system available to record upper limb trauma. Hand trauma registry systems are already employed in many hand reconstruction surgery centers worldwide and endemic patterns of injuries are identified in order to design preventive strategies and allocate required resources [2-9]. Hence, there is a need to establish similar programs in Iran as well.

The aims of establishing a trauma registry program were to outline a clinical data bank evaluating epidemiological information of patients, facilitating clinical research studies and qualitative assessment of patient care.

METHODS

The present study is a pilot of implementing a registry system to record patients' information in addition to causes and mechanisms of upper limb injuries at Hazrate fatemeh Hospital Tehran, Iran. The ethics code is: IR.IUMS.FMD.REC.1398.538.

Based on previous studies on trauma registries, and after reviewing the literature a questionnaire was prepared in form of a checklist initially which recorded basic information of patients including characteristics of trauma, history of patients, and injury caused by the trauma in form of a minimal dataset[3-12]. The questionnaires were approved by a team of hand surgeons, physiotherapist and hand therapist. The questionnaires were full-filled by the duty physician in the emergency department. Then, the data was evaluated on a daily basis by the designated registry personnel to monitor and sort out any missing data. Researchers randomly checked the collected data in order to monitor accuracy of the registry.

These data were recorded in paper-format for 2 months and an assessment of barriers was conducted and these barriers were adjusted. In the duration of the study, a web-based program was designed and conducted as a pilot study for another 4 months to evaluate the challenges. The web based data collected was presented in Microsoft Excel software. The check list includes:

Age
Sex
Marital status
The referral origin
Date of injury

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Presence of active bleeding
Associated injuries
The anatomic site of injury
The dominant hand
The scene of the accident
The cause of accident: which includes: accidental, occupational, self harm, violence
Type of job
Type of tool causing the injury
Years of job experience
Drug abuse
Past medical history
Medications

RESULTS

From 6.11.2019 to 5.3.2020, 1675 patients were enrolled into the registry system in 4 months. According to ED office, the number of patients admitted urgently to ED with upper limb trauma was 1753. Therefore, it is concluded that about 95.5% of patients were recruited in the registry system.
Sixteen items were included in the checklist used for the registered patients. Overall, documents of 220 patients were randomly selected by researchers to re-assess with the registry staff in order to ensure the quality is maintained on a weekly basis. Hence, 3520 items were re-evaluated in total. Out of this figure, only 2746 items were recorded by the ED physician. Therefore, the accuracy of recording items of the registry by physicians was 78%. Then, following re-evaluation by the registry staff, this figure increased to 3418 (97.1%). Most of the missing data was related to three items: associated injuries, job experience and active bleeding.
Out of a total of 1675 patients, 198 (11.8%) patients were female and 1477 (88.2%) patients were male. The male to female ratio was 7.45: 1. The mean patients' age was 32± 9years.
Distribution of injury in different age groups is as follows:

Group 1: under 18 (12.9%)
Group 2: 18-35 (52.2%)
Group 3: 35-60 (32.1%)
Group 4: over 60 (2.7%)

Based on our results, 894 (53.4%) patients were married and 46.8% of them were single. Active bleeding was only reported in 5.1% of injuries. Amputation was reported in 403 (24.1%) patients. One thousands and four patients (59.9%) were injured at workplace, 467 (27.9%) patients were injured at home and 200 (12%) patients were injured in other places including gym, school and etc.
Self-harm was noted in 73 patients (4.4%), harm

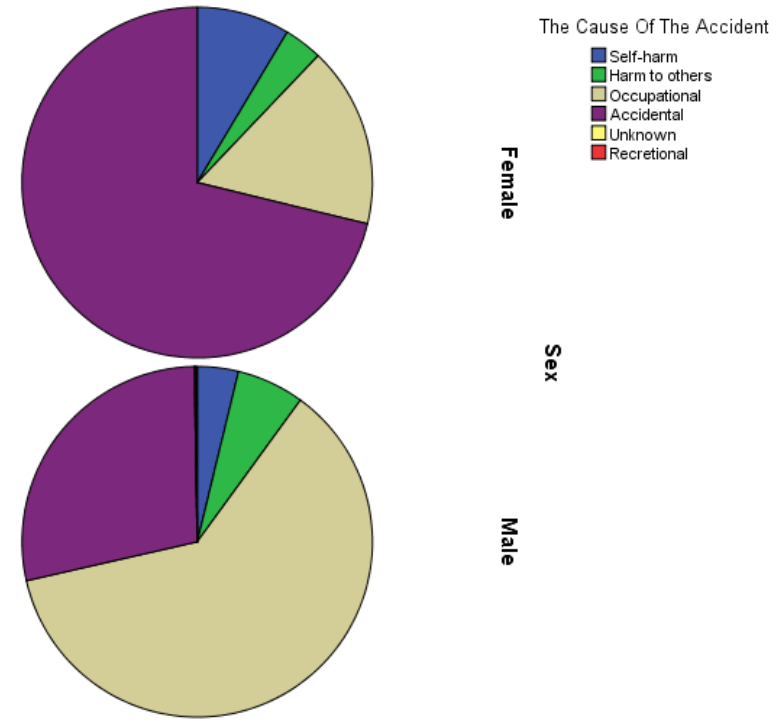


Figure 1: Causes of injuries in different sexes

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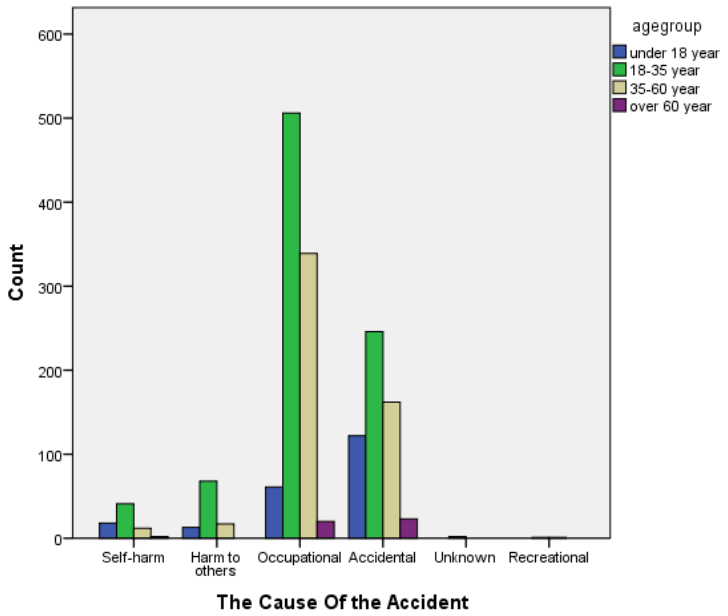


Figure 2: Distribution of age groups based on various causes of injury

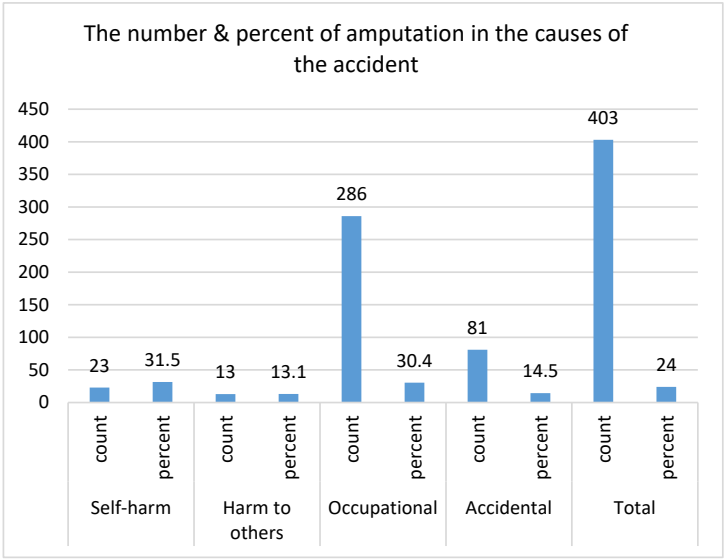


Figure 3: Rate of amputation in different causes

to others in 99 patients (5.9%), occupational injury in 940 patients (56.1%), accidental injury in 559 (33.4%) patients and cause of injury was unknown in 4 patients (0.2%).

Distribution of causes of injuries by sex is shown in Figure 1. In males, the most common cause of injuries were occupational injuries and in females it was accidental injuries. There was a significant difference between males and females regarding cause of injury (*P* value < 0.001)

The mean age in the group with occupational injury was 34.29 which was significantly greater than this figure amongst patients with injuries due to self-harm (27.3), harm to others (28.22) and accidental (31.1) (*P* value< 0.01).

In Figure 2, the cause of the injury according to the 4 age groups has been demonstrated.

The majority of patients in age group 1 and 4 suffered from an accidental injury, while the majority of patients in group 2 and 3 suffered from an occupational injury. Distribution of age groups based on the cause of the injury was significantly different (*P*<0.001)

As previously stated, 403 (24.1%) patients had an

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amputation of some parts of the upper limb. The incidence of amputation in various age groups was as follows (*P*: 0.21):

1st group (under 18 years old): 42 patients (10.62% of all amputated cases)

2nd group (18-35 years old): 202 patients (50.9% of all amputated cases)

3rd group (35-60 years old): 141 patients (35.5% of all amputated cases)

4th group (over 60 years old): 12 patients (3% of all amputated cases)

Incidence of amputation in the 1st age group (under 18 years old) was 19.62% , which was the lowest incidence among all 4 age groups. In the 2nd, 3rd and 4th age group, this figure was 23.3%, 26.55% and 26.66%, respectively (Figure 3).

Thirty-four females (8.4 % of all cases of amputation) and 369 males (91.6% of all cases of amputation) suffered partial amputation. The incidence of amputation amongst males was 24.98% and in females was 17.17% (*P*:0.016).

The greatest risk of amputation was observed in self-harm injuries and then occupational injuries (30.4%). While, accidental injuries led to amputation in only 14.5% of cases (Figure 3).

In occupational injuries, the risk of amputation was 47.2% (17 out of 36 patients). Here we mention incidence of occupational injury amputation in different age groups: (*P* value: 0.08).

1st group (under 18 years old): 47.2%

2nd group (18-35 years old) and 3rd group (35-60 years old):29.4%

4th group (over 60 years old):40%

Thursdays, Fridays and other official holidays were taken into account in this study. Four hundred and eight (24.4%) patients suffered an injury during holidays, while 1267 (75.6%) patients suffered an injury during working days.

The cause of hand trauma was significantly different in working days and holidays. 45.2% of self-harm, 33.3% of cases of harm to others and 30.2% of accidental injuries occurred in holidays. Whereas, only 18.3% of occupational injuries occurred during holidays (*P*< 0.001). Analysis of various occupations showed a significant difference in terms of incidence in holidays (*P*<0,001).

The occupations bellow were active more often during holidays:

Carpentry, Construction labor, Press machine, Milling

Daily hours:

The period of 24 hours was divided into three groups:

Group 1: 6 am to 12 noon

Group 2: 1 pm to 9 pm

Group 3: 9 pm to 5 am

Overall, 564 patients (33.7%) were injured in the morning (6-12 am). Eight hundred and fifty one patients (50.8%) were injured in the afternoon (1pm to 9 pm) and 190 patients (11.3%) suffered a trauma after 9 pm.

The time distribution of injuries was significantly different regarding the cause of injury (*P*< 0.001). Three hundred eighty two42.7%) patients with occupational injuries suffered the injury in the morning. This was 25.4%, 15.6% and 27.3% amongst those admitted due to self-harm, harming to others and accidental injuries which occurred in the morning, respectively.

The dominant hand**:**

One hundred and thirty three patients (7.9%) were left-handed and 1542 patients (92.1%) were right handed. The likelihood of dominant hand injury was significantly higher in left-handed patients (65.2% vs 50.4%) (*P*: 0.001). Bilateral injury was not observed in left-handed patients. Twenty-two right handed patients (1.4%) suffered bilateral injury. Amputation was significantly more common among those with a dominant hand injury compared to those with a non-dominant hand injury (27.2% vs 20.4%) (*P*: 0.001).

Addiction

Patients were also assessed in terms of drug addiction. Smoking and vape use were reported separately. Use of other drugs of abuse as well as alcohol were reported separately.

Sixty seven patients (4%) consumed alcohol, 673 patients (40%) were smoking, and 93 patients (5.6%) were using other drugs of abuse.

The most common tools of injury in occupational injuries include:

Press machine, milling machine, powered saw, heavy objects and elevators.

In occupational injuries, 477 (57.7%) patients suffered of left hand injury and 455 (48.4%) suffered

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from right hand injury and 8(0.9%) patients had bilateral injury thus most of the injuries happened in non-dominant hand when injury was occupational. Injuries were also recorded based on the anatomical region of the hand. There was a possibility that a patient was injured in more than one area. In total, there were 590 (62.8%) lacerations on palmar aspect, 312 (33.2%) lacerations on dorsal aspect and 38 (4%) lacerations on both aspects.

The degree of injury in various anatomical regions was as follows:
Digit 1 : 222 patients (23.6%)
Digit 2: 378 patients (40.2%)
Digit 3: 297 patients (31.6%)
Digit 4: 222 patients (23.6%)
Digit 5: 135 patients (14.4%)
Palm or dorsum of hand: 298 patients (31.7%)
Wrist: 20 patients (2.1%)
Elbow: 39 (4.1%)

DISCUSSION

Recruiting over 95% of patients reflects the high degree of accuracy of the recruitment to the registry system. This recruitment strategy was implemented with minimum cost and input of only 1 trained registry staff starting work at 7:30 in the morning until the end of registering all patients admitted to 3 inpatient wards and an intensive care unit (ICU). There is a possibility to increase the number of registry staff in order to ensure more patients are recruited. The accuracy of recruitment by trained registry staff, highlights the importance of their presence in a successful registry project.
In a study in Canada which discussed the causes of failure and success of trauma registries, one of the main causes of failure to recruit patients was asking the clinical staff to do it[10]. Based on this study, although it is cheaper to ask the clinical staff to register patients, but clinicians may fail to register patients accurately due to the significant amount of clinical workload they are normally dealing with. Therefore, it is strongly advised to employ trained registry staff for doing this job. Unfortunately, this is the case in most developing countries. In Netherland the accuracy of multicentre registered data was 88%[5]. Since our study was in single centre we had a higher accuracy.
It seems that the patterns of upper extremity injury vary significantly in different societies [11-20]. Higher incidence of injury in men has been found in many other studies[10-18]. Social activities of women could slightly change this gender distribution. In Emirate, 93% of injuries happened in men[4]. This was 87% in a large study in United States [13].
Most of the upper extremity injuries in the studied population is related to occupational injury. Another study in Iran also had the same results[21]. Panagopoulou and colleague in Poland found that 45% of hand injuries were job related and mostly related to carpenters [22]. In Yazd (central Iran) most of the occupational injuries were related to tile industry[23]. Accidental injury was the second most injury in our study which can be seen in many other studies. However, in Mexico homicidal injuries was the most common cause of hand injury secondary to occupational injuries[8].
The common cause of injury in children and elderly seems to be accidental, which might be related to their higher vulnerability and may need preventive measures. Suicidal and homicidal injuries is much higher in young patients.
Most of the injuries in holidays was related to age group from 18 to 35-year-old. This might be related to their dangerous amusement activities in holidays also higher alcohol and drug abuse. Most of the injuries in holiday was accidental. In a large study in China, the occupational injury was still dominant in holidays[24]. Most of these injuries were related to construction laborers, who are active all days of the week. As we mentioned there are some jobs that are active in holidays in Iran and thus are still prone to injury.
In our study we found that in elderly there was a higher incidence of limb amputation. This might be due to decrease in concentration in this age group. However, in occupational injuries we noticed that both extreme of age was vulnerable to amputation. Inexperience and lack of concentration might be the main factors in occupational injuries amputation. Young patient who were inexperience had the highest amputation in occupational injury group[24]. Accidental injuries usually happen with non-powered tools which rationalize the lower incidence of amputation in this group.
The rate and causes of amputation are highly variable among different societies. In Greece carpentry [21], in china constructions[24] and in United States, agriculture and fishing[25] was mostly related

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to amputation injuries.
Unfortunately, we found a high incidence of smoking in our population. Smoking not only cause lack of concentration, but can decrease the success of replantation surgeries.
The high incidence of press machine and Milling machine injuries was not found in any other study; it may be related to low safety standards in these industry in Iran. The injury of dominant hand is usually related to machines which are fixed to a site like press machine and elevators.

CONCLUSION

The pattern of injury is variable among different societies with different culture and economy. This highlights the importance of epidemiologic studies in Iran to find safety defects and programming for health policy makers. It seems that an accurate data registry can be implemented with low cost in our hospitals.

CONFLICT OF INTERESTS

None

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