



Investigation of Undiagnosed Injuries in Patients With Multiple Trauma Referred to the Northwest Emergency Center of Iran

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Abstract

Objectives: Failure to diagnose some injuries in patients with multiple trauma referring to the emergency room can lead to problems and disabilities. Thus, it is necessary to be aware of these cases. In this respect, this study was conducted to investigate undiagnosed injuries in patients with multiple trauma who referred to the Northwest Emergency Center of Iran.

Materials and Methods: This descriptive-analytical study was conducted in Imam Reza hospital in Tabriz with the participation of 1000 patients by random sampling during 2019. Demographic data and data related to trauma (during hospitalization and after discharge) were obtained from patients' medical records. Finally, data were analyzed in SPSS (version 20) using χ^2 and logistic regression tests.

Results: The type of the accident was significantly associated with damage to the central nervous system (CNS) and the musculoskeletal system ($P=0.001$ and $P=0.003$, respectively). Based on the evaluation of patients who came for examination for the second time, it was observed that 22.4% of cases with injuries were not diagnosed during hospitalization. Motorcycle and pedestrian accidents were significantly associated with failure to diagnose in the hospital, and age, motor accident, and winter variables were significantly contributed to the lack of diagnosis.

Conclusions: Orthopedic injuries (upper limbs are much more common than lower limbs) are the most common injuries that are not diagnosed in hospitalized patients with multiple trauma. These injuries are more prevalent among individuals aged 5-30 years old who have been involved in car accidents in the winter.

Keywords: Multiple trauma, Undiagnosed injuries, Orthopedic, Neurosurgery

Introduction

Nowadays, trauma is the third leading cause of death in the world (1,2). Traumatic brain injury (a change in brain function caused by an external factor) is one of the major health problems that can lead to morbidity, disability, and mortality (3,4). It is estimated that traumatic brain injury is responsible for nearly half of all trauma-related deaths. According to the World Health Organization, traumatic brain injuries will outweigh most diseases by 2020 (5,6). In addition, multi-trauma affects between 20 and 50 million people each year, and 1.25 million people are disabled (7,8). Statistics show that Iran is among the world's leading countries in terms of accidents. More than 21 000 people are killed in road accidents each year. Accidents are the second leading cause of death, the most important cause of hospitalization, the leading cause of death in people under the age of 40, and the leading cause of morbidity in all ages and both genders in Iran (9-11). On the other hand, it has been determined that the mortality rate of road accidents is 1130.80 per 10000 in the latest studies conducted in Iran (8).

The proper management of trauma and related problems will effectively reduce mortality rates and complications that occur following trauma and have been repeatedly reported in studies (12,13). The emergency department is highly important as it is the first ward that usually accepts trauma patients, and its staff take the first steps in treating the patient at the hospital in critical situations. The prompt and proper care of patients in this ward can be life-saving and reduce the severity and duration of the disease (13,14).

Unfortunately, in the study of patients with multiple trauma, there have been reports of undiagnosed cases. Most of these cases have been after discharge from the hospital. Failure to diagnose these injuries can lead to irreversible damages, or it may be much more difficult to treat them because of the delay, which can lead to disability and permanent damage to the relevant tissue or organs. Therefore, a thorough examination of all organs of patients with multiple trauma is essential to diagnose all injuries in the hospital and to minimize the high costs of treatment that may be postponed until after discharge.

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Key Messages

- ▶ The prevalence of undiagnosed problems in patients with multiple trauma was high.
- ▶ Unexplained orthopedic problems had the highest number of undiagnosed problems.

Therefore, according to the above-mentioned explanation, the purpose of this study was to investigate undiagnosed injuries in patients with multiple trauma who referred to the emergency department.

Materials and Methods

Study Design

This descriptive-analytical study was conducted in the Emergency Department of Emam Reza hospital affiliated to Tabriz University of Medical Sciences in 2019. It should be noted that this center is the largest emergency section in the northwest of Iran. The minimum sample size of 466 people was considered based on a similar study (15), but 1000 patients with multiple trauma were enrolled in the study to increase the power and validity of the study. Random sampling was conducted in this study, and the medical records of patients were randomly selected from the Health Information System.

The patients' medical records were reviewed twice before and after discharge such that patients' information was reviewed upon follow-up visits to the hospital to find undiagnosed injuries. The inclusion criteria consisted of a diagnosis of multiple trauma based on the diagnosis of an emergency medicine specialist, and patients were referred to the hospital by emergency medical services. On the other hand, the exclusion criteria included people with previous injuries over the past month and those with trauma over the past three months, disabilities, damage of body systems (e.g., musculoskeletal, circulatory, and urinary systems), known cancers, and receiving psychiatric medications.

Applied Checklist and Collected Information

The applied instrument in this study included a researcher-made checklist that gathered data such as age group, gender, season and month of the accident, the type of accident, the length of hospital stay, and the length of stay in the intensive care unit. This checklist was designed by two epidemiologists (who were not the members of the research team) based on research objectives. It should be noted that the study groups were children (0-4 years old), adolescents (5-19 years old), youths (20-29 years old), middle-aged individuals (30-59 years old), and elderly (over 60 years old). This type of grouping of the group is based on epidemiological studies in the expression of accidents and trauma caused by accidents (16) and the type of inflicted accidents and injuries are announced based on this type of grouping, and in this study, the study groups were divided in this way.

Statistical Analysis

The required data for this study were extracted from patients' files (based on inclusion and exclusion criteria), and then entered into relevant forms and registered in the designed form after reviewing and verifying their accuracy. On the other hand, another researcher matched the collected data with the files to ensure the accuracy of the entered information. The data were entered in SPSS (version 20) after completing the checklist by the researcher (in pen and paper) and analyzed using χ^2 and logistic regression tests. A *P* value of less than 0.05 was considered statistically significant.

Results

The number of people referring to the emergency services of both Shohada and Imam Reza hospitals was 2130 during 2019. In general, 1000 cases were examined out of this number. All these information files were complete and were examined and analyzed until the last step (no sample drop was observed based on data in Figure 1). The mean age of the patients in the study was 29.14 ± 03.49 years, and most of them were males (62.10%). Further, the most common causes of trauma were motor crashes (69.00%) and violence (14.60%). The demographic data and the causes of trauma are presented in Table 1.

An evaluation of the relationship of the type of accident with age, gender, season, and location revealed that most accidents occurred between the ages of 20 and 29. However, most cases of fall accidents occurred over the age of 60, and most animal attacks and violence occurred between the ages of 5 and 19 years. Moreover, the highest number of car accidents, motorcycle accidents, and violence occurred among males while the highest number

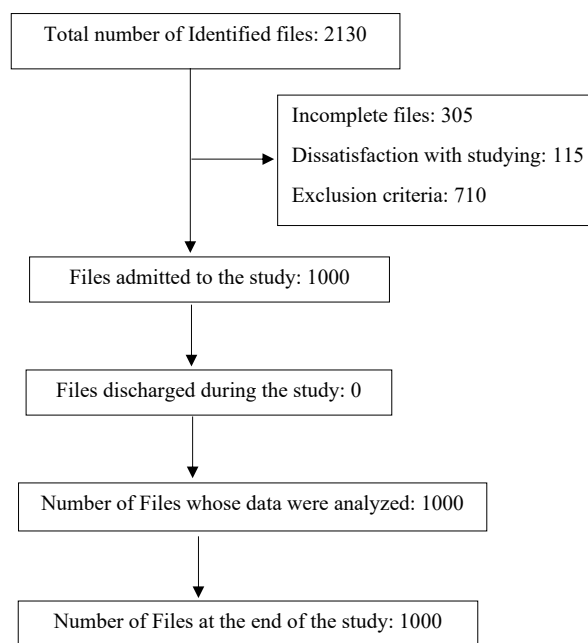


Figure 1. Flowchart of the Study.

Table 1. Demographic Data and Type of Trauma of the Study Participants

Variable	Number	%	P Value
Age (y)			0.003
0-4	29	2.9	
5-19	289	28.9	
20-29	412	41.2	
30-59	160	16.0	
>60	110	11	
Gender			0.001
Male	621	62.1	
Female	379	37.9	
Type of accident			0.009
Vehicle accident			
Car accident	265	26.5	
Motorcycle accident	273	27.3	
Pedestrian accident	152	15.2	
Fall	103	10.3	
Animal attacks	61	6.1	
Violence	146	14.6	
Season			0.015
Spring	186	18.6	
Summer	266	26.6	
Fall	279	27.9	
Winter	269	26.9	
Location of the accident			0.023
Urban	668	66.8	
Rural	332	33.2	

Test used: χ^2 .

of pedestrian accidents, fallings, and animal attacks was observed in females. Summer and winter were the most dangerous seasons with regard to accidents, and trauma was more common in urban areas. Figure 2 shows the prevalence of the type of accidents with the mentioned variables separately.

The results of a study on the type of injury and the type of accident demonstrated that the injuries of the CNS and

the musculoskeletal system were the most common ones in patients with trauma. In addition, car and motorcycle accidents were associated with most spinal cord and brain injuries, respectively. Pedestrian accidents also caused the most damage to the limbs. Pedestrian accidents were the most prevalent cause of thoracic and abdominal injuries. Finally, motorcycle accidents were the most widespread cause of facial injuries. It should be noted that injuries to the CNS ($P=0.001$) and the musculoskeletal system ($P=0.003$) were significantly associated with the type of accident. Table 2 separately lists the type of accident and the type of injury.

Based on the assessment of undiagnosed injuries, orthopedic injuries were the most common injuries, and the injuries of 224 (22.4%) patients were diagnosed on the second visit. Among them, injuries to upper limbs (15.3%) were more considerable compared to those to lower limbs (7.1%), which were significantly different ($P=0.006$). There were also significant relationships between injuries to the upper limbs and car accidents ($P=0.016$), motorcycle accidents ($P=0.009$), and pedestrian accidents ($P=0.043$). Additionally, lower-limb injuries were significantly associated with falling ($P=0.001$), motorcycle accidents ($P=0.009$), and pedestrian accidents ($P=0.018$). The most common undiagnosed injuries to the upper limbs included finger fractures, ulnar fractures, wrist dislocations, finger dislocations, tendons injuries, and nerve injuries. Injuries such as finger fractures, finger dislocations, nerve injuries, and tendon injuries were among the most common undiagnosed cases in the lower limbs (Table 3).

The examination of the relationship between hand and foot injuries represented that in both limbs, variables such as age groups of 5-19, 19-29, and more than 60 years, vehicle accidents, and accident occurring in the winter

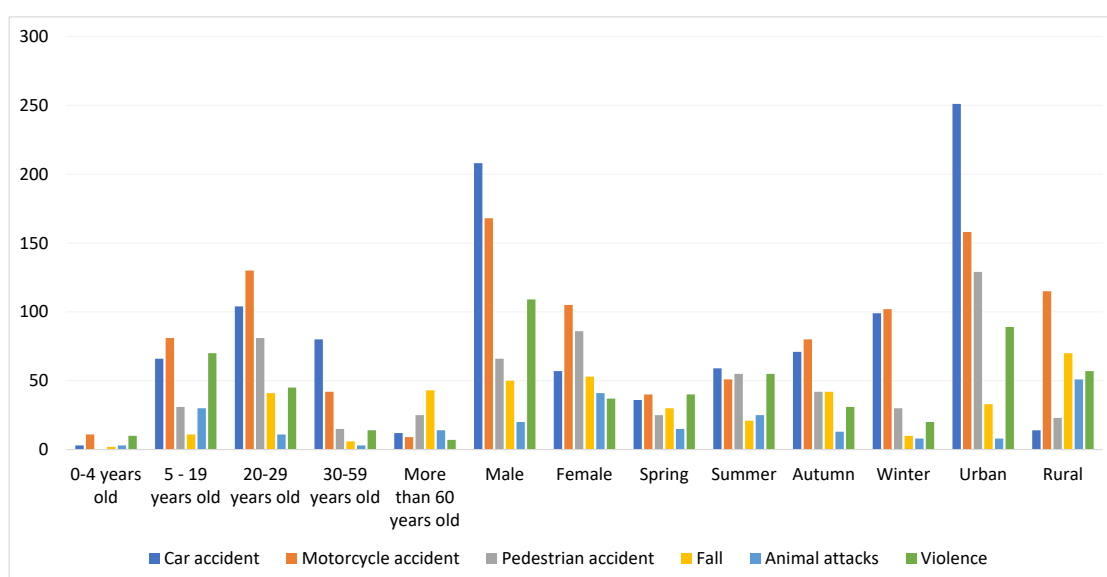


Figure 2. Investigate the Type of Accident With Age, Gender, Season and Location.

Table 2. The Type of Injury Caused by Different Accidents

Damaged Place		Car Accident	Motorcycle Accident	Pedestrian Accident	Fall	Animal Attacks	Violence
Central nervous system	Brain	121	136	103	23	3	1
	Spinal	152	103	112	39	5	9
	P Value	0.001					
Orthopedics	One hand	36	18	63	56	18	59
	One foot	58	61	92	78	9	18
	Two hands	20	6	52	39	5	13
	Two Feet	15	3	49	31	2	10
	All limbs*	6	1	21	15	0	3
	P value	0.003					
Abdomen and thorax	Liver	15	36	19	49	10	6
	Intestines	23	39	20	12	18	3
	Spleen	11	9	14	2	1	2
	Gallbladder	3	2	5	0	0	0
	Esophageal	9	17	38	2	0	1
	Tracheal	1	2	9	0	0	0
	Lungs	6	14	34	43	5	0
	Stomach	1	6	15	0	0	0
P value	0.059						
Cardiovascular	Heart	0	1	3	0	0	1
	Arteries	2	6	18	0	0	4
	Vein	18	41	39	15	21	55
	P value	0.119					
Face	Eye	16	29	11	10	0	5
	Eyebrows	2	19	6	0	0	1
	Nose	11	19	3	0	0	5
	Teeth	17	58	29	2	0	57
	Ear	1	3	9	0	0	1
P value	0.103						
Urinary system	Urinary system	3	29	6	0	0	3
P value	0.501						

* One hand and one foot / One hand and two feet / Two hands and one foot / Two hands and two feet.

Test used: χ^2 ; P value <0.05: Significant.

were significantly effective in the lack of diagnosing the injuries. The relationship of the type of undiagnosed injuries with their affecting variables is separately provided in Table 4.

Discussion

This study aimed to investigate undiagnosed injuries in patients with multiple trauma visiting the Northwest Emergency Center of Iran. In this study, the medical records of 1000 patients were evaluated, among which the age group of 20-29 years was the most common age group who had multiple trauma. The results also showed that male gender, motorcycle accidents and winter were more associated with multiple trauma. Furthermore, trauma to the brain and the spinal cord and orthopedic trauma were among the most common injuries caused by multiple trauma. The study of people visiting a physician after discharge revealed that orthopedic injuries received less attention, and among undiagnosed orthopedic injuries, injuries to the upper limbs were far more prevalent compared to those of the lower limbs.

In relation to the first findings of this study, the age range of 20-29 years, male gender, motorcycle accidents, and

winter were significantly more prevalent in patients with multiple trauma in comparison with other variables. In this regard, the results of our study differ from the findings of Guina et al (17), indicating that the female gender was more associated with trauma. However, our results are in line with those of Kruit et al (18), representing that males were more affected in both studies. On the other hand, the average age of patients with multiple trauma in our study is different from the results of Yucel et al (19). The average age of our participants was 15 years less than the average age of their study participants. The results of a study by Lam et al (20), as well as those of our study pointed to the role of motorcycles in the occurrence of a large number of multiple trauma. It is believed that the larger number of male drivers in Iran and snowfalls in the winter are among the reasons that can play a role in road accidents and cause trauma. Moreover, the age of 20-29 in Iran is the range at which a person has not yet reached financial independence, and it is also a time of excitement, thus the use of motorcycles is more common, and these reasons can result in an increase in trauma cases. However, these hypotheses require epidemiological studies that should be considered in the future.

Table 3. The Frequency of Undiagnosed Injuries Based on the Causes

Injured Limbs		Car Accident	Motorcycle Accident	Pedestrian Accident	Fall	Animal Attacks	Violence
Hand	Finger fractures	5	9	0	0	0	1
	Palm fractures	0	0	0	0	0	0
	Wrist fracture	0	0	0	0	0	0
	Radius fracture	0	0	0	0	0	0
	Ulnar fracture	6	7	6	0	0	3
	Elbow joint fracture	1	3	0	0	0	0
	Arm fracture	0	0	0	0	0	0
	Shoulder fracture	0	0	0	0	1	0
	Shoulder dislocation	3	6	5	3	1	2
	Elbow dislocation	5	0	0	0	0	0
	Wrist dislocation	9	9	11	9	0	6
	Finger dislocation	8	11	18	15	0	12
	Cut tendons	11	13	7	0	3	14
Cut nerves	9	10	14	4	2	10	
Foot	Finger fractures	1	3	5	9	0	0
	Finger dislocation	3	4	11	6	0	1
	Fracture of the sole of the foot	0	0	1	0	0	0
	Ankle fractures	0	1	1	0	0	0
	Ankle dislocation	3	3	0	0	0	0
	Knee joint fracture	0	0	1	0	0	0
	Knee joint dislocation	0	2	3	1	0	0
	Cut nerve	3	5	4	3	0	3
	Cut tendon	3	4	3	3	1	1

Based on the finding of our study, CNS and orthopedic injuries were common in patients with multiple trauma. In this regard, the results of our study corroborate with the

results of similar studies conducted in this field (16,21,22). It seems that the high vulnerability of CNS and organs to injuries can play a key role in damage to these areas. Additionally, the lack of protection for the head, neck, arms, and legs during an accident causes these organs to be more injured in comparison with other organs. The vulnerability of these organs will be extremely higher if a person is exposed to an accident while these organs are not protected, which can justify the results of our study.

The results further demonstrated that orthopedic injuries were significantly undiagnosed in hospitals, but diagnosed in subsequent follow-ups. In this regard, the results of our study are in conformity with the results of other similar studies (15,23). The pain and bruising of the limbs are common in trauma patients, thus there is a possibility of limb bandaging, and orthopedic examinations are not considered as emergency examinations in patients with trauma, and orthopedic problems are often forgotten accordingly. On the other hand, trauma patients are hospitalized for a long time and several weeks, and these patients are prone to forgetting orthopedic procedures because of various reasons such as low hemoglobin, forgetfulness, lack of preparation for anesthesia, and the priority for brain surgery.

Finally, it was found that different types of motor accidents (i.e., motorcycle, car, and pedestrian accidents) and winter accidents are significantly forgotten between the ages of 5 and 30 years. Therefore, it is better for orthopedic and trauma specialists to pay more attention to these variables than other variables since awareness of these variables can prevent undiagnosed injuries in

Table 4. The Relationship of the Type of Injuries With its Causes

Variable	P Value of Hand	P Value of Hand
Age (y)		
0-4	0.412	0.0512
5-19	0.002	0.003
20-29	0.003	0.002
30-59	0.087	0.059
>60	0.032	0.030
Gender		
Male	0.203	0.309
Female	0.185	0.113
Type of accident		
Vehicle accident		
Car accident	0.003	0.001
Motorcycle accident	0.001	0.031
Pedestrian accident	0.003	0.026
Fall	0.185	0.203
Animal attacks	0.129	0.200
Violence	0.036	0.051
Season		
Spring	0.099	0.059
Summer	0.063	0.114
Fall	0.055	0.201
Winter	0.030	0.013
Location of the accident		
Urban	0.209	0.236
Rural	0.222	0.225

Test used: Logistic regression; P value <0.05: Significant.

patients with multiple trauma. In this regard, the results of our study are consistent with those of similar studies conducted in this field (15,24).

One of the most important issues in multi-trauma patients is to increase the level of hope and happiness in these people. Due to reasons such as long-term hospital stays, disability, long-term follow-ups to achieve health, and the like, these patients need to take intervention measures to increase their level of hope. One of the most effective methods is to increase the level of these patients' adaptation to their disease (25). Considering that this issue is beyond the scope of this study, we recommend that this issue be carefully considered in future studies.

Suggestions for Further Research

Researchers suggest that patients who have not visited the hospital for further follow-ups should also be screened in future studies to obtain more comprehensive data. In addition, presenting the results of this study and paying attention to them can be a guide for physicians in emergency centers to reduce undiagnosed injuries.

Study Limitations

Some traumatic patients always die due to severe injuries. Furthermore, some of these patients who are travelers return to their place of residence after relative stability. The lack of the identification of these people in this study affected the results of our study and thus could be considered a limitation of this study.

Conclusions

In general, orthopedic injuries (upper limbs are much more common than lower limbs) are among the most common injuries that are not diagnosed in hospitalized patients with multiple trauma. These injuries are more prevalent in people between the ages of 5-30 years who have had vehicle-related accidents in the winter.

Authors' Contribution

BN: Study design, data collection. SP and MM: data analysis, article summary. FM: data analysis, article submission, article summary.

Conflict of Interests

Authors have no conflict of interests.

Ethical Issues

In this study, it was attempted to fully observe the principles of ethics in human research. In this way, first, the code of ethics was taken from Tabriz University of Medical Sciences (Approval code: IR.TBZMED.REC.1398.858). The information of patients' files was extracted after obtaining permission from the officials of the mentioned hospitals. Conscious consent was obtained from all participants by telephone. All participants were also assured that information will not be misused but would only be used for the research project.

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