

Research Paper: Comparative Study of Road Traffic Accident Victims Transferred by Air and Ground Emergency to Shahid Beheshti Medical Center in Qom City, Iran, 2015-2018



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ABSTRACT

Background: Prehospital emergency department provides land, air, boat, and rail ambulance care. This study aimed to compare the situation of air and ground emergency casualties in road traffic accidents transferred to Shahid Beheshti Medical Center in Qom City, Iran, 2015-2018.

Materials and Methods: The present study is a retrospective descriptive-analytical study. All road traffic accident victims transferred to Shahid Beheshti Medical Center in Qom by prehospital emergency land or air staff from 2015 to 2018 at 6 to 20 o'clock were included in this study (census method). The exclusion criteria included burns, death, transmission during cardiopulmonary resuscitation or by urban ambulances, and information deficiencies. We used a researcher-made checklist to examine victims' age, sex, type of transmission, type of accident, type of trauma, distance, initial vital signs, time intervals, and day of the accident. SPSS software version 16 was used to analyze the data. Data were compared in two groups with the t test and the Chi-square test.

Results: A total of 2057 casualties were included in the study: 566 casualties were transferred by air emergency and 1491 by ground emergency. The mean age of air emergency casualties was significantly lower than the ground emergency ($P=0.008$). Trauma to the neck, chest, abdomen and lower back was significantly higher in air emergency casualties, but hand and foot trauma were more common in ground emergency casualties. Most air missions took place on holidays or weekends, while most ground missions were done during weekdays ($P<0.001$). The mean distance of the air emergency missions was more than Beheshti Medical Center ($P<0.001$). Compared with ground emergency casualties, air emergency casualties had average systolic blood pressure, lower level of consciousness, and higher heart rate and respiration ($P<0.001$). The mean duration of transfer from the accident scene to the medical center in the air emergency was significantly shorter ($P<0.001$).

Conclusion: Air emergency casualties were usually accompanied by more critical vital signs and severe injuries to the neck, chest, abdomen, and back. This study can provide clinical triage criteria that focus on key environmental factors and reduced transport time. Further studies are needed to investigate the consequences of traffic accident casualties at the medical center to determine which subgroups will benefit most from using air emergency.

Keywords:

Air ambulance, Ambulance, Medical emergency services, Accidents, Traffic

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1. Introduction

Every 24 seconds, one person in the world dies in a traffic accident. Traffic accidents are the leading cause of death in people aged 5 to 29 years and the eighth leading cause of death at all ages [1]. Qom Province in Iran has the highest urbanization rate and the shortest road route in Iran, but it is the transportation route of 17 provinces. Therefore, with its many vehicles compared to road routes, it is prone to traffic accidents [2, 3]. The longer time of receiving care in traffic accidents is associated with an increase in mortality. This issue is the basic premise of emergency medical services [4]. The prehospital emergency provides care for the land, air, boat, and rail ambulances.

Ground ambulances are distributed regionally and quickly dispatched to the scene. If the distance of the accident scene is far from the medical center, the ground transfer will be delayed [5]. An air emergency can eliminate this delay in transfer. The main task of the air emergency is to provide primary care at the scene of the accident and deliver the injured to the medical center quickly [6]. Today, the use of air emergencies is common in most developed countries [7]. Iran's first air emergency started operating in Tehran City in June 2000 [8]. Qom Air Emergency was also opened in August 2014 [9]. Speed is the most obvious advantage of air emergency over ground emergency [10], but it is not the only advantage [11]. Another advantage of air emergency is access to difficult places [12]. Air emergency caregivers also include skilled individuals, including physicians, emergency and intensive care nurses, and experienced paramedics [6, 11].

Air emergencies also have limitations, including greater risk for occupants [11, 13, 14], high maintenance and flight costs [5, 6, 13, 15, 16], limited cabin space for operations, a small number compared to ground emergencies [12] and more sensitive to climate change [6, 10, 12, 14, 15]. The escalation of emergency helicopter crashes over the past few years has raised concerns about air emergency safety. In addition to the risk to the injured, the caretakers on board the helicopter also have a high risk of death [11]. Also, using an air emergency costs 10-15 times more than a ground emergency [17]. So, air emergency is a limited and costly resource, and its use is associated with potential risk. This study aimed to compare the situation of traffic accident victims transferred to Shahid Beheshti Hospital in Qom with air and ground emergency.

2. Materials and Methods

In this descriptive-analytical study, all road traffic accident victims transferred to Shahid Beheshti Research and Training Center in Qom by land or air prehospital emergency from April 1, 2015, to March 20, 2018, were examined. Caregivers in the air and ground emergency have a university education at the associate's or bachelor's degree and receive regular in-service training. The air emergency is located in Shahid Beheshti Medical Center and transports and takes care of the injured only outside the city. Also, because of a helicopter landing pad in Shahid Beheshti Medical Center, the injured are transferred to this center by air emergency. Therefore, the injured of the ground emergency were selected from the injured transferred to this medical center. The inclusion criteria included all the injured who were transferred to Shahid Beheshti Medical Center in Qom by air or ground emergency from traffic accidents outside the city in the period of 6 to 20 hours. The exclusion criteria included information deficits, burns, death, transmission during cardiopulmonary resuscitation, or by urban ambulances.

Prehospital emergency records were used to obtain information about the injured. The collected data included age, sex, type of transfer, type of accident, type of trauma, distance from the treatment center, vital signs (heart rate, respiration rate, systolic blood pressure, and level of consciousness according to Glasgow Coma criteria), mission time intervals (time to receive the mission to reach the accident, time to get the scene of the accident to start the transfer to the medical center, and time to leave the scene of the accident to deliver the injured to the medical center), and the day of the accident (official holiday or weekend, non-holiday or working days).

Regarding the type of accident, it comprised collision of a light vehicle with fixed obstacles, a light car with a pedestrian, a light vehicle with a motorcycle, a light vehicle with a light vehicle, a light vehicle with a heavy car, as well as overturning of a light vehicle. Also, it included the collision of a motorcycle with fixed obstacles, motorcycle with a pedestrian, motorcycle with a motorcycle, motorcycle with a heavy vehicle, as well as overturning of a motorcycle. Finally, it could be the collision of a heavy vehicle with fixed obstacles, heavy vehicle with the pedestrian, heavy vehicle with a heavy vehicle, as well as overturning of a heavy vehicle, overturning of a bicycle, and chain accident. In the type of trauma, the injury site was identified in the injured, which included the head, face, neck, chest, abdomen, hands, arms, legs, feet, back, and genital area. If the two upper or lower limbs were injured, the arm or leg was placed in the type of trauma,

respectively. If the casualty did not have obvious trauma to areas of the body and was transmitted only for further investigation based on the severity of the vehicle collision, the mechanism of injury in the type of trauma was recorded. In the case of a pedestrian injured, we checked the information about the driver of the bicycle, the driver of the motorcycle, the occupant of the motorcycle, the driver of the light vehicle, the occupant of the light vehicle, the driver of the heavy vehicle, and the occupant of the heavy vehicle. Official holidays or weekends (Thursdays and Fridays) and non-holidays or working days were also examined on the day of the incident.

SPSS software v. 16 was used to analyze the data. Quantitative continuous data were characterized by mean and standard deviation and qualitative data by number and percentage. Data were analyzed using t test in quantitative data and Chi-square in qualitative data. The P values less than 0.05 were set as significant. This article is part of the results of the Master's degree dissertation of Qom School of Nursing, approved by the Ethics Committee of Qom University of Medical Sciences (IR.MUQ.REC.1399.067). Before the study, the consent of the relevant authorities was obtained.

3. Results

During the four years of the study, 2057 injured people (1491 [72.49%] ground transfers and 566 [27.51%] air transfers) were transferred to Shahid Beheshti Hospital. The Mean±SD age of the injured was 30.87±16.58 years, and 64% were male. The most common type of trauma to the injured in both groups was head trauma (42.4%), and the least was genital trauma (0.7%). Trauma to the neck, chest, abdomen, and lower back was significantly higher in air emergency casualties, but trauma to the arm and leg was more common in ground emergency casualties (Table 1).

The most common type of accident in air and ground emergency transport was overturning with 809 cases (32.4%) ($P<0.001$). The highest number of injuries in both groups was related to the occupants of light vehicles, with 1174 cases (57%) ($P<0.001$). Most air emergency missions were on holidays or weekends (53%) ($P<0.001$), while most ground emergency casualties (50.6%) ($P<0.001$) were transferred on non-holidays. In general, the Mean±SD time to reach the scene of the accident was 11.09±7.38 min, presence on the scene was 17.28±11.38 min, and transfer to the medical center was 25.37±13.50 min. The Mean±SD distance from the accident site to the medical center was generally 45.63±20.31 ($P<0.001$), which was longer for the air emergency

(53.11±18.30) ($P<0.001$) than the ground emergency (20.32±79.42) ($P<0.001$) (Table 2). A researcher-made checklist was used to obtain information, the validity and reliability of which were confirmed by the Coefficient of Variation Index (CVI) and re-test by 23 faculty members and prehospital emergency specialists (Table 3).

4. Discussion

The present study compared the condition of the injuries before transferring to the treatment center based on the method of transportation. For this purpose, we used the prehospital information of the injured in traffic accidents transferred to Shahid Beheshti Medical Center in Qom by air and ground emergency from 2015 to 2018.

In this study, most of the injured in traffic accidents transferred by air and ground emergencies were males. This finding is also observed in several studies [15-18]. In the study of Abe et al., 71.1% of the injured were male [15]. In the study of Jiyoung Kim et al., 67.8% of the injured were male [16]. There are several reasons for this result, including the fact that men usually drive more than women. Also, in some cases where driving is a job, the men typically work in this job. For these reasons, they are more at risk of traffic accidents [2].

In the present study, the mean age of air emergency casualties was significantly lower than that in ground emergencies. In the study of Stewart et al., the mean age of air emergency casualties was significantly lower than ground emergency casualties [17]. However, in the study of Oh Hyun Kim et al., these means were not significantly different [18]. In the study of Michael et al., the mean age of air emergency casualties was significantly higher [12]. The difference in the age of the injured is related to the research environment and the people under study. Therefore, it is suggested that more studies be conducted with a larger sample size to examine and compare this issue in different environments.

The most common type of accident in air and ground emergency transport casualties was light vehicle overturning, and the most commonly injured in both groups were light vehicle occupants. Based on the study of TSochia et al., these results can be justified by the greater use of light vehicles [19]. Parvaresh Massoud et al. studied mortality in traffic accidents in Qom Province. They concluded that the majority of the mortality belonged to the drivers (51.25%) and then the occupants of the car (25.5%). Also, in 36.25% of traffic accidents, no other vehicle was involved, and the vehicle's collision caused the death of the driver or passenger. Because of the de-

Table 1. Demographic information and characteristics of traffic accident victims

Variables	Mean±SD/No.(%)			P		
	All Injured, (n=2057)	Air Emergency, (n=566)	Ground Emergency, (n=1491)			
Age (y)	30.87±16.58	29.29±16.05	31.47±16.75	0.008		
Gender	Male	1312(63.8)	332(58.7)	980(65.7)	0.003	
	Female	745(36.2)	234(41.3)	511(34.3)		
Vital signs and level of consciousness	Systolic blood pressure	112.57±18.07	110.58±18.75	113.33±17.76	0.002	
	heartbeat	84.51±10.71	87.21±11.63	83.47±10.16	<0.001	
	Number of breaths	16.84±2.62	17.33±2.70	16.65±2.56	<0.001	
	Glasgow Coma Criterion	14.85±0.87	14.61±1.40	14.94±0.53	<0.001	
Type of trauma	Head trauma	Yes	873(42.4)	253(44.7)	620(41.6)	0.220
		No	1184(57.6)	313(55.3)	871(58.4)	
	Face trauma	Yes	184(8.9)	52(9.2)	132(8.9)	0.880
		No	1873(91.1)	514(90.8)	1359(91.1)	
	Neck trauma	Yes	370(18)	135(23.9)	235(15.8)	<0.001
		No	1687(82)	431(76.1)	1256(84.2)	
	Chest trauma	Yes	1827(88.8)	487(86)	1340(89.9)	<0.001
		No	175(8.5)	73(12.9)	102(6.8)	
	Abdominal trauma	Yes	175(8.5)	73(12.9)	102(6.8)	<0.001
		No	1882(91.5)	493(87.1)	1389(93.2)	
	Trauma to the hand	Yes	513(24.9)	109(19.3)	404(27.1)	<0.001
		No	1544(75.1)	457(80.7)	1087(72.9)	
	Trauma to the hands	Yes	148(7.2)	39(6.9)	109(7.3)	0.815
		No	1909(92.8)	527(93.1)	1382(92.7)	
	Foot trauma	Yes	416(20.2)	95(16.8)	321(21.5)	0.020
		No	1641(79.8)	471(83.2)	1170(87.5)	
	Trauma to the legs	Yes	152(7.4)	44(7.8)	108(7.2)	0.752
		No	1905(92.6)	522(92.2)	1383(92.8)	
	Back trauma	Yes	313(15.2)	123(21.7)	190(12.7)	<0.001
		No	1744(84.8)	443(78.3)	1301(87.3)	
Genital trauma	Yes	14(0.7)	2(0.4)	12(0.8)	0.417	
	No	2043(99.3)	564(99.6)	1479(99.2)		
Damage mechanism	Yes	152(7.4)	42(7.4)	110(7.4)	>0.999	
	No	1905(92.6)	524(92.6)	1381(92.6)		

Table 2. Characteristics of air and ground emergency traffic accidents

Variables	No.(%)			P
	Total Injured (n=2057)	Type of Ambulance		
		Air Emergency, (n=566)	Ground Emergency, (n=1491)	
Light car with fixed obstacles	129(6.3)	14(2.5)	115(7.7)	
Light car with pedestrians	36(1.8)	1(0.2)	35(2.3)	
Light car with a motorcycle	93(4.5)	6(1.1)	87(5.8)	
Light car with light car	590(28.7)	194(34.3)	396(26.6)	
Light car with heavy car	41(2)	24(4.2)	17(1.1)	
Overtuning a light vehicle	809(32.4)	265(46.8)	544(36.5)	
Motorcycle with fixed obstacles	5(0.2)	0(0)	5(0.3)	
Motorcycle with pedestrian	16(0.8)	4(0.7)	12(0.8)	
Motorcycle with bicycle	2(0.1)	0(0)	2(0.1)	
Motorcycle with motorcycle	40(2)	11(1.9)	29(1.9)	<0.001
Motorcycle with a heavy vehicle	6(0.3)	2(0.4)	4(0.3)	
Motorcycle overturning	172(8.4)	17(3)	155(10.4)	
Heavy vehicle with fixed obstacles	7(0.3)	0(0)	7(0.5)	
Heavy vehicle with pedestrian	4(0.2)	0(0)	4(0.3)	
A heavy vehicle with heavy vehicle	43(2.1)	12(2.1)	31(2.1)	
Overtuning a heavy vehicle	56(2.7)	14(2.5)	42(2.8)	
Overtun with a bicycle	4(0.2)	0(0)	4(0.3)	
Chain accident	4(0.2)	2(0.3)	2(0.1)	
Passerby	51(2.5)	3(0.5)	48(3.2)	
Bicycle driver	8(0.4)	0(0)	8(0.5)	
Motorcycle driver	223(10.8)	22(3.9)	201(13.5)	
Motorcycle passenger	83(4)	15(2.7)	68(4.6)	<0.001
Light car driver	410(19.9)	89(15.7)	321(21.5)	
Light car occupant	1174(57)	412(72.8)	762(51.1)	
Heavy vehicle driver	71(3.5)	13(2.3)	58(3.9)	
Heavy vehicle occupant	37(1.8)	12(2.1)	25(1.7)	
On the day of the accident				
Holiday-Weekend	1036(50.4)	300(53)	736(49.4)	<0.001
Weekdays	1021(49.6)	266(47)	755(50.6)	

Variables	Total Injured (n=2057)	No.(%)		P
		Type of Ambulance		
		Air Emergency, (n=566)	Ground Emergency, (n=1491)	
Reach the scene of the accident	11.09±7.38	16.54±5.86	9.12±7.24	
Presence at the scene of the incident	17.28±11.38	12.17±8.33	19.49±12.08	
Time				
Transfer to a medical center	25.37±13.50	13.12±4.75	30.36±13.20	<0.001
Total prehospital time	45.15±20.39	14.49±12.24	58.58±21.12	
Distance of the accident site from the medical center	45.63±20.31	53.11±18.30	42.79±20.32	

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velopment of urban communities and the increasing use of light and personal vehicles, the probability of traffic accidents in this group is higher, and many injured are air and ground emergencies [2].

Trauma to the neck, chest, abdomen, and lower back was significantly higher in air emergency casualties, and trauma to the arm and leg was significantly higher in ground emergency casualties. This finding has been reported in the study of Al-Thani et al. and Enomoto et al. that air transport casualties usually had more severe injuries to the neck and trunk [20, 21]. The study of Stewart et al. also shows that ground emergency casualties were more associated with limb injuries, while air emergency casualties were usually associated with neck and trunk injuries [17]. According to the scientific sources studied in the preparation of prehospital triage instructions, the victims with trunk and neck injuries had worse consequences than the other injured. For example, the length of hospital stay and the need for emergency surgery were higher in this group. The guideline emphasizes that head and trunk injuries be transferred to the highest-care trauma center in the shortest possible time [22, 23].

At the accident scene, the ability to diagnose is limited, which makes the injured prioritize a higher level of care for the use of air emergencies. The study showed that more than half of the patients transferred by air emergency have minor or non-life-threatening injuries that can have similar results if transferred by ground emergency [13]. Therefore, the final criteria for proper triage of air emergencies are controversial. Because of the inherent mission of the air emergency, which is to care for and transport the severely injured, the more severe casualties should be transported by the air emergency. Otherwise, this limited and costly resource has not been used properly. Owing to differences in infrastructure, prehospital emergency systems, and treatment centers, the interpre-

tation of the results of this study should be cautiously extended to other cities. It is suggested that further studies be conducted to investigate the consequences of traffic accident casualties to determine which group of casualties will benefit the most from using the air emergency. Finally, based on the results, a comprehensive local guideline should be developed for selecting transport casualties by air emergency.

Most air emergency transfers were on holidays or weekends, while most ground emergency transfers were on weekdays. In the study of Massoud et al., most of the deaths were in traffic accidents that happened on weekends [2]. In the study of Stewart et al., air and ground transfers in the pediatric group were examined. Their results were similar on weekdays and holidays [17]. In the study of TSochi et al., this ratio was almost identical [19]. Because of the differences in the study population and cultural and social differences, the increase in intercity travel during the holidays can increase the road traffic load and the likelihood of accidents during these days. Therefore, traffic laws should be monitored and implemented more on holidays and weekends. Also, this amount of traffic on the roads can affect the choice of transfer of the injured to the medical center, and more air emergencies can be used for the rapid transfer of the injured in the weekend traffic.

The average time to reach the scene in the ground emergency was shorter and the average time to stay on the scene in the air emergency was shorter. This result is consistent with the study of Eghbali et al., who compared the time indices of air and ground emergencies in Qom in traffic accidents [24]. The short time to reach the scene of the accident can be justified by the regional distribution of ground emergency bases that are responsible for arriving at the scene of the accident in the shortest time [5]. Because of the further distance of the air ambulance

Table 3. Checklist validity

Items in the Checklist	%				Accept/Reject
	CVR	CVI	CVCI	CVCS	
Transmission type	73.91	100	95.65	100	Accept
Mission time	65.21	91.30	97.82	95.65	Accept
Moving time from base	39.13	91.30	95.65	100	Accept
Time to get to the place of urgency	82.60	91.30	100	100	Accept
Time of departure from the place of urgency	65.21	95.65	97.82	100	Accept
Time to get to the medical center	32.60	95.65	97.82	100	Accept
Mission time (day, night)	56.52	95.65	100	91.30	Accept
Emergency location (urban, road)	73.91	91.30	97.82	95.65	Accept
Accident day (holiday, weekday)	73.91	86.95	95.65	86.95	Accept
Type of accident	39.13	91.30	95.65	95.95	Accept
Injured condition	56.52	95.65	95.65	100	Accept
Type of lesion	65.21	100	95.65	100	Accept
Vital signs and level of consciousness	73.91	100	97.82	100	Accept
Distance to the accident site	65.21	91.30	97.82	95.65	Accept

sent to the accident site from Shahid Beheshti Medical Center, the time to reach the accident site was longer. Also, the average transfer time from the accident scene to Beheshti Medical Center was shorter in the air emergency. According to the principle of the gold watch on which the use of air emergency is designed, the injured must be transported to trauma centers in the shortest possible time to receive definitive treatment. Therefore, air emergency evacuation in the shortest time is a saving principle in many traumas that can be treated only in a trauma center [11].

The duration of the air emergency scene may be to transport the casualty from the scene to a suitable area for the helicopter to land on busy roads, or it may be necessary to immunize the casualty and caregivers before departure. Also, taking special care is impossible or challenging in a limited helicopter environment (such as airway management), and it may cause spending time on the scene in an air emergency. In addition to less time on stage, the subsequent transport time and the total pre-hospital time for air emergency casualties were significantly shorter. In the case of severely injured and time-sensitive injuries, shortening prehospital time may be a useful component of an air emergency. Given the higher

prevalence of neck, chest, abdomen, and back injuries in air emergency casualties, these casualties may have had worse consequences if they had been transferred by ground emergency. Also, our results showed that the total prehospital time in a ground emergency was 17:14 minutes longer, and the time taken to transfer from the scene of the accident to the medical center is 17:24 longer than in the air emergency.

The average distance of the air emergency mission from Beheshti Medical Center was significantly longer than the ground emergency mission, which is consistent with the study of Stewart et al. [25]. According to the study of Moradian et al., the injured whose distance from the medical center was longer than the medical center or was in difficult places benefited the most from air emergency transportation [26]. Therefore, the transfer of casualties from long distances to medical centers in the shortest time is one reason for air emergency use in many countries, which is observed in this study.

Air emergency casualties had average systolic blood pressure, lower level of consciousness, and higher heart rate and respiration, which is consistent with the findings of several studies [5, 15, 17, 27, 28]. These symptoms

are known as shock indicators. Many air emergency casualties usually have unstable hemodynamic conditions and are in shock. The same unstable clinical condition is one of the essential reasons for transferring the injured by air emergency [28]. Therefore, it is recommended that specialized courses of shock recognition and treatment be held periodically for air emergency caregivers so that appropriate care and treatment can be provided to these injured people.

Given the relatively recent establishment of the Air Emergency, our findings can help evaluate evidence-based guidelines and practical solutions for the pre-hospital delivery of traffic accident victims. The present study results have been studied in a province with a limited sample size, so to generalize the results, the studies should be repeated in other environments. One of the factors that reduced the sample size was the lack of information recorded in the prehospital settings. Therefore, it is recommended to use more comprehensive systems for recording data. Because of the transfer of more critical casualties by air emergency, some consequences, such as the condition of vital signs in these casualties, are unavoidable. We suggest that the confounding variables be adjusted to obtain a more accurate analysis and compare these casualties.

5. Conclusion

The comparison between air and ground emergencies is very complex and is influenced by different variables. Because of the nature of air emergency work in Iran, the injured people with more serious and complex clinical conditions are usually transported in this way. In the present study, air emergency casualties were generally associated with more critical vital signs and severe injuries to the neck, chest, abdomen, and lower back. The time to reach the accident scene in the ground emergency was shorter, but the time of presence on the scene and the time of transfer of the injured from the accident scene to the medical center were shorter in the air emergency. This study can provide clinical triage criteria that focus on key environmental factors and reduced transport time. Further studies are needed to investigate the consequences of traffic accident casualties at the medical center to determine which subgroups will benefit most from using air emergency. Also, studies with larger sample sizes and longer periods elsewhere are needed to obtain more accurate and generalized results.

Ethical Considerations

Compliance with ethical guidelines

This article was approved by the Ethics Committee of Qom University of Medical Sciences (IR.MUQ.REC.1399.067). Before the study, the consent of the relevant authorities was obtained.

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Authors' contributions

All authors equally contributed to preparing this article.

Conflict of interest

The authors declared no conflict of interest.

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