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ORIGINAL ARTICLE

Trauma outcomes in Saudi Arabia: a study of helicopter emergency medical services

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ABSTRACT

Background: Helicopter Emergency Medical Services (HEMSs) improve trauma outcomes by enabling rapid transport to specialized centers. In Saudi Arabia, HEMS is expanding through a partnership between The Helicopter Company and the Saudi Red Crescent Authority. However, regional outcome data remain limited. This study examines the characteristics and outcomes of trauma patients transported by HEMS to a Level I trauma center in Riyadh.

Methods: This retrospective study reviewed 541 adult trauma patients transported by air ambulance to a tertiary hospital in Riyadh between January 2021 and July 2024. Data from the hospital's trauma registry and electronic medical records were analyzed for demographics, injury mechanisms, prehospital interventions, trauma team activation, and survival outcomes.

Results: Most patients were young men (85.4%), with motor vehicle accidents (87%) as the leading cause of injury. Blunt trauma accounted for 98% of cases. Prehospital interventions included intubation (13.1%) and chest tube insertion (7.4%). Trauma team activation occurred in 28.5% of cases. More than half of the patients were discharged home without requiring emergency interventions, suggesting potential overtriage. Survival analysis showed rates of 95.2% at 14 days and 93.3% at 30 days, with trauma severity, head and abdominal injuries, and prehospital intubation significantly associated with mortality.

Conclusion: This study highlights the need to optimize HEMS utilization and prehospital triage protocols. Future multicenter studies should assess the broader impact of HEMS on trauma care in Saudi Arabia.

Keywords: Helicopter Emergency Medical Services, trauma, emergency department, traumatic injuries

Introduction

Trauma-related injuries are a leading cause of death worldwide. In trauma care, timely and effective management is critical for improving survival rates and patient outcomes [1,2]. Helicopter Emergency Medical Services (HEMSs) have become essential to prehospital care, facilitating the rapid transport of critically injured patients to specialized trauma centers. Since the 1970s, helicopters have offered significant advantages over ground emergency medical services (GEMSs), including reduced transport times and improved patient care [3–5].

Numerous studies have demonstrated the positive impact of HEMS on trauma patient outcomes, consistently showing higher survival rates for patients transported by helicopter than those transported by ground ambulance [5–7]. A study in the United States reported better survival rates among trauma patients airlifted by HEMS than those transported by GEMS [6]. Similarly, a local study of 335 trauma patients found that among the 123 transported by HEMS, survival rates were higher than for those transported by GEMS [7].

In Saudi Arabia, The Helicopter Company, owned by the Public Investment Fund, has partnered with the Saudi Red Crescent Authority to expand emergency medical services. This initiative includes a significant fleet expansion aimed at covering 90% of emergency cases, including both road and off-road accidents, with helicopters capable of taking off within 15 minutes of a dispatch call [8,9]. Despite these advancements, data

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on HEMS transport outcomes in Saudi Arabia remain limited. As air transport systems continue to grow, understanding the factors influencing patient outcomes is necessary for optimizing trauma care. This study examines the characteristics and outcomes of trauma patients transported by HEMS to a trauma center in Saudi Arabia, analyzing injury mechanisms, intervention patterns, and survival rates.

Subjects and Methods

Study design and setting

This retrospective study included all trauma patients transported by air ambulance and evaluated at the Department of Emergency Medicine in a Level I trauma center in Riyadh between January 2021 and July 2024. This hospital, the only tertiary facility in Riyadh with an operational helicopter landing pad, manages approximately 1,000 HEMS transports annually.

Data collection

Patient data were obtained from the hospital's trauma registry and electronic medical records. The study included adults (≥14 years) with either blunt or penetrating traumatic injuries who were transported by air ambulance. A total of 545 patients were identified during the study period, of whom 541 met the inclusion criteria. Four patients under 14 years of age were excluded.

Statistical analysis

Statistical analyses were conducted using IBM SPSS Statistics Version 20.0 (IBM Corporation, Armonk, NY, USA). Descriptive statistics were used to summarize demographic data, with categorical variables reported as frequencies and percentages and continuous variables as medians with interquartile ranges (IQRs). Survival probabilities for hospital length of stay were estimated using the Kaplan-Meier method. Differences between groups were assessed using Fisher's exact test or Pearson's chi-squared test for categorical variables and the Kruskal-Wallis or Wilcoxon rank-sum test for continuous variables.

Multivariable linear regression was used to identify predictors of trauma team activation time, including variables with $p < 0.05$ in univariate analyses. Results are reported as beta coefficients (β) with 95% confidence intervals (CIs). A multivariable logistic regression model assessed predictors of at least one emergency department (ED) intervention (e.g., intubation, chest tube insertion, central line insertion, or thoracotomy), with results presented as odds ratios and 95% CIs. A multivariable Cox proportional hazards regression model estimated hazard ratios (HRs) for in-hospital mortality, with 95% CIs. A *P*-value < 0.05 was considered statistically significant for all analyses.

Results

Demographic and prehospital characteristics

This study included 541 patients transported by HEMS. Most patients were men (n = 462; 85.4%) and younger

Table 1. *Demographic and prehospital characteristics.*

Characteristic		N (%)
Trauma Level	1	57 (10.5)
	2	311 (57.5)
	3	173 (32)
Age (years)	<30	247(45.8)
	30 to <45	220 (40.7)
	45 to <60	54 (10)
	60 or more	20 (3.7)
Gender	Male	462 (85.4)
	Female	79 (14.6)
Injury Mechanism	Motor vehicle accident	469 (86.7)
	Motorcycle accident	30 (5.5)
	Pedestrian	25 (4.6)
	Fall	7 (1.3)
	Stab wound	2 (0.4)
	Burn	2 (0.4)
	Others	6 (1.1)
Comorbidities	None	457 (84.5)
	Diabetes	28 (5.2)
	Hypertension	27 (5)
	Asthma	11(2)
	Cardiac disease	4 (0.7)
	Dyslipidemia	5 (0.9)
	Seizure	3 (0.6)
	Kidney disease	2 (0.4)
	Stroke	2 (0.4)
Location of Pickup by the Helicopter	Missing location of helicopter pickup	530 (97.9)
	AlKharj	3 (0.6)
	Outside Riyadh	2 (0.4)
	Desert	2 (0.4)
	AlMuzahmeiah Hospital	1 (0.2)
	Mountain	1 (0.2)
	AlHota	1 (0.2)
Involved Injury	Extremities	299 (55.3)
	Head	232 (42.9)
	Chest	173 (32)
	Abdomen	137 (25.3)
	Facial bone	122 (22.6)
	Back	100 (18.5)
	Spine	99 (18.3)
	None	76 (14)
Type of Injury	Blunt	512 (98)
	Penetrating	65 (12.4)
	Missing type of injury	18 (3.3)
Procedures Performed During HEMS Transport	Intubation before arrival	71 (13.1)
	Chest tube insertion before arrival	2 (0.4)

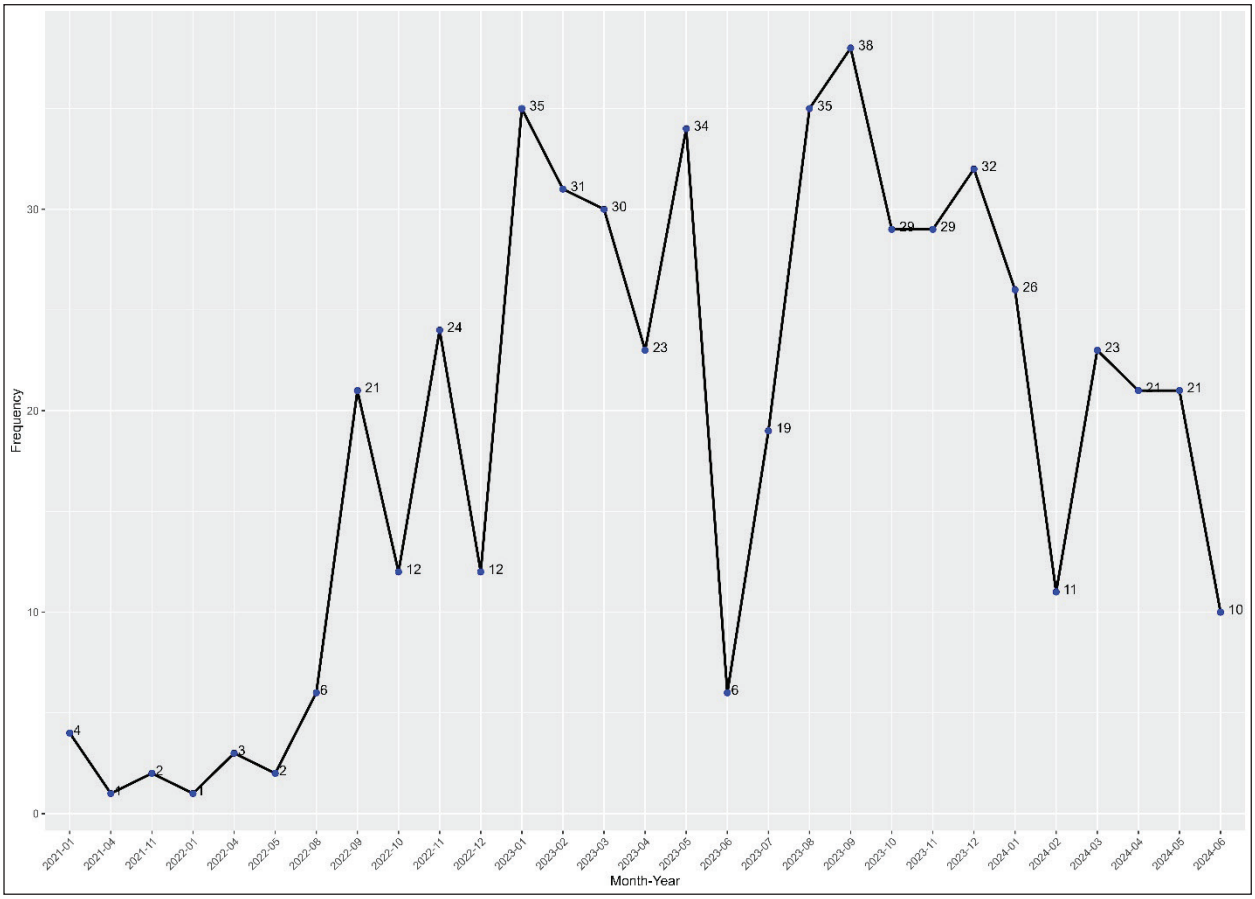

Figure 1. *HEMS transport trends.*

HEMS, helicopter emergency medical services.

than 30 years (n = 247; 46%). Trauma severity varied, with 57.5% classified as level 2 (n = 311), 32% as level 3 (n = 173), and 10.5% as level 1 (n = 57). The leading cause of injury was motor vehicle accidents (MVAs, n = 469; 87%), while falls (n = 7) and motorcycle accidents (n = 30) accounted for less than 10% combined. Blunt trauma was the predominant injury type (n = 512; 98%), with 12.4% involving penetrating wounds (n = 65). Most patients (n = 457; 85%) had no reported comorbidities, though diabetes (n = 28; 5.2%) and hypertension (n = 27; 5.0%) were the most common among those with underlying conditions. The most frequently injured sites were the extremities (n = 299; 55.3%) and head (n = 232; 43%). The location of helicopter pickup was documented in only 2% of cases (n = 11), while the remainder had missing or undocumented location data. Prehospital interventions were common, with intubation performed in 13.1% of patients (n = 71) and chest tube insertion in 0.4%. Table 1 summarizes the demographic and prehospital characteristics of patients transported by HEMS.

Trend analysis

HEMS transport frequency fluctuated over time, gradually increasing in early 2021. Peaks were observed in January 2023 (35 transports), August 2023 (35 transports), and September 2023 (38 transports), followed by a decline into 2024, stabilizing between 10 and 26 transports per month. Figure 1 illustrates the trend in HEMS transports over the study period. Most transports occurred in the afternoon (46.4%) and morning (41.0%), collectively accounting for 87.4%. Fewer transports occurred in the evening (2.0%) and at night (10.5%).

Patient characteristics upon arrival and ED stay

At trauma center arrival, the median Glasgow Coma Scale (GCS) score was 15.0 (IQR 14.0-15.0), with 73% of patients (n = 395) having a GCS of 15. The median systolic blood pressure was 129.0 mmHg (IQR 118.0-141.0), diastolic blood pressure was 81.0 mmHg (IQR 71.0-92.0), heart rate was 92 bpm (IQR 80.0-105.0), and oxygen saturation was 98% (IQR 97.0-100.0). Intoxication was documented in 2.6% of patients (n = 14). ED interventions included intubation (7%), chest tube insertion (7.4%), and central line placement (9.6%). Trauma team activation occurred in 28.5% of cases, with a median activation time of 11 minutes (IQR 5-24). The median ED length of stay was 8.8 hours (IQR 5.9-13.8). Cardiac arrest occurred in 0.7% (n = 4) of patients, with three deaths in the ED. Most patients (51.2%, n = 277) were discharged home, while 20.9% were admitted to the general ward and 16.3% to the intensive care unit (ICU). Tables 2 and 3 summarize patient characteristics upon arrival and during the ED stay.

***Table 2**. Characteristics of patients upon arrival and during stay in the ED.*

Characteristic		N (%)
Arrival Time	Morning (6:00-12:00)	222 (41)
	Afternoon (12:00-18:00)	251 (46.4)
	Evening (18:00-12:00)	11 (2)
	Midnight (12:00-6:00)	57 (10.5)
Interventions Performed in the ED	Intubation	38 (7)
	Chest tube insertion	40 (7.4)
	Central line insertion	52 (9.6)
	Thoracotomy	1 (0.2)
Glasgow Coma Scale	3	68 (12.57)
	4	1 (0.18)
	5	3 (0.55)
	6	2 (0.4)
	7	4 (0.7)
	8	3 (0.55)
	9	2 (0.4)
	10	2 (0.4)
	11	3 (0.55)
	12	1 (0.18)
	13	16 (2.95)
	14	41 (7.57)
	15	395 (73)
Disposition from ED	Discharge home	277 (51.2)
	Ward	113 (20.9)
	ICU	88 (16.3)
	OR	44 (8.1)
	Angio	6 (1.1)
	Other	13 (2.4)
Arrest in ED		4 (0.7)
Died in ED		3 (0.6)
Intoxicated		14 (2.6)
Disposition from the hospital	Discharge home	507 (93.7)
	Transfer to other hospital	19 (3.5)
	Long-term facility	3 (0.6)
	Death in the hospital	12 (2.2%)

ED, emergency department; ICU, intensive care unit.

Factors Influencing ED Interventions and Trauma Team Activation

ED interventions

Several factors were significantly associated with ED interventions in univariate analysis. Patients with level 1 trauma underwent interventions most frequently (39.8%). Injury type also influenced intervention rates, with higher rates among those with abdominal injuries (50.5% vs. 20.1%, $p < 0.001$), back injuries (28.0% vs. 16.5%, $p = 0.010$), extremity injuries (67.7% vs. 52.7%, $p = 0.008$), spine injuries (26.9% vs. 16.5%, $p = 0.019$), chest injuries (66.7% vs. 24.8%, $p < 0.001$), and head injuries (77.4% vs. 35.7%, $p < 0.001$). Patients with penetrating injuries had significantly higher intervention rates than those with blunt trauma (23.6% vs. 10.1%, $p < 0.001$). Intubation before arrival was strongly associated with ED interventions (51.6% vs. 5.1%, $p < 0.001$). In multivariable regression analysis, head injuries ($p = 0.015$), chest injuries ($p = 0.013$), and prehospital intubation ($p < 0.001$) were significant predictors of ED interventions. Table 4 presents the results of inferential and regression analyses on factors influencing ED interventions.

***Table 3**. Clinical characteristics and length of stay.*

Characteristic	Median (IQR)
Systolic blood pressure (mmHg)	129.0 (118.0-141.0)
Diastolic blood pressure (mmHg)	81.0 (71.0-92.0)
Heart rate (beat/min)	92.0 (80.0-105.0)
Respiratory rate (breath/min)	20.0 (19.0-23.0)
Oxygen saturation (%)	98.0 (97.0-100.0)
Time to trauma team activation (minutes)	11.0 (5.0-24.0)
Length of stay in the ED (hours)	8.8 (5.9-13.8)
Length of stay in the hospital (days)	0.6 (0.4-9.7)

ED, emergency department; IQR, interquartile range.

Trauma Team Activation

Trauma team activation times were shortest for patients with level 1 trauma, with a median of 6.0 minutes (IQR 4.0-13.0), compared with longer times for levels 2 and 3. Patients with head and chest injuries had faster activation than those without such injuries. Intubated patients experienced the shortest activation times (median 6.0 minutes, IQR 4.0-12.0) compared to non-intubated patients (median 18.0 minutes, IQR 9.0-50.0, $p < 0.001$). Central line insertion was also associated with shorter activation times (median 8.5 minutes, IQR 4.0-14.8) compared with those who did not undergo central line insertion (median 12.0 minutes, IQR 5.0-27.0, $p = 0.022$). In multivariable regression analysis, prehospital intubation was a significant predictor of faster trauma team activation (beta = −69.3, 95% CI −137 to −1.50, $p = 0.047$), while other variables were not statistically significant. Table 5 presents the results of inferential and regression analyses on trauma team activation.

Survival analysis and factors associated with mortality

Kaplan-Meier survival analysis showed a gradual decline in survival over time. At 14 days, survival probability was 95.2% (95% CI 92.2%-98.4%), decreasing to 93.3% (95% CI 89.4%-97.4%) at 30 days.

Several factors were significantly associated with in-hospital mortality. Patients with level 1 trauma had the highest mortality rate (75.0%), compared with those in levels 2 (16.7%) and 3 (8.3%, $p < 0.001$). Mortality was also significantly associated with abdominal injuries (58.3% vs. 24.6%, $p = 0.014$) and head injuries (91.7% vs. 41.8%, $p < 0.001$). Prehospital intubation was strongly correlated with mortality, with 83.3% of deceased patients intubated before arrival, compared with 11.5%

***Table 4**. Inferential and regression analyses of undergoing any interventions inside the ED.*

Characteristic		Undergoing any ED interventions			Multivariable regression		
		No, N (%)	Yes, N (%)	*p* Value	OR	95% CI	*P*-value
Total		448 (82.8)	93 (17.2)		Reference	Reference	
Trauma level	1	20 (4.5)	37 (39.8)	<0.001			
	2	259 (57.8)	52 (55.9)		1.23	0.40, 4.03	0.724
	3	169 (37.7)	4 (4.3)		0.33	0.06, 1.60	0.175
Age (years)	<30	199 (44.5)	47 (50.5)	0.718			
	30 to <45	184 (41.2)	36 (38.7)				
	45 to <60	46 (10.3)	8 (8.6)				
	60 or more	18 (4)	2 (2.2)				
Gender	Male	384 (85.7)	78 (83.9)	0.647			
	Female	64 (14.3)	15 (16.1)				
Injury mechanism	Motor vehicle accident	385 (85.9)	84 (90.3)	0.148			
	Motorcycle accident	27 (6.0)	3 (3.2)				
	Pedestrian	22 (4.9)	3 (3.2)				
	Fall	6 (1.3)	1 (1.1)				
	Stab wound	0 (0)	2 (2.2)				
	Burn	2 (0.4)	0 (0)				
	Others	6 (1.3)	0 (0)				
Involved injury	Abdomen	90 (20.1)	47 (50.5)	<0.001	1.62	0.87, 3.00	0.122
	Back	74 (16.5)	26 (28)	0.010	1.27	0.55, 2.84	0.565
	Extremities	236 (52.7)	63 (67.7)	0.008	1.19	0.63, 2.28	0.596
	Spine	74 (16.5)	25 (26.9)	0.019	0.78	0.34, 1.73	0.546
	Chest	111 (24.8)	62 (66.7)	<0.001	2.24	1.19, 4.27	0.013
	Head	160 (35.7)	72 (77.4)	<0.001	2.28	1.19, 4.51	0.015
Type of injury	Blunt	424 (97.7)	88 (98.9)	0.700			
	Penetrating	44 (10.1)	21 (23.6)	<0.001	1.51	0.72, 3.09	0.264
Intubation before arrival		23 (5.1)	48 (51.6)	<0.001	8.08	2.93, 23.8	<0.001
Chest tube insertion before arrival		0 (0)	2 (2.2)	0.029	926,700	NA	0.982

ED, emergency department; OR, odds ratio; CI, confidence interval.

of survivors ($p < 0.001$). Mortality was also associated with chest tube insertion (41.7% vs. 6.6%, $p < 0.001$) and central line insertion (33.3% vs. 9.1%, $p = 0.021$). However, in the multivariable hazard regression model, none of these factors remained statistically significant after adjustment. Table 6 presents factors associated with patient mortality.

Discussion

This study examines the characteristics and outcomes of trauma patients transported by HEMS to a trauma center in Riyadh, Saudi Arabia, to inform strategies for optimizing prehospital care and improving patient outcomes.

Blunt trauma from MVAs was the leading cause of injury, consistent with existing literature identifying MVAs as the primary reason for trauma requiring air transport [10]. This contrasts with regions experiencing higher violence rates, where penetrating injuries, such as gunshot wounds, are more prevalent [11]. The most frequently injured sites were the extremities (55.3%) and head (43%), a pattern also observed in other HEMS trauma systems, reflecting high-velocity accidents [11,12]. The gender and age distribution in this study aligns with prior research, showing an overrepresentation of younger male patients in trauma-related HEMS transports [13,14].

A notable finding was that 62.6% of patients had no reported comorbidities, likely reflecting the younger age group and relatively low prevalence of preexisting health conditions. The high rates of prehospital interventions, including intubation (13.1%), central line insertion (9.6%), and chest tube insertion (7.4%), underscore the critical role of HEMS in managing severe trauma. These rates are consistent with findings from other high-resource HEMS systems, where advanced care is frequently administered during transport to trauma centers [15,16].

Transport volumes fluctuated over time, with a notable increase in 2023, particularly in January, August, and September, reflecting periods of heightened demand. This pattern is consistent with global trends in HEMS utilization, where transport frequency varies due to multiple influencing factors [16–18]. The decline in transport volumes in early 2024, following the peaks of 2023, suggests a stabilization period. In this study, most HEMS operations occurred in the afternoon (46.4%) and morning (41.0%), accounting for 87.4% of all transports. This finding contrasts with other studies reporting that

***Table 5**. Inferential and regression analyses of the time to trauma activation.*

Characteristic		Time to trauma activation (minutes)			Multivariable regression		
		Median (IQR)		*P*-Value	Beta	95% CI	*P*-Value
Trauma level	1	6.0 (4.0-13)		<0.001	11.3	−113, 135	0.859
	2	13.5 (6.0-33.3)			6.63	−103, 116	0.906
	3	53.0 (9.5-87)			Reference	Reference	
Age (years)	<30	10.0 (5.0-23.0)		0.054			
	30 to <45	10.0 (5.0-20)					
	45 to <60	14.0 (11.0-27)					
	60 or more	56.5 (22-96.3)					
Gender	Male	10.0 (5.0-22.0)		0.147			
	Female	16.0 (7.0-33.0)					
Injury mechanism	Motor vehicle accident	11.0 (5.0-26.0)		0.648			
	Motorcycle accident	9.5 (4.5-16.0)					
	Pedestrian	14.0 (10.5-23.0)					
	Fall	5.0 (5.0-5.0)					
	Stab wound	9.0 (9.0-9.0)					
	Others	8.5 (6.8-10.3)					
Involved injury	Location	**No**	**Yes**	0.051			
	Abdomen	13.0 (7.5-27.5)	8.0 (5.0-19.0)				
	Back	10.5 (5.0-25.8)	12.0 (4.3-19.0)	0.746			
	Extremities	7.0 (4.0-15.0)	12.0 (5.0-26.0)	0.107			
	Spine	11.0 (5.0-25.3)	11.5 (4.0-19.0)	0.459			
	Chest	12.0 (6.0-32.0)	10.0 (4.0-19.0)	0.022	−40.3	−88.1, 7.52	0.101
	Facial bone	10.0 (5.0-24.5)	12.0 (5.0-24.0)	0.839			
	Head	14.0 (6.0-56.3)	10.0 (4.0-19.5)	0.016	−3.65	−58.6, 51.3	0.897
Type of injury	Type	**No**	**Yes**				
	Blunt	3.0 (2.5-7.5)	11.0 (5.0-25.5)	0.117			
	Penetrating	12.0 (5.0-31.0)	10.0 (5.0-15.0)	0.110			
Intubation before arrival	No	18.0 (9.0-50.0)		<0.001	Reference	Reference	
	Yes	6.0 (4.0-12.0)			−69.3	−137, −1.50	0.047
Chest tube insertion before arrival	No	11.0 (5.0-24.8)		0.821			
	Yes	9.5 (7.8, 11.3)					
Intubation in ED	No	10.0 (5.0-22.0)		0.177			
	Yes	14.0 (6.0-31.5)					
Chest tube insertion in ED	No	12.0 (5.0-26.3)		0.092			
	Yes	7.5 (4.0-18.3)					
Central line insertion in ED	No	12.0 (5.0-27.0)		0.022	Reference	Reference	
	Yes	8.5 (4.0-14.8)			7.41	−45.6, 60.5	0.785
Thoracotomy in ED	No	11.0 (5.0-24.5)		0.584			
	Yes	6.0 (6.0-6.0)					

ED, emergency department; IQR, interquartile range; CI, confidence interval.

over half of air medical transports occur during nighttime or early morning hours [19].

Overtriage is a well-documented concern in HEMS, with studies indicating that many patients do not require the specialized care of air transport [20,21]. A key indicator is that up to 25% of HEMS patients are discharged within 24 hours of transport. Consistent with prior findings, this study revealed that more than half of the patients were discharged home immediately without requiring ED interventions [20,21]. Most had a GCS score of 15 upon arrival, indicating alertness and consciousness, with stable initial vital signs. These findings suggest that many patients could have been managed without helicopter transport, highlighting concerns about overtriage in HEMS.

However, trauma team activation occurred in 28.5% of cases, with a median activation time of 11 minutes. Faster activation was observed in patients with head and chest injuries, emphasizing the importance of timely care. Similarly, a study from the United Kingdom found that trauma team activation was common for HEMS patients with a GCS above 10, particularly in cases of

***Table 6**. Factors associated with patient mortality.*

Characteristic		Death			Multivariable regression		
		No, N (%)	Yes, N (%)	*P*-Value	HR	95% CI	*P*-Value
Total		529 (97.78)	12 (2.2)				
Trauma level	1	48 (9.1)	9 (75)	<0.001	0.56	0.02, 16.0	0.736
	2	309 (58.4)	2 (16.7)		0.19	0.01, 3.13	0.245
	3	172 (32.5)	1 (8.3)		Reference	Reference	
Age (years)	<30	238 (45.1)	8 (66.7)	0.233			
	30 to <45	217 (41.1)	3 (25)				
	45 to <60	54 (10.2)	0 (0)				
	60 or more	19 (3.6)	1 (8.3)				
Gender	Male	453 (85.6)	9 (75)	0.397			
	Female	76 (14.4)	3 (25)				
Injury mechanism	Motor vehicle accident	458 (86.6)	11 (91.7)	0.684			
	Motorcycle accident	30 (5.7)	0 (0.0)				
	Pedestrian	24 (4.5)	1 (8.3)				
	Fall	7 (1.3)	0 (0.0)				
	Stab wound	2 (0.4)	0 (0.0)				
	Burn	2 (0.4)	0 (0.0)				
	Others	6 (1.1)	0 (0.0)				
Involved injury	Abdomen	130 (24.6)	7 (58.3)	0.014	1.11	0.34, 3.62	0.866
	Back	98 (18.5)	2 (16.7)	>0.999			
	Extremities	291 (55)	8 (66.7)	0.422			
	Spine	96 (18.1)	3 (25)	0.467			
	Chest	168 (31.8)	5 (41.7)	0.534			
	Facial bone	118 (22.3)	4 (33.3)	0.482			
	Head	221 (41.8)	11 (91.7)	<0.001	2.67	0.24, 30.2	0.866
	None	76 (14.4)	0 (0)	0.390			
Type of injury	Blunt	502 (98)	10 (2)	>0.999			
	Penetrating	63 (12.3)	2 (20)	0.359			
Intubation before arrival		61 (11.5)	10 (83.3)	<0.001	5.96	0.42, 84.4	0.187
Chest tube insertion before arrival		2 (0.4)	0 (0)	>0.999			
Intubation in ED		37 (7.0)	1 (8.3)	0.587			
Chest tube insertion in ED		35 (6.6)	5 (41.7)	<0.001	2.11	0.62, 7.16	0.232
Central line insertion in ED		48 (9.1)	4 (33.3)	0.021	0.55	0.16, 1.94	0.353
Thoracotomy in ED		1 (0.2)	0 (0.0)	>0.999			

ED, emergency department; IQR, interquartile range; CI, confidence interval.

severe head or chest injuries [15]. A key finding was the strong association between prehospital intubation and higher rates of ED interventions. Intubated patients required significantly more interventions (51.6%) than non-intubated patients (5.1%), indicating that early intubation often reflects higher acuity and the need for more complex care. Other studies have also shown that HEMS patients requiring intubation experience higher ED intervention rates, emphasizing the critical role of prehospital care in preparing patients for urgent treatment before arrival [22–24].

Survival analysis demonstrated a decline in survival rates from 95.2% at 14 days to 93.3% at 30 days. Key mortality factors included trauma severity, head and abdominal injuries, and prehospital intubation. The high mortality rate associated with head injuries (91.7% of deceased patients) aligns with findings from other studies reporting similar outcomes in trauma patients with severe head injuries transported by HEMS [19]. Abdominal injuries were strongly associated with mortality in this study (58.3%), a trend identified as a major predictor of poor outcomes in trauma patients [25,26]. Other research has also found that prehospital intubation is associated with poorer survival rates [24]. The lack of significant findings in the multivariable regression model highlights the complexity of trauma care, where multiple factors complicate the identification of independent mortality predictors.

Limitations and Future Research

This study has several limitations, including missing data on helicopter pickup locations, which are crucial for assessing response times and transport delays. Additionally, the absence of critical information for some patients, such as injury type (blunt or penetrating), limited subgroup analysis, and reduced the overall applicability of the results. Since this study was conducted at a single center, the findings may not be broadly generalizable. Future studies should address these limitations and incorporate multicenter, large-scale research to better understand the clinical outcomes of helicopter transport for trauma patients.

Conclusion

This study examined the characteristics and outcomes of trauma patients transported by HEMS. The key findings highlight a predominance of young male patients, with MVAs as the leading cause of injury. Blunt trauma was the most common injury type, particularly affecting the extremities and head. Notably, many patients had stable vital signs and were discharged home without requiring ED interventions, suggesting a potential issue of overtriage. Survival analysis identified trauma severity, head and abdominal injuries, and prehospital intubation as significant factors associated with mortality. These findings have important implications for trauma care in Saudi Arabia, where HEMS continues to expand. Optimizing prehospital triage protocols could enhance patient selection, reduce unnecessary air transports, and improve overall trauma system efficiency. Future multicenter studies should further investigate HEMS utilization, refine triage guidelines, and assess long-term patient outcomes to strengthen prehospital trauma care and improve survival rates.

List of abbreviations

bpm	Beats per minute
CI	Confidence interval
ED	Emergency department
GCS	Glasgow Coma Scale
GEMS	Ground Emergency Medical Services
HEMS	Helicopter Emergency Medical Services
HR	Hazard ratio
ICU	Intensive care unit
IQR	Interquartile range
MVA	Motor vehicle accident
OR	Odds ratio

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Conflict of interests

The authors declare no conflicts of interest.

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Consent for participate

Ethical approval was sought and obtained for the study from KAIMRC to access medical records. Patient confidentiality and autonomy regarding patients' identities were ensured throughout the study. No patient identifiers (e.g., medical record number, national ID, date of birth, and so on) were revealed in the data analysis or the published results. No direct patient contact was made. No interventions were conducted in cases of incomplete information. The patients' medical record numbers remained confidential and were accessed only by the research team members.

Ethical approval

Ethical approval was obtained from the Institutional Review Board (IRB) of the Deanship of Scientific Research (Ref No: 0000033224) (08/07/2024) at King Abdullah International Medical Research Center, Riyadh, Saudi Arabia. Participants were required to sign a consent form at the beginning of the survey.

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