

HELICOPTER TRANSPORT OF PEDIATRIC VERSUS ADULT TRAUMA PATIENTS

Stephen J. Kotch, MD, Brian E. Burgess, MD

ABSTRACT

Objective: Conflicting reports exist regarding the appropriate utilization of helicopter transport for victims of trauma. It has been suggested that adult patients are more severely injured compared with pediatric patients when transported by helicopter. The purpose of this study was to determine whether injury severity and survival probability in pediatric trauma patients were similar to those for adults when helicopter transport was utilized at a suburban trauma center. **Methods:** The authors conducted a retrospective review of all trauma patients transported by helicopter from the accident scene. Patients were identified from the Christiana Care Health System trauma registry from January 1995 to November 1999. Pediatric patients were defined as those aged 15 years and younger. Data collected were utilized to determine injury severity score (ISS), revised trauma score (RTS), and survival probability. **Results:** Nine hundred sixty-nine patients were transported; 143 were pediatric. There was no statistical difference noted in ISS (14.21 adult, 12.76 pediatric; $p = 0.1506$) and RTS (7.23 adult, 7.31 pediatric; $p = 0.1832$). Mean length of stay was less for the pediatric group (7.5 days adult, 5.2 days pediatric; $p = 0.008$). Survival probabilities were likewise similar for the two groups, yet the difference met statistical significance (0.92 adult, 0.95 pediatric; $p = 0.03$). **Conclusion:** Pediatric patients transported from the accident scene by helicopter have similar ISSs and RTSs compared with adults. These data suggest that prehospital selection criteria for the two groups are similar. **Key words:** helicopter; emergency medical services; trauma; triage; pediatrics; children; transport; injury severity; survival probability.

PREHOSPITAL EMERGENCY CARE 2002;6:306–308

Trauma is the primary cause of death in the first four decades of life in the United States.¹ Over the past 20 years, numerous advances have occurred in the care of trauma patients. There have been increased utilization of designated trauma centers, improvements in technology, and advanced training of physicians and prehospi-

tal providers. Since the early 1970s, helicopter transport has also seen rapid growth and popularity. Conflicting reports exist, however, regarding the benefit and appropriate use of air transport for victims of trauma.^{2–5}

Several studies have compared air versus ground transportation of trauma patients, yet direct comparison of pediatric and adult trauma patients transported by air is limited.³ Anecdotal experience suggests that pediatric patients are often transported by helicopter with less-severe injuries than adults. The purpose of this study was to determine whether pediatric patients transported directly from the accident scene by air were less severely injured than adults.

METHODS

We conducted a retrospective review of all trauma patients transported directly from the scene to a community-based Level 1 trauma center by helicopter. The state of Delaware receives its primary air medical support from the Delaware State Police Aviation Division. The state police operate two aircraft (Bell 407, Bell Longranger) during the hours of 0800 to 2400. Each aircraft is staffed by one pilot and a Nationally Registered Emergency Medical Technician–Paramedic, both of whom are police officers. An on-call crew is available during the remainder of the time. The Maryland State Police Aviation Division also transports trauma victims to our facility and can provide backup for the Delaware State Police. Aircraft are ideally dispatched at the time of incident alarm, or upon request of the incident commander on scene.

Subjects were identified utilizing the Christiana Care Health System trauma registry from January 1995 until November 1999. Pediatric patients were defined as less than or equal to 15 years of age. Data collected were used to determine mechanism of injury, revised trauma score (RTS), injury severity score (ISS), survival probability (SP), and hospital length of stay (LOS). Patients were excluded if they were transferred from another facility, or if data were incomplete for analysis. Statistical analysis was performed utilizing Mann-Whitney and Student's *t*-test. This study was approved by the Christiana Care Institutional Review Board.

RESULTS

During the study period, 969 patients were transported; 143 patients were pediatric and 819 were adult. Seven patients were excluded from analysis due to unknown age. There was no statistical difference

Received November 20, 2001, from Washington County Emergency Physicians, Washington County Hospital (SJK), Hagerstown, Maryland; the Department of Emergency Medicine, Emergency Medicine Residency Program, Christiana Care Health System (SJK, BEB), Newark, Delaware; and the Department of Emergency Medicine/Surgery, Thomas Jefferson University School of Medicine (BEB), Philadelphia, Pennsylvania. Revision received March 13, 2002; accepted for publication March 13, 2002.

Presented at the Society for Academic Emergency Medicine Regional Meeting, York, Pennsylvania, March 2000; and the American College of Emergency Physicians Scientific Assembly, Philadelphia, Pennsylvania, October 2000.

Address correspondence and reprint requests to: Stephen J. Kotch, MD, 11114 Shalom Lane, Hagerstown, MD 21742. e-mail: <kotchmd@aol.com>.

noted in RTS (7.23 adult, 7.31 pediatric; $p = 0.1832$) and ISS (14.21 adult, 12.76 pediatric; $p = 0.1506$). Mean LOS was 7.5 days for adult patients and 5.2 days for pediatric patients ($p = 0.008$) (Table 1). The SP was 0.92 for adults versus 0.95 for pediatric patients ($p = 0.03$).

DISCUSSION

Helicopter transport of trauma patients has been both praised and criticized. Conflicting evidence exists regarding reduction in transport time, morbidity, mortality, and hospital LOS.²⁻⁵ Pediatric patients represent approximately 10% of paramedic calls and often present a unique challenge from both treatment and transport perspectives.⁶

Moront et al. found that children transported by air were often more seriously injured than children transported by ground when comparing groups by Glasgow Coma Score (GCS), ISS, SP, and mortality.⁴ In their study, however, 83% of patients transported by air had an ISS of <15, a value previously associated with "serious" injury.^{1,7} The low mean ISS score we found for both groups likewise suggests that the majority of patients were not seriously injured. In contrast to this, Tortella et al. noted no difference in ISS between pediatric trauma patients transported by ground and air.³

As mentioned previously, data regarding pediatric helicopter transport are sparse. Even more lacking is the direct comparison between adult and pediatric aeromedical transports. This current study closely resembles the previously mentioned work by Tortella et al. No difference was noted when comparing the ISSs of adult and pediatric patients transported by helicopter ($p = 0.2023$).³ They also noted no difference in ISSs between pediatric patients transported by air and ground, while adults appeared to have a significant difference (18.0 vs 13.6, $p < 0.0001$).

Harrison et al. noted that pediatric patients were transferred by air to Level 1 trauma centers more quickly than adults with similar injuries.⁵ They measured aircraft activation times and noted a 34-minute mean difference between adults and children with similar GCSs. Whether this difference represents a more expedient transfer of young patients or a relative delay in the adult sample is unclear. These results may also reflect the overall comfort level of the emergency physician or surgeon in dealing with children who are victims of trauma. Prior to undertaking this study, we hypothesized that pediatric patients would have a significantly lower RTS, ISS, and LOS than adults transported by air. We also felt that paramedic comfort level with injured children would be less, thus leading to more frequent transport by air. Our data, however, did not suggest this.

Previous suggestions for appropriate helicopter use have included severe injury, potential salvage, and direct benefit from reduced transport time.⁸ These

TABLE 1. Results of the Study

	Blunt Mechanism of Injury	Penetrating Mechanism of Injury	Unknown Mechanism of Injury	
Age				
≤15 years	133	4	6	
>15 years	728	80	11	
	Total Patients Reviewed	Minimum	Maximum	Mean
Age				
Patients ≤15 years old	143	<1	15	8.55
Patients >15 years old	819	16	97	38.57
All patients	962	<1	97	34.45
Revised trauma score				
Patients ≤15 years old	129	<1	8	7.31
Patients >15 years old	790	<1	8	7.23
All patients	919	<1	8	7.23
Injury severity score				
Patients ≤15 years old	143	0	43	12.76
Patients >15 years old	819	0	66	14.21
All patients	962	0	66	14.01
Length of stay				
Patients ≤15 years old	137	<1	45	5.22
Patients >15 years old	782	<1	165	7.53
All patients	919	<1	165	7.15

guidelines, however, are largely subjective, which leads to the question of how can we objectively evaluate the need for air transport? In the urban setting, the Helicopter Utilization Audit Committee has established criteria for trauma scene flights: 1) >2 patients; 2) extrication >20 minutes; 3) heavy traffic patterns; and 4) difficult access by ground vehicles.⁹ Rhodes et al. found that unresponsiveness to verbal stimulus is 93% sensitive for predicting the need for air transport in adult patients, as this was usually associated with more severe injury.¹⁰ Moront et al. confirmed that GCS is sensitive and specific for identifying patients who may benefit from helicopter transport.⁴

One potential problem with studies such as this is comparing adults and pediatric patients utilizing uniform scoring systems. The RTS is a weighed summation of the systolic blood pressure, GCS, and respiratory rate.⁹ This tool has been well validated in the pediatric population and is the most widely used triage scoring system in trauma.^{7,11} The ISS is a measure of multiple anatomic injuries. Each body region is given a numerical score based on how severely injured.^{7,12} These values are then squared and added together to yield the final value. ISS scores of 15–20 have previously been suggested as indicating the need for triage to a regional trauma center.^{1,7} The only problem is that this score is typically obtained from medical records, and is of little help for prehospital personnel. However, the ISS has been shown to correlate well with the RTS. It also has been well validated as a

predictor of trauma mortality, hospital LOS, intensive care unit stay, and hospital billing.^{7,13,14}

Several key points should be taken from these findings. There appears to be no difference between ISS and RTS for adult and pediatric patients transported by air. This may indicate that selection criteria for air transport are the same for the two groups. However, both groups had a mean ISS that did not indicate "severe" injury. Whether this demonstrates mistriage or overtriage needs further evaluation. It is also difficult to interpret the decreased LOS for the pediatric group. A combination of medical, financial, and psychosocial factors likely attribute to this.

LIMITATIONS AND FUTURE STUDIES

This study is limited by its retrospective nature and the relatively small number of pediatric patients compared with the adults. Additionally, the data collected are largely dependent on the medical documentation of many individuals. Prospective studies following patients flown from the trauma scene may aid in improved data collection. Goals should be directed at formulating and testing specific objective criteria for trauma scene flights.

CONCLUSION

In our study population, pediatric patients transported directly from the trauma scene have ISSs and RTSs similar to those of adults. Survival probability is slightly greater, while hospital length of stay is less for pediatric patients. These data suggest that the prehospital selection criteria for helicopter transport is similarly utilized for the two groups. Overtriage within both groups remains potentially problematic until more refined criteria for air transport are established.

References

1. Braithwaite CE, Rosco M, McDowell R, Gallagher J, Proenca J, Spott MA. A critical analysis of on-scene helicopter transport on survival in a statewide trauma system. *J Trauma*. 1998;45:140-6.
2. Koury SI, Moorer L, Stone CK, Stapczynski JS, Thomas SH. Air versus ground transport and outcome in trauma patients requiring urgent operative interventions. *Prehosp Emerg Care*. 1998;2:289-92.
3. Tortella BJ, Sambol J, Lavery RF, Cudihy K, Nadzam G. A comparison of pediatric and adult trauma patients transported by helicopter and ground EMS: managed care considerations. *Air Med J*. 1996;15:24-8.
4. Moront ML, Gotschall CS, Eichelberger MR. Helicopter transport of injured children: system effectiveness and triage criteria. *J Pediatr Surg*. 1996;31:1183-6.
5. Harrison T, Thomas SH, Wedel SK. Interhospital aeromedical transport: air medical activation intervals in adult and pediatric trauma patients. *Am J Emerg Med*. 1997;15:122-4.
6. Paul TR, Marias M, Pons PT, Pons KA, Moore EE. Adult versus pediatric trauma care: is there a difference? *J Trauma*. 1999;47:455-9.
7. Furnival RA, Schunk JE. ABCs of scoring systems for pediatric trauma. *Pediatr Emerg Care*. 1999;15:215-21.
8. Burney RE, Fischer RP. Ground versus air transport of trauma victims: medical and logistical considerations. *Ann Emerg Med*. 1986;15:1491-5.
9. Norton R, Wortman E, Eastes L, Daya M, Hedges J, Hoyt J. Appropriate helicopter transport of urban trauma patients. *J Trauma*. 1996;41:886-91.
10. Rhodes M, Perline R, Aronson J. Field triage for on-scene helicopter transport. *J Trauma*. 1986;26:963-9.
11. Eichelberger MR, Gotschall CS, Sacco WJ, Bowman LM, Mangubat EA, Lowenstein AD. A comparison of the trauma score, the revised trauma score, and the pediatric trauma score. *Ann Emerg Med*. 1989;18:1053-60.
12. Aprahamian C, Cattey RP, Walker AP, Gruchow HW, Seabrook G. Pediatric trauma score. *Arch Surg*. 1990;125:1128-31.
13. MacKenzie EJ. Injury severity scales. *Am J Emerg Med*. 1984;2:537-49.
14. Tepas JJ, Ramenofsky ML, Mollitt DL, Gans BM, DiScala C. The pediatric trauma score as predictor of injury severity: an objective assessment. *J Trauma*. 1988;28:425-9.