BRIEF REPORT

A Prospective Study of the Impact of Multiple Patient Transports on Care Provided during Aeromedical Transport

Edmond A. Hooker, MD, Dorian Drigalla, MD, Daniel J. O'Brien, MD, Jodie Hignite, RN

Abstract

Objectives: The purpose of the current study was to determine reasons for multiple-patient transports using a helicopter emergency medical services (HEMS) and to observe for any negative impact on patient care caused by the presence of the second patient.

Methods: The study was a prospective observational study of all two-patient trauma transports (doubles) over a 12-month period, from January 2004 through December 2004. The authors selected a sample of 20% of single-patient transports (singles) from the same time period for comparison. Flight crews completed a study form after the flight. Information requested included Glasgow Coma Scale (GCS) score, Revised Trauma Score (RTS), and negative impact on care of the primary patient caused by transporting the secondary patient. Data were analyzed using Mann-Whitney rank test and descriptive statistics.

Results: There were a total of 59 double-trauma transports. A total of 269 single-trauma transports were identified for comparison. Although there was no statistically significant difference in GCS score or RTS (single vs. primary double), doubles never included the most severely injured trauma patients. The secondary patients from the doubles were the least severely injured. There were nine patients in whom the crew felt there was a negative impact from the second patient. Need for trauma center evaluation of the second patient and distance of transport were common reasons for double transports.

Conclusions: Patients transported as doubles do not include the most severely injured trauma patients. In only a small percentage of doubles did the second patient have a perceived impact on care of the primary patient.

ACADEMIC EMERGENCY MEDICINE 2008; 15:294–297 © 2008 by the Society for Academic Emergency Medicine

Keywords: air ambulances, outcomes measure, helicopter, transportation of patients, prospective

Helicopter emergency medical services (HEMS) transport has been demonstrated to benefit trauma patients.[1–5] Some authors have called in question the benefit of HEMS.[6–8] However, other authors have shown that direct transportation to a trauma center improves survival compared to initial treatment at a nontrauma center and subsequent transfer.[9] Most transports by HEMS are done with only one patient in the aircraft (singles). There is limited research on the number of two-patient transports or impact of transporting more than one trauma patient.[10–12] In these reports, there were 9% to 10% multiple patient transports. Tortella et al.[12] did examine the impact of multiple-patient transport on outcome with a retrospective study. In that study, the authors found no negative impact of transporting the second patient. The second patient was frequently less severely injured than the average patient transported by the flight service.

There have been no prospective studies on the transport of multiple trauma patients during flight by HEMS. The purpose of the current study was to identify the reasons for multiple-patient transports in our system and determine if there were any negative impacts on

From the Department of Health Services Administration, Xavier University (EAH), Cincinnati, OH; the Department of Emergency Medicine, University of Louisville (EAH, DJO), Louisville, KY; the Department of Emergency Medicine, Scott & White Memorial Hospital & Clinic, Texas A&M Health Science Center College of Medicine (DD), College Station, TX; STATCARE, Louisville, KY (JH).

Received August 6, 2007; revisions received October 15 and October 23, 2007; accepted November 11, 2007.

Jodie Hignite is currently with PHI, Inc., Lafayette, LA.

Presented at the Annual Meeting of the Society for Academic Emergency Medicine, New York, NY, May 21–25, 2005.

Address for correspondence and reprints: Edmond A. Hooker, MD; e-mail: hookere@xavier.edu.

ISSN 1069-6563
PII ISSN 1069-6563583

doi: 10.1111/j.1553-2712.2008.00047.x

either patient due to the transporting of the second patient.

METHODS

Study Design

The study was a prospective observational investigation of two-patient HEMS transports. The study was approved by the Human Studies Committee of the University of Louisville.

Study Setting and Population

This study setting was a HEMS with three bases of operation. All two-patient trauma transports (doubles) over a 12-month period from January 2004 through December 2004 were included. We selected 20% single-patient trauma transports (singles) from the same time period for comparison by taking every fifth flight. If the fifth flight was a medical flight or a two-patient transport, the next single transport was utilized.

Study Protocol

Flight crews completed a study form after every flight with multiple trauma patients. Information requested included designation of the primary patient, total scene time, transport time to trauma center, nature of the call, procedures performed, vital signs, age, Glasgow Coma Scale (GCS) score, Revised Trauma Score (RTS),[13] identification of who requested the second patient to be transported, identification of the reason given for transporting the second patient, and any perceived negative impact on care of the primary patient caused by transporting the secondary patient. To ensure 100% compliance with the study protocol, a physician and a nurse reviewed all flights to make sure that a multiple-patient flight was not missed. If a multiple-patient flight had occurred without the study sheet being completed, one of the investigators called the flight crew to get the information and completed the form. We also examined every fifth single-patient transport during 2004. The RTS, GCS score, time on scene, and age were compared to determine any differences between single- and double-patient transports.

Data Analysis

Data was analyzed using Mann-Whitney rank test and descriptive statistics. Nonparametric tests were utilized because the data were not normally distributed. Although multiple comparisons were made between the groups, all comparisons were specified before looking at the data. Therefore, the Bonferroni procedure was not utilized. Analysis was performed using Statistical Package for the Social Sciences Version 14 (SPSS-14, SPSS Inc., Chicago, IL).

RESULTS

During 2004, our flight program transported a total of 1,404 patients. There were 1,336 patients transported by rotorwing in 1,274 missions. In 62 of these missions, two patients were transported. Three of the doubles were medical cases and were excluded from the analysis. This left 59 double-trauma transports for evaluation. There were no transports with more than two patients. A total of 269 single-trauma patient transports were pulled to compare to the two-patient transports (every fifth chart). There were no statistically significant differences between the singles and primary patients of the doubles in GCS score or RTS (see Table 1). However, examining the range of values of the singles and double reveals that the singles were frequently more critically injured. The lowest GCS score for the primary double was 7, and the lowest for the secondary double was 13. Fifty-two of the 269 (19%) singles had a GCS score below 7. The lowest RTS for the primary double was 4.09, and the lowest for the secondary double was 7.11. There were 37 of 269 (14%) singles with a RTS below 4.09.

The scene times were similar; however, average flight time to the hospital was longer for single missions

Table 1
Comparison of Patients Transported as Part of a Multiple Patient Flight and Patients Transported as a Single Patient Flight

Variable	Singles	Doubles	
		Primary Patient	Secondary Patient
Total scene time (min)	19 ± 11	22 ± 14 (p = 0.080)	
Time from arrive scene to arrive hospital (min)	39 ± 17	40 ± 20 (p = 0.627)	
Flight time to hospital (min)	20 ± 9	17 ± 8 (p = 0.008)	
GCS	12.06 ± 4.44	13.82 ± 1.95*	14.68 ± 0.54†
Maximum	15	15	15
Minimum	3	7	13
RTS	6.89 ± 1.73	7.43 ± 0.91‡	7.80 ± 0.15§
Maximum	7.84	7.84	7.84
Minimum	2.20	4.09	7.11
Age (yr)	35.02 ± 17.85	28.80 ± 20.13¶	26.52 ± 19.1‖

*p = 0.148, double primary vs. single.
†p < 0.001, double secondary vs. single; p = 0.007; double secondary vs. double primary.
‡p = 0.130, double primary vs. single.
§p < 0.001, double secondary vs. single; p = 0.014, double secondary vs. double primary.
¶p = 0.005, double primary vs. single.
‖p < 0.001, double secondary vs. single; p = 0.552, double secondary vs. double primary.

Table 2
Reasons Why Second Patient Was Transported ($n = 59$)

Reason	Number
Crew felt that patient needed trauma center evaluation	36
Distance to the trauma center	14
Convenience of the ground ambulance*	7
No reason given	2

*In many cases these were rural emergency medical services (EMS) and if they had to transport the patient to a trauma center it would have left their community with limited EMS resources.

(20 ± 9 min vs. 17 ± 8 min). The average age of single patients was higher than the average age of the primary patient on the doubles (35.0 years vs. 28.8 years; $p < 0.005$). The secondary patients from the doubles were not as injured as either the singles or the primary patient from the doubles (Table 1).

The flight crew did feel that the delay might have had an impact in nine cases. There were five cases where the crew felt that transporting the second patient caused delays in the transport of the first patient. None of these patients died or had any apparent negative effects from the perceived delay. There was one primary patient of a double in which the crew could not start a second intravenous line because of limited access. Again, the patient survived and suffered no apparent negative effects. In three cases, the crew felt that there was limited ability to assess the primary patient because of transporting the secondary patient. Two of these primary patients died. One patient died of an aortic transection, and it does not appear from reviewing the medical record that there was anything else that could have been done differently to save that patient. The total scene time for this patient was 11 minutes. The other patient was a 75-year-old male who had significant multiple injuries, including traumatic brain hemorrhage and multiple fractures, and an expected survival, based on Trauma and Injury Severity Score (TRISS) methodology, of 3.4%. The total scene time for this patient was 12 minutes.

The most common reason for taking a second patient was that it was felt that the second patient also met criteria for trauma center evaluation (Table 2). In almost every case (55 of 59 doubles), the emergency medical providers on the scene requested that the second patient be transported. In two cases, the HEMS crew initiated the transport of the second patient on a scene flight. There were only two doubles that were not scene flights, and in both cases the emergency physician initiated the double. There were 19 cases where the crew said that both patients were equally injured. The flight time from the scene to the trauma center averaged 17 minutes (minimum, 6 minutes; maximum, 47 minutes).

DISCUSSION

The results of our study indicate that it appears to be safe to transport two trauma patients in the same helicopter, as long as neither is severely injured (GCS score < 7 or RTS < 4). During the year of study, no patient with a GCS score below 7, or a RTS below 4, was flown as a double. There appears to have been a selection by the flight crews to avoid double transports when patients were severely injured. The results of the current study confirm the results of Tortella et al.,[12] who also showed that there did not appear to be any adverse effect on mortality from transporting the second patient. However, Tortella et al. did not document the range of GCS scores or RTS. It is likely that there may have been patient selection by flight crews in that study. The strength of the current study is its prospective determination of any negative impact of the second patient and determination of which patient was the primary patient.

We were unable to detect any significant differences between the patients transported as singles and the primary patient of the doubles with regard to RTS, GCS score, average scene time, average time from arrival on scene to arrival at the trauma center. However, the lack of the most severely injured patients in any of the double transports limits the generalizability of the results to all trauma victims. It may be that the results of the current study could be utilized to develop criteria for selection of patients appropriate for two-patient transports. We did note that the second patient of the double transport was, on average, less severely injured.

The intention of the current study was to prospectively examine any negative impact from the perspective of the flight crew. Retrospectively examining differences in outcomes is unlikely to identify any significant differences due to the small number of double flights in any one program. Our crews identified a total of nine transports of the 59 where there was some perceived negative impact on patient care. These included five cases of delayed transport, three cases of difficulty completing assessment, and one case of not being able to start a second intravenous line. In the five cases where the crew felt that there was a delay in transport due to the second patient, there were no deaths. In the two of the three cases where the crew felt that there was inability to completely assess the patient, there were two deaths. However, the scene times in those cases were 11 and 12 minutes respectively. There were no procedures that could not be performed due to the presence of the second patient.

In comparing our results to those of Tortella et al.,[12] we noted, on average, that our missions were almost as far from the trauma center. The flight times to the hospital for Tortella et al. averaged 9 minutes for singles and 10 minutes for doubles. Our flight times to the hospital averaged 17 minutes. Our HEMS flies into many rural areas, with limited advanced life support capabilities and long transport times to the hospital. Many of these rural EMS programs are basic life support–level responders. This may result in the need for more two-patient transports.

LIMITATIONS

There may have been some more severely injured patients for whom the flight crews refused to fly a second patient, because of the need to care for the primary

patient. However, there is no way to go back and determine retrospectively if a second patient was refused because of the critical nature of a primary patient. It is likely that there were times when the crew refused to transport a second patient because of the critical nature of the primary patient. In examining the doubles, we found no patients with GCS score below 7 or RTS below 4.09 who were transported. In the singles, there were frequently patients with lower GCS score and RTS transported. Future studies should have crews document all request for transport of a second patient that are denied.

The current research is limited by its study size. Although this is the largest series in the literature of two-patient transports, a larger study may have shown a statistically significant difference in the RTS or GCS score between the primary patient of the double and the patient transported as a single. In the single transports, there were a large number of patients who had lower GCS scores and RTS than the sickest patient transported as a double. It is likely that there is a difference between patients selected for a single transport and those transported as a double.

Another limitation is the lack of Injury Severity Score (ISS) comparison between the two groups. Owing to the unavailability of data from our trauma registry for all patients, we were unable to obtain ISS for all patients, which would make any comparison meaningless.

CONCLUSIONS

There appears to be no negative impact of transporting a second trauma patient during HEMS transportation of selected trauma patient. The patients transported as doubles never included the most severely injured trauma patients, and the secondary patient is frequently much less severely injured. HEMS should consider transporting more than one patient when both patients require trauma center evaluation; however, when the primary patient is severely injured, crews must be given the discretion to refuse transport of the second patient.

The authors thank Kathy Spry, RN, and Robert Smith, MD, for their work in helping to make sure that all data were collected in a timely manner.

References

1. Sampalis JS, Lavoie A, Williams JI, Mulder DS, Kalina M. Impact of on-site care, prehospital time, and level of in-hospital care on survival in severely injured patients. J Trauma. 1993; 34:252–61.
2. Baxt WG, Moody P. The impact of a rotorcraft aeromedical emergency care service on trauma mortality. JAMA. 1983; 249:3047–51.
3. Frankema SP, Ringburg AN, Steyerberg EW, Edwards MJ, Schipper IB, van Vugt AB. Beneficial effect of helicopter emergency medical services on survival of severely injured patients. Br J Surg. 2004; 91:1520–6.
4. Oppe S, De Charro FT. The effect of medical care by a helicopter trauma team on the probability of survival and the quality of life of hospitalised victims. Accid Anal Prev. 2001; 33:129–38.
5. Thomas SH. Helicopter emergency medical services transport outcomes literature: annotated review of articles published 2000–2003. Prehosp Emerg Care. 2004; 8(3):322–33.
6. Brathwaite CE, Rosko 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; 45:140–4.
7. Cunningham P, Rutledge R, Baker CC, Clancy TV. A comparison of the association of helicopter and ground ambulance transport with the outcome of injury in trauma patients transported from the scene. J Trauma. 1997; 43:940–6.
8. Shatney CH, Homan SJ, Sherck JP, Ho C. The utility of helicopter transport of trauma patients from the injury scene in an urban trauma system. J Trauma. 2002; 53:817–22.
9. Sampalis JS, Denis R, Frechette P, Brown R, Fleiszer D, Mulder D. Direct transport to tertiary trauma centers versus transfer from lower level facilities: impact on mortality and morbidity among patients with major trauma. J Trauma. 1997; 43:288–95.
10. Gabram SG, Libby MC, Jacobs LM, et al. Peer review of on-scene air medical triage in Connecticut. Conn Med. 1994; 58:3–12.
11. Criddle LM. The hot-loaded patient: review and analysis of 1 year's experience. Air Med J. 1999; 18:140–4.
12. Tortella BJ, Lavery RF, Corriere C, Bell RA, Mann KJ. The impact of multiple patient transport on patient care in helicopter emergency medical services. Air Med J. 1996; 15:108–10.
13. Champion HR, Sacco WJ, Copes WS, Gann DS, Gennarelli TA, Flanagan ME. A revision of the Trauma Score. J Trauma. 1989; 29:623–9.