The Impact of Aeromedical Response to Patients With Moderate to Severe Traumatic Brain Injury

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Study objective: Aeromedical crews offer an advanced level of practice and rapid transport to definitive care; however, their efficacy remains unproven. Previous studies have used relatively small sample sizes or have been unable to adequately control for the effect of other potentially influential variables. Here we explore the impact of aeromedical response in patients with moderate to severe traumatic brain injury.

Methods: This was a retrospective analysis using our county trauma registry. All patients with head Abbreviated Injury Score of 3 or greater were included; interfacility transfers were excluded. The impact of aeromedical response was determined using logistic regression, adjusting for age, sex, mechanism, preadmission Glasgow Coma Scale score, head Abbreviated Injury Score, Injury Severity Score, and the presence of preadmission hypotension. Propensity scores were used to account for variability in selection of patients to undergo air versus ground transport. Patients with moderate and severe traumatic brain injury, as defined by head Abbreviated Injury Score and Glasgow Coma Scale score, were compared. Finally, aeromedical patients undergoing field intubation were compared with ground patients undergoing emergency department (ED) intubation.

Results: A total of 10,314 patients meeting all inclusion and exclusion criteria and with complete data sets were identified and included 3,017 transported by aeromedical crews. Overall mortality was 25% in the air- and ground-transported cohorts, but outcomes were significantly better for the aeromedical patients when adjusted for age, sex, mechanism of injury, hypotension, Glasgow Coma Scale score, head Abbreviated Injury Score, and Injury Severity Score (adjusted odds ratio [OR] 1.90; 95% confidence interval [CI] 1.60 to 2.25; $P<.0001$). Good outcomes (discharge to home, jail, psychiatric facility, rehabilitation, or leaving against medical advice) were also higher in aeromedical patients (adjusted OR 1.36; 95% CI 1.18 to 1.58; $P<.0001$). The primary benefit appeared to be in more severely injured patients, as reflected by head Abbreviated Injury Score and Glasgow Coma Scale score. Improved survival was also observed for air-transported patients intubated in the field versus ground-transported patients given emergency intubation in the ED (adjusted OR 1.42; 95% CI 1.13 to 1.78; $P<.001$).

Conclusion: Here we analyze a large database of patients with moderate to severe traumatic brain injury. Aeromedical response appears to result in improved outcomes after adjustment for multiple influential factors in patients with moderate to severe traumatic brain injury. In addition, out-of-hospital intubation among air-transported patients resulted in better outcomes than ED intubation among ground-transported patients. Patients with more severe injuries appeared to derive the greatest benefit from aeromedical transport. [Ann Emerg Med. 2005;46:115-122.]

0196-0644/$-see front matter

doi:10.1016/j.annemergmed.2005.01.024

Editor's Capsule Summary

What is already known on this topic

Aeromedical transport is frequently used for head-injured patients but there have been few data to support its effectiveness compared with ground emergency medical services transport.

What question this study addressed

This retrospective study of 10,314 patients, which used propensity scores to account for variability in patient selection, evaluated the impact of aeromedical response on the outcomes of patients with moderate to severe traumatic brain injury.

What this study adds to our knowledge

This paper suggests that air medical transport of patients with traumatic brain injury confers better outcomes than ground transport. The primary benefit appeared to be in more severely injured patients.

How this might change clinical practice

This paper provides support for the use of air medical transport for patients with moderate to severe head injuries.

INTRODUCTION

Multiple factors have been demonstrated to affect outcome in traumatic brain injury, including those influenced by care received in the out-of-hospital environment.[1-4] Foremost among these factors include the avoidance of secondary insults, such as hypoxia and hypotension, and the identification of potential traumatic brain injury and subsequent triage to a facility capable of definitive care,[5-10] which has led to the development of emergency medical services (EMS) systems that provide a rapid response to major trauma victims and can offer a variety of therapeutic interventions, such as endotracheal intubation and intravenous fluids, as well as rapid transport to a designated receiving facility.[11,12]

Helicopters are used in many systems to respond to major trauma victims, with 3 theoretical therapeutic advantages: (1) rapid transport to a designated receiving facility when ground transport is unavailable or would lead to inordinate delays, (2) response by advanced practitioners with an expanded scope of practice to optimize early care, and (3) response by crews with greater experience managing critically injured patients. Establishing the efficacy of aeromedical response to major trauma victims has been challenging, however, because controlled trials are difficult and may not be ethical in systems with established aeromedical presence, which has resulted in descriptive, pseudoexperimental (eg, revised trauma score and injury severity score [TRISS]), or cohort analyses that have generally supported the use of aeromedical resources but may have been influenced by selection bias.[13-52] Several large, registry-based analyses have been performed that attempt to control for various factors that influence outcome in major trauma victims; however, results have been inconsistent, and a complete set of data available for regression modeling has not been available.[33,38,46]

Here we perform an analysis using a large database of head-injured patients from the same EMS system, including multiple factors that affect outcome in traumatic brain injury. The following specific issues were addressed: (1) the impact of air medical response in moderate to severe traumatic brain injury, (2) identification of patients who benefit most from aeromedical transport, and (3) the relative efficacy of field intubation in patients transported by air versus emergency department (ED) intubation in patients transported by ground.

MATERIALS AND METHODS

Study Design

This was a retrospective analysis using data from the San Diego County Trauma Registry. Waiver of informed consent was granted by our investigational review board. Approval for this project was obtained from each of the 5 adult trauma centers.

San Diego County has a population of about 3 million in an area of more than 4,000 square miles. A minimum of 2 paramedics respond to all adult major trauma victims, who are transported to 1 of 5 designated trauma centers, all of which are Level I or II and have advanced neurosurgical capabilities. Helicopter crews are stationed at 2 bases located in the northwestern and eastern aspects of the county. Aeromedical crews consist of a certified flight nurse, along with a flight paramedic, an emergency medicine resident physician, or a second certified flight nurse. Physicians and certified flight nurses can perform advanced procedures, including rapid sequence intubation, tube thoracostomy, central venous catheterization, and pericardiocentesis; paramedics can perform intubation without rapid sequence intubation and needle thoracostomy. Helicopters are requested at the discretion of ground providers, usually for expedited transport to a trauma center or for the anticipated need for an advanced procedure. This decision is typically made at the initial assessment by ground providers; autolaunch of helicopters is not routinely practiced. Paramedics are instructed to attempt endotracheal intubation in major trauma victims with a Glasgow Coma Scale score of 8 or less. If endotracheal intubation is unsuccessful or not possible because of clenched jaw or intact airway reflexes, paramedics either transport to the closest trauma center or await air medical resources for definitive airway management.

Selection of Participants

All major trauma victims included in the trauma registry from January 1987 to December 2003 with moderate to severe traumatic brain injury, defined as a head Abbreviated Injury Score value of 3 or greater, were included. This excluded patients with a head Abbreviated Injury Score defined by a nonhead injury. In addition, patients without complete data and those undergoing interfacility transport to a trauma center were excluded from this analysis.

Table 1. Demographic and clinical variables for all patients included in this analysis.

Variable	All Patients (n=10,314)
Age, y	38.1
Sex, % male	76.9
Mechanism of injury, %	
Assault	4.8
Fall	18.3
Found down	0.6
GSW	6.4
MVC	40.5
Pedestrian versus auto	10.4
Stab wound	0.8
Other	18.2
GCS score	9.5
Hypotensive, %	51.7
Head AIS	3.99
ISS	26.3
Mortality, %	25.3

AIS, Abbreviated Injury Score; *GSW,* gunshot wound; *GCS,* Glasgow Coma Scale; *ISS,* Injury Severity Score; *MVC,* motor vehicle collision.

Table 2. Demographic and clinical variables for air- versus ground-transported patients with moderate to severe traumatic brain injury.

Variable	Air Transports (n=3,017)	Ground Transports (n=7,295)	Difference or OR (95% CI)
Age, y	34.6	39.5	−4.9 (−5.8 to −4.1)
Sex, % male	76.5	77.0	1.0 (0.9–1.1)
Penetrating mechanism, %	6.8	7.4	0.9 (0.8–1.1)
GCS score	8.8	9.8	−1.0 (−1.2 to −0.8)
Hypotensive, %	65.1	46.1	2.2 (2.0–2.4)
Head AIS	4.04	3.97	0.07 (0.02–0.10)
ISS	28.4	25.5	2.9 (2.2–3.5)
Scene time, min	24.6	13.9	10.7 (7.8–13.6)
Transport time, min	13.0	14.3	−1.3 (−4.6 to 2.1)

AIS, Abbreviated Injury Score; *GCS,* Glasgow Coma Scale; *ISS,* Injury Severity Score.

Primary Data Analysis

The intent of this analysis was to explore the impact of aeromedical transport on outcome with moderate to severe traumatic brain injury. Logistic regression was performed to identify the association between primary transport by air and mortality. The following variables that affect outcome in traumatic brain injury were included in the regression model: age as a surrogate for comorbid disease, sex, mechanism of injury (penetrating versus blunt), preadmission Glasgow Coma Scale score as a measure of level of consciousness, the presence of preadmission hypotension (systolic blood pressure 90 mm Hg or less), head-injury severity as reflected by head Abbreviated Injury Score, and overall severity of injury as reflected by the Injury Severity Score. These variables were selected based on their previously documented association with outcome in traumatic brain injury and their availability in the trauma registry, which includes a combination of out-of-hospital and hospital data on all admitted major trauma victims. Trained nurses abstract data from medical records using definitions agreed on by each of the 5 county trauma centers. In addition, individuals responsible for maintaining the registry meet regularly to discuss data management and abstraction issues and address quality-assurance issues with regard to the completeness and validity of registry fields.

To account for nonrandom distribution of patients into the air transport and ground transport cohorts, propensity scores were used in the logistic regression model for all analyses. Propensity scores were calculated using logistic regression including all variables used in the logistic regression models, as well as race and trauma center, with air versus ground transport defined as the outcome variable. For the main analysis, patients transported by air were compared to those transported by ground with regard to mortality. Identical analyses were performed using "good outcome" as the outcome variable and after stratification by head Abbreviated Injury Score (3 versus 4+) and Glasgow Coma Scale score (3 to 8, 9 to 12, 13 to 15). A good outcome was defined as discharge to home, jail, psychiatric facility, rehabilitation, or leaving against medical advice; in our system, discharge to rehabilitation implies the expectation of improvement compared with an extended-care facility.

The final regression analysis was intended to explore the relative efficacy of early invasive airway management by aeromedical crews compared with emergency intubation on arrival at the hospital for patients with severe traumatic brain injury, defined by a preintubation Glasgow Coma Scale score of 3 to 8. This was thought to be a reasonable comparison because paramedics attempt intubation in these patients before either arrival of aeromedical crews or transport to the ED, leaving a similar group of patients who typically require use of rapid sequence intubation medications in either cohort. In addition, differences between the 2 groups were addressed by use of logistic regression adjusting for the same variables defined above. Propensity scores were used in the analysis and calculated as described previously. The effect of each variable on outcome was quantified using odds ratios. Statistical calculations were performed using StatsDirect (StatsDirect Software Inc., Ashwell, UK). Goodness of fit of the multivariate models was verified using the Hosmer-Lemeshow test.

RESULTS

A total of 13,625 patients were identified with a head Abbreviated Injury Score of 3 or greater; the overall mortality in this group was 23%. A total of 3,313 patients were excluded from this analysis, which included 1,398 patients who underwent interfacility transport by helicopter (mortality 14%) and 1,913 patients with incomplete data (mortality 18%).

Table 3. Mortality and good outcomes (discharge to home, jail, psychiatric facility, rehabilitation, or leaving against medical advice) for patients transported by air versus those transported by ground.* Odds ratios are oriented such that values greater than 1 indicate better outcomes in the air-transport cohort.

Variable	No.	Mortality or Good Outcomes (%)	OR (95% CI)	Adjusted OR (95% CI)
All patients				
Air transports	3,017	759 (25.2)	1.01 (0.91, 1.11)	1.90 (1.60, 2.25)†
Ground transports	7,295	1,845 (25.3)		
Good outcomes				
Air transports	3,017	1,737 (57.6)	0.97 (0.89, 1.06)	1.36 (1.18, 1.58)†
Ground transports	7,295	4,256 (58.3)		
Head AIS 3				
Air transports	1,030	67 (6.5)	0.86 (0.64, 1.15)	1.86 (1.17, 2.96)‡
Ground transports	2,725	153 (5.6)		
Head AIS 4+				
Air transports	1,977	689 (34.9)	1.08 (0.97, 1.21)	1.68 (1.39, 2.03)†
Ground transports	4,636	1701 (36.7)		
GCS score 3-8				
Air transports	1,527	666 (43.6)	1.24 (1.09, 1.40)†	1.84 (1.51, 2.23)†
Ground transports	2,996	1464 (48.9)		
GCS score 9-12				
Air transports	328	38 (11.6)	1.25 (0.85, 1.84)	1.15 (0.60, 2.21)
Ground transports	874	123 (14.1)		
GCS score 13-15				
Air transports	1,152	52 (4.5)	1.28 (0.94, 1.75)	1.19 (0.66, 2.13)
Ground transports	3,491	199 (5.7)		

AIS, Abbreviated Injury Score; *GCS,* Glasgow Coma Scale; *ISS,* Injury Severity Score.
*Separate comparisons were made after stratification by head Abbreviated Injury Score and GCS. ORs were adjusted for age, sex, mechanism, preadmission hypotension, head Abbreviated Injury Score, ISS, and preintubation GCS score.
†$P<.001$.
‡$P<.05$.

The remaining 10,314 patients were included in this analysis, with an overall mortality of 25%. Demographic and clinical variables for all patients are displayed in Table 1. A total of 3,017 patients (29%) underwent primary transport by helicopter. Demographic and clinical variables for air- versus ground-transported patients are displayed in Table 2. Overall mortality in air-transported patients was similar to that for ground-transported patients; however, when adjusting for age, sex, mechanism of injury, Glasgow Coma Scale score, the presence of hypotension, head Abbreviated Injury Score, and Injury Severity Score, air transport was associated with a survival benefit (Table 3). Good outcomes were also increased among air- versus ground-transported patients after adjustment for the same variables. The primary benefit appeared to be in patients with more severe injuries, as defined by head Abbreviated Injury Score and Glasgow Coma Scale score.

A total of 1,250 helicopter-transported patients underwent out-of-hospital intubation, 1,022 ground-transported patients underwent out-of-hospital intubation, and 993 ground-transported patients underwent emergency ED intubation. Demographic and clinical variables for aeromedical-intubated patients and ED-intubated patients are displayed in Table 4. Overall mortality was similar between the 2 cohorts; however, outcomes were better in the helicopter-transported cohort when adjusted for each of the variables included in the logistic regression model, as defined above (Table 5). Hosmer-Lemeshow testing indicated appropriate goodness of fit for the logistic regression models ($P>.05$).

LIMITATIONS

There are several limitations to the analysis that must be considered when these data are interpreted. Although our registry is subject to several layers of quality-assurance oversight, it is ultimately limited by the ability of out-of-hospital providers to accurately collect and communicate these data. In addition, we selected patients for inclusion based on head Abbreviated Injury Score score, which is calculated after admission based on radiographic, operative, and autopsy findings that are not available to out-of-hospital providers. It is possible that selection of patients based on out-of-hospital clinical variables would yield different results. In theory, the advanced procedures performed by aeromedical crews carry the potential to harm patients who appear seriously injured in the field but ultimately do not have a moderate to severe head injury.

The retrospective design may introduce selection biases that even the most sophisticated analytic strategies cannot overcome. A prospective, randomized trial to determine the efficacy and optimal use of aeromedical resources would be desirable but may not be practical because of logistic and economic factors. Results from our system may not be generalizable because all

Table 4. Demographic and clinical variables for patients with severe traumatic brain injury (head AIS 3+ with preintubation GCS score 3 to 8) transported by air and intubated in the field versus transported by ground and intubated in the ED.

Variable	Air Transports (n=1,250)	Ground Transports (n=993)	Difference or OR (95% CI)
Age, y	33.0	37.5	−4.5 (−6.0 to −3.1)
Sex, % male	79.0	77.8	1.1 (0.9–1.3)
Penetrating mechanism, %	8.7	7.9	1.1 (0.8–1.5)
GCS score	4.1	4.6	−0.5 (−0.6 to −0.3)
Hypotensive, %	70.2	53.8	2.0 (1.7–2.4)
Head AIS	4.42	4.42	0.00 (−0.06 to 0.07)
ISS	32.9	31.2	1.7 (0.6–2.8)

AIS, Abbreviated Injury Score; *GCS,* Glasgow Coma Scale; *ISS,* Injury Severity Score.

Table 5. Comparison between severely head-injured patients (head AIS 3+ with preintubation GCS score 3 to 8) intubated by aeromedical crews versus those intubated in the ED during the initial resuscitation phase.* Odds ratios are oriented such that values greater than 1 indicate better outcomes in the air-transport cohort.

Variable	No.	Mortality (%)	OR (95% CI)	Adjusted OR (95% CI)
Air intubation	1,250	531 (42.5)	1.03 (0.87–1.21)	1.42 (1.13–1.78)†
ED intubation	993	428 (43.1)		

AIS, Abbreviated Injury Score; *GCS,* Glasgow Coma Scale; *ISS,* Injury Severity Score.
*Odds ratios were adjusted for age, sex, mechanism, preadmission hypotension, head AIS, ISS, and preintubation GCS score.
†$P<.01$.

designated trauma-receiving facilities have the capability for definitive trauma and neurosurgical care and undergo comprehensive quality-assurance oversight. Finally, our conclusion that more critically injured patients may benefit from aeromedical transport may not easily translate into out-of-hospital protocols.

DISCUSSION

Defining the optimal role of helicopters in an EMS or trauma system is difficult for a variety of reasons. Performing a randomized, controlled trial to define the efficacy of aeromedical response would be logistically challenging, prohibitively expensive, and ethically suspect in a system with established aeromedical presence. Thus, it is not surprising that so many previous studies have relied on suboptimal methodologies or had limited generalizability outside of their local EMS system.[13-52] In addition, aeromedical resources are more expensive, complicating the analysis and forcing the conversion of human lives and disability into economic terms.[31,41,53-56] Finally, out-of-hospital medicine is constantly in evolution, with advances in therapeutics and our understanding of the basic pathophysiology of injury potentially influencing the optimal use of out-of-hospital resources.

Here we analyze one of the largest collections of traumatic-brain-injury patients to explore the impact of aeromedical response on outcome. Using a comprehensive logistic regression analysis, with multiple factors important to outcome in traumatic brain injury incorporated in the model, we demonstrate decreased mortality and an increase in good outcomes with use of aeromedical resources. This benefit appeared to come from patients with more significant injuries, as defined by either preadmission Glasgow Coma Scale score or head Abbreviated Injury Score. Although a selection bias toward more survivable injuries in the aeromedical cohort could theoretically exist, aeromedical patients generally had more significant injuries, suggesting that this was not the case.

Improved outcomes were also observed among aeromedical patients undergoing out-of-hospital intubation versus ground patients undergoing emergency intubation in the ED, which was somewhat surprising because this eliminates patients undergoing non–medication-assisted intubation in the ED cohort, selecting for patients who are more neurologically intact. The registry is not able to reliably identify medication-assisted intubations in the field; thus, some of the aeromedical patients may have undergone non–medication-assisted intubations by either ground or aeromedical personnel. Recent data suggest an adverse effect of paramedic intubation on outcome, including a separate analysis using traumatic-brain-injury data from our own out-of-hospital system (Davis et al, unpublished data).[57-66]

The potential reasons for improved outcomes in aeromedical patients warrant some discussion. The results reported here may reflect the benefit of greater experience with advanced procedures or optimal monitoring during ventilation of patients with severe traumatic brain injury. Airway management has long been regarded as an important factor in traumatic-brain-injury outcomes, with endotracheal intubation representing definitive airway management. More recently, postintubation ventilatory management has emerged as being as important, if not more so, as the intubation procedure itself.[64] Previous studies about aeromedical intubation performance document superior success rates, likely because of use of rapid sequence intubation medications.[67] In addition, data from our EMS system suggest that aeromedical crews provide better ventilatory management, specifically in their ability to avoid hyperventilation, which appears to translate into superior outcomes.[68,69] In addition, greater experience with critically injured patients may allow for a more judicial use of invasive airway management, which may lead to better outcomes.

More critically injured patients appeared to benefit most from the use of aeromedical resources. This is consistent with the findings from previous studies.[33,46,48] The optimal use of aeromedical resources is a subject of considerable controversy.

Most dispatch protocols rely on estimated ground transport time or distance in the decision to request aeromedical resources.[70] It is possible that patient acuity factors, beyond simply the designation of a major trauma victim, should be integrated with estimated transport time into helicopter dispatch protocols. These might include a combination of physiologic measurements or the anticipated need for invasive airway management. In such a patient, the relative time to definitive airway management, whether by aeromedical or ED personnel, should be explored as an important factor in triage and dispatch decisionmaking. As our ability to prospectively identify the presence of severe traumatic brain injury and the need for invasive airway management improves with better screening strategies and emerging technologies, this factor may take on even more importance.

Time to definitive care likely plays some role in the outcome of traumatic-brain-injury patients but was not factored into the regression analysis, which likely created a selection bias in favor of the ground-transported cohort because air-transported patients generally have longer transport distances but were compared to ground patients with shorter transport times in this analysis. In addition, scene times were significantly longer in patients transported by aeromedical crews, likely reflecting the time required for arrival of the helicopter and the performance of advanced procedures, such as rapid sequence intubation, on scene rather than in the air. Thus, a comparison between aeromedical- and ground-transport patients with longer transport times would likely produce an even greater outcome differential.

Most previous studies support the efficacy of aeromedical crews with regard to outcome. Baxt and Moody[13-16] and Baxt et al[17] published several small studies evaluating the efficacy of helicopter versus ground transport of major trauma victims, as well as the optimal aeromedical crew configuration. Although they were able to demonstrate improved survival versus that predicted by TRISS methodology, these were calculated in the field for aeromedical patients, which may lead to artificially low predicted survival values. Multiple other investigators have since performed similar descriptive or pseudoexperimental studies, often using TRISS calculations with or without comparison to a ground cohort, most of which support the efficacy of aeromedical response to major trauma victims.[18-32,34-37,39-45,47,49-52]

Biewener et al[48] performed a small cohort analysis comparing patients transported to a Level I trauma center by air to those transported to a Level II or III trauma center by ground. Improved outcomes were observed with immediate transport to a Level I trauma center by helicopter. This difference in outcome could not be explained by any measurable differences in injury severity. Cunningham et al[33] performed a regression analysis using 18,490 patients from their trauma registry. They used age, sex, Revised Trauma Score, Injury Severity Score, Abbreviated Injury Score, and mortality risk ratio (based on the *International Classification of Diseases, Ninth Revision*) in their model. Although overall mortality did not appear to be affected by helicopter transport, this may reflect the high percentage of patients without significant injuries. A subgroup of patients with moderate to severe injuries (Trauma Score 5 to 12; Injury Severity Score 21 to 30) did demonstrate improved outcomes from aeromedical response. Thomas et al[46] performed a similar registry-based analysis using 16,699 major trauma victims. Although overall mortality was higher for the air cohort, logistic regression analysis adjusting for age, sex, year, hospital, level of provider (Advanced Life Support/Basic Life Support), Injury Severity Score, and scene versus transfer revealed improved outcomes with aeromedical transport. Again, overall mortality was fairly low in their patients. Brathwaite et al[38] studied 22,411 major trauma victims, the majority of whom were transported by air. Although air mortality was higher overall, logistic regression adjusting for age, sex, year, urban versus rural, Injury Severity Score, hypotension, and Revised Trauma Score revealed no effect of air versus ground on outcome. Again, overall mortality was relatively low. In addition, the generalizability of this study is unclear because their proportion of air to ground transports was substantially higher than in other studies, including our own. Most recently, Wang et al[58] documented improved outcomes with aeromedical performance of endotracheal intubation compared with patients undergoing intubation in the ED. Similar to our own analyses, this was in distinct contrast to outcomes in ground-transported patients undergoing endotracheal intubation.[66]

The present study has several advantages over previous analyses. First, we selected a relatively homogeneous population by limiting the database to patients with moderate to severe head injury. In addition, our population had a higher overall mortality than that in previous analyses, allowing us to better evaluate the impact of aeromedical transport using mortality as the main outcome measure. The size of our database allowed for use of subgroup analyses, which appears to have addressed some of the concerns with use of retrospective data and helped identify specific patient populations that benefit from use of helicopter resources. Finally, the availability of multiple out-of-hospital variables in the registry allowed us to control for many factors that influence outcome in traumatic brain injury.

From these data, we conclude that aeromedical transport of patients with moderate to severe traumatic brain injury is associated with an improvement in outcomes that could not be explained by selection bias. The primary benefit appears to be in more critically injured patients. Out-of-hospital intubation in patients undergoing aeromedical transport is associated with better outcomes than ED intubation in patients undergoing ground transport.

Supervising editor: William G. Barsan, MD

Author contributions: DD, JS, CB, GV, MS, and DH conceived the study design. Data collection was completed by DD, MS, FK, ABE, TV, and DH. Data analysis was done by DD, JP, JS, CB, GV and AS. All authors contributed substantially to manuscript preparation. DD takes responsibility for the paper as a whole.

Funding and support: The authors report this study did not receive any outside funding or support.

Publication dates: Received for publication October 8, 2004. Revisions received November 17, 2004, and December 1, 2004. Accepted for publication January 4, 2005. Available online June 22, 2005.

Presented at Air Medical Transport Conference, 2004, Cincinnati, OH.

Reprints not available from these authors.

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