Air Ambulance Transport Times and Advanced Cardiac Life Support Interventions During the Interfacility Transfer of Patients with Acute ST-segment Elevation Myocardial Infarction

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Abstract

Objectives. To characterize transport times for the interfacility air ambulance transport of patients with acute ST-segment elevation myocardial infarction (STEMI), to estimate the proportion of patients at risk of in-transport clinical decompensation, and to explore associated risk factors for such. **Methods.** The electronic medical records of 35 air ambulance programs in the United States from December 2003 through December 2008 were reviewed. We defined *clinical decompensation* during transport as the combined outcome of either cardiopulmonary arrest or the receipt of any of a prespecified set of advanced life support (ALS) interventions. Multiple logistic regression employing generalized estimating equations to model autocorrelation of measures within air ambulance programs was used to explore the relationship between time from dispatch to transport and the outcome of interest. **Results.** Three thousand seven hundred sixty-seven transports of STEMI patients were identified during the period of interest. Eighty-five percent of rotor wing transports (median 80 minutes, interquartile range [IQR] 66–104) and 7% of fixed-wing transports (median 162 minutes, IQR 142–210) attained a total transfer time of ≤2 hours. Clinical decompensation in transport occurred in 182 of 3,767 (4.8%, 95% confidence interval [CI] 4.2–5.6%) transports. The most frequent critical ALS interventions were the administration of antiarrhythmics and the initiation of vasopressors. The odds ratios (ORs) for clinical decompensation comparing higher pretransport time quartiles with the lowest quartile (i.e., Q1: 6–50 minutes) were as follows: Q4: 82–1,500 minutes, OR 2.5 (95% CI 1.3–4.8, p = 0.007); Q3: 64–81 minutes, OR 1.9 (95% CI 1.0–3.6, p = 0.0499); and Q2: 51–63 minutes, OR 1.45 (95% CI 0.7–3.1, p = 0.34). Cardiac arrest or need for an ALS intervention prior to transport and a history of diabetes were also predictive of the outcome of interest. **Conclusions.** The majority of interfacility rotor-wing air ambulance transfers of patients with STEMI achieved a total transfer time of ≤2 hours. Clinical decompensation requiring ALS treatment occurred in a small percentage of patients. Diabetes, prior arrest or decompensation, and delays to transport were associated with clinical decompensation in the air. Efforts to reduce delays to transport may reduce this risk in transported patients. **Key words:** myocardial infarction; patient transfer; cardiac arrest

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Introduction

Background

Approximately 500,000 ST-segment elevation myocardial infarctions (STEMIs) occur each year in the United States.[1] Primary percutaneous coronary intervention (PCI), consisting of either coronary artery stenting or angioplasty, has proven generally superior to fibrinolysis in the treatment of STEMI.[2,3] Consequently, from 1990 to 2006, the proportion of patients with STEMI receiving fibrinolytic therapy fell from 53% to 28%, while the percentage of those receiving PCI increased from 3% to 43%.[4] Nevertheless, the majority of the U.S. population does not live near a hospital with 24-hour PCI capability.[5]

Rationale

The survival benefit of both reperfusion strategies is time-dependent, with most of the benefit accruing to those treated within the first two hours after presentation.[6,7] The benefits of PCI to those in cardiogenic shock appear to extend beyond the two-to-three-hour window, however.[8] Regionalization of prehospital systems for the delivery of patients to primary PCI centers by emergency medical services (EMS) is one strategy for overcoming these limitations.[9] For the 50% of myocardial infarction patients who present by personal transport,[10] protocols for the rapid interfacility transfer to PCI centers have been shown to improve outcomes, particularly if transfer can be accomplished within two to three hours.[11–17] Many times, transfer to a PCI center is accomplished by air because of the long distances to a tertiary center and the time-dependent nature of the disease process. It is not known, however,

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if delays to reperfusion result in discernible differences in outcomes during transport.

The goal of this study was to characterize current transport times for the interfacility air ambulance transfer of patients with acute STEMI in a sample of communities within the United States using a large, existing database. A secondary goal was to estimate the proportion of such patients suffering from cardiac arrest or other clinical decompensation in transport and to explore associated risk factors for such. We hypothesized that delays to transport would increase the risk of in-transport clinical decompensation.

METHODS

Study Design

This was a retrospective review of an existing electronic medical record and logistical database (Golden Hour Data Systems, Inc., San Diego, CA). The standardized database contains the integrated dispatch, clinical, and administrative records and air transport metrics of over 450,000 air ambulance transports from over 150 different air medical vehicles between June 1999 and December 2008.

Setting

Transports were performed in 26 states in the United States, with a significant number of transports being from rural to urban tertiary care centers. Transports in the database are approximately 60% scene and 40% interfacility. We concerned ourselves only with interfacility transfers for this analysis.

Thirty-five air ambulance programs contributed data for this analysis. Pediatric-only programs were excluded. The institutional review board at our institution approved this study.

Methods of Measurement

Clinical information was collected during patient care, and the electronic medical record was completed after patient care was finished for the majority of patients. The lead author (STY) met with a company software engineer to structure a database query using broad criteria. All charts related to a cardiopulmonary complaint along with important clinical and logistical variables were drawn from the database and exported into a Microsoft Excel 2003 spreadsheet (version 11.8, Microsoft Corp., Redmond, WA). The software engineer who provided the data was blinded to the study hypothesis. The lead author identified eligible flight records from among this set, using a combination search strategy, including *International Classification of Diseases, Ninth Revision* (ICD-9) diagnosis codes (410.x) and free-text searches for the words "ST-elevation myocardial infarction," "STEMI," or the descriptive combination of acute myocardial infarction and the naming of an infarct-related distribution, such as "acute *anterior* myocardial infarction." The lead author hand-reviewed the records that were so identified to prevent the inclusion of non–ST-segment elevation myocardial infarctions (NSTEMIs).The analysis was restricted to transports from December 2003 through December 2008 inclusive. This period was anticipated to more accurately reflect current referral patterns with the more recent emphasis[1] on primary PCI as the preferred reperfusion strategy in the setting of STEMI.

Reports of sending facility electrocardiograms and laboratory data were not always available in the database, nor were receiving facility discharge diagnoses, and we were thus unable to corroborate the diagnosis by secondary means. Because the time of STEMI onset was largely unavailable in the database and we wished to limit the analysis to acute (nonconvalescent) STEMI patients as much as possible, cases were included only if the sending facility was an emergency department (ED). We furthermore included only cases in which the receiving facility was a coronary catheterization laboratory (CCL) or an ED.

The absence of certain clinical variables in the record (i.e., cardiac risk factors, interventions administered by transport personnel) was considered to be negative for this analysis. However, such fields were coded as "missing" for cases in which the provider wrote "unknown" for items of past medical history.

Transport times were collected automatically using times synchronized with the Atomic Clock and corrected for time zone differences. Transport mileage was collected, in most cases prospectively, using integrated global positioning system (GPS) technology. Transfer time was broken down into constituent intervals as depicted in Figure 1. The pretransport times included the following: activation of flight team to liftoff (time from dispatch call to departure for the sending facility (t_1), time spent en route to the sending facility (t_2), and time spent at the sending facility scene (t_3). This combined time ($t_1 + t_2 + t_3$) represented the exposure of interest and included any ground ambulance times to and from helipads and airports. Patient transport time (time spent transporting the patient to the receiving facility, including any ground ambulance segments from the airport or helipad; t_4) was the final constituent of total transfer time and the period in which the outcome of interest might occur (as described below). Individual transport times were set to missing if incompatible with what were, in our a priori judgment, a reasonable lower limit; specifically, patient transport times of less than 5 minutes were considered implausible and likely due to measurement error ($n = 71$), and so were censored.

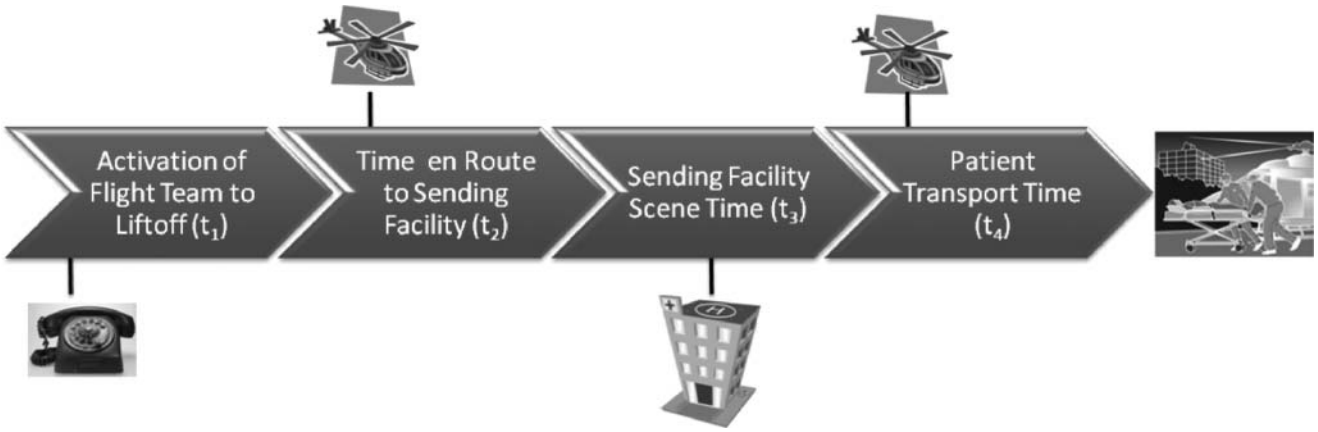

FIGURE 1. Cartoon timeline depicting constituent transfer time intervals.

Outcome Measures

We defined *clinical decompensation* as the combined endpoint of cardiac arrest or the receipt of any of a set of critical ALS interventions defined prior to the study, including endotracheal intubation, cardiac pacing, defibrillation, electrical cardioversion, the initiation of vasopressor medication, or the administration of epinephrine, atropine, vasopressin, or an antiarrhythmic medication occurring in flight to the receiving facility. The outcome was coded as a binary variable and could thus occur only once per patient flight, even in cases where multiple interventions were performed during the flight.

Primary Data Analysis

Data were imported into SAS statistical software (version 9.1, SAS Institute Inc., Cary, NC) for analysis. Summary measures of normally distributed variables are reported as means and standard deviations (SDs). Nonnormally distributed variables are reported as medians and interquartile ranges (IQRs).

We performed multivariate logistic regression using the SAS procedure PROC GENMOD to model the relationship between pretransport times ($t_1 + t_2 + t_3$) and the combined outcome of cardiac arrest or need for critical ALS intervention during the period of transport (t_4), while controlling for potentially confounding variables available to us in the data set. Autocorrelation of measures within flight programs (clustering effects) was accounted for using generalized estimating equations, with the REPEATED statement in PROC GENMOD used for this purpose. Pretransport times were categorized into quartiles to improve the linearity assumption between the originally continuous, highly right-skewed predictor and the outcome response (the log odds of clinical decompensation). We assumed that cardiac arrest or the administration of a critical ALS intervention prior to transport (before the call to transfer) would be the single most important potential confounding variable and, in its own right, an independent predictor for the outcome of interest. Other variables were included in the model based on both a priori considerations and assessments of model fit, primarily through scaled deviance and scaled Pearson chi-square values. No automated variable selection methods were employed.

Multiple imputation using Markov chain–Monte Carlo techniques was utilized to estimate the influence of missing data on parameter estimates using PROC MI and PROC MIANALYZE, and the results of this analysis are reported separately.

RESULTS

Baseline Data and Demographics

There were 3,767 air ambulance transports of STEMI patients identified in the database during the period of interest. Of these, 3,179 (84%) were rotor-wing transports and 153 (4%) were fixed-wing transports. In 435 cases (12%), the type of vehicle was not identified in the database. The majority of transports, 2,792 (79%), were destined for the receiving hospital's coronary catheterization laboratory. The remainder, 795 (21%), were sent to the receiving hospital's ED.

The mean patient age was 59 years (SD = 13 years), with a range of 18–97 years; 2,702 (72%) patient were male. Patient race included 2,773 white (86%), 191 black (6%), 183 Latino (6%), 15 Asian (0.5%), eight Native American (0.3%), two Pacific Islander (0.1%), and 71 (2%) listed as "other." In 524 cases (14%), no race or ethnicity was provided. The distribution of selected clinical variables from the past medical history is given in Table 1.

Transfer Times

Summary measures for transfer times, as well as their constituent intervals and loaded miles traveled (miles traveled with a patient on board), are given in Table 2.

TABLE 1. Selected Clinical Values for 3,671 Patients* Transferred by Air Ambulance Transport for ST-segment Elevation Myocardial Infarction

Past Medical History	Number (Percent)
Hypertension	1,395 (38.0%)
Diabetes mellitus	644 (17.5%)
Coronary artery disease	963 (26.2%)
Coronary artery bypass grafting	103 (2.8%)
Hypercholesterolemia	341 (9.3%)
Chronic renal failure	61 (1.7%)
Congestive heart failure	112 (3.1%)
Cancer	129 (3.5%)
Chronic obstructive pulmonary disease	139 (3.8%)
Cerebrovascular accident/transient ischemic attack	99 (2.7%)

*The past medical history was missing or unknown for 96 patients (2.5%).

There were 2,693 (85%) rotor-wing transports that achieved a total transfer time of ≤2 hours and 3,097 (97%) that achieved a total transfer time of ≤3 hours. Among fixed-wing transports, 11 (7%) achieved a total transfer time ≤2 hours and 90 (59%) were transferred in ≤3 hours. Most of the total transfer time owed to pretransport time. Pretransport times (activation to liftoff, en route to the sending facility, and sending facility scene times [$t_1 + t_2 + t_3$]) made up, on average, 78% of the total transfer times (95% confidence interval [CI] 78.2–78.7%).

Fibrinolytic Use

Few patients, 37 (1%), received fibrinolytics prior to transport. All but one of these patients was transported by rotor wing. Another 24 patients (0.6%) received fibrinolytics in transport to the receiving facility. All in-transport fibrinolytics were given during rotor-wing flights.

TABLE 2. Summary Measures for the Constituent Components of Total Transport Times for the Interfacility Air Ambulance Transport of 3,671 Patients with ST-segment Elevation Myocardial Infarction from the Emergency Department

Transport Variables		Median (IQR)	Range
Activation to liftoff (minutes)	Rotor	9 (6–12)	0–1,439
	Fixed	21 (15–32)	0–161
En route to sending facility (minutes)	Rotor	27 (20–41)	0–235
	Fixed	48 (38–63)	0–200
Sending facility scene time (minutes)	Rotor	25 (19–32)	0–103
	Fixed	49 (29–63)	0–153
Patient transport time (minutes)	Rotor	15 (10–24)	5–112
	Fixed	42 (35–51)	20–99
Total transfer time (minutes)	Rotor	80 (66–104)	21–1,551
	Fixed	162 (142–210)	76–399
Loaded miles*	Rotor	29 (19–50)	3–196
	Fixed	148 (113–163)	48–347

*Miles traveled with the patient loaded in the air vehicle.
IQR = interquartile range.

TABLE 3. Proportion of 3,671 Patients with ST-segment Elevation Myocardial Infarction Requiring Critical Advanced Life Support Interventions While in Transport during Interfacility Transfer

ALS Intervention	Number (Percent)	(95% Confidence Interval)
Antiarrhythmic administration	40 (1.08%)	(0.7–1.4)
Initiation of vasopressors	38 (1.02%)	(0.7–1.4)
Endotracheal intubation	31 (0.8%)	(0.6–1.2)
Defibrillation	18 (0.5%)	(0.3–0.8)
Epinephrine administration	18 (0.5%)	(0.3–0.8)
Atropine administration	18 (0.5%)	(0.3–0.8)
Cardiac pacing	3 (0.08%)	(0.02–0.2)
Electrical cardioversion	1 (0.03%)	(0–0.2)
Vasopressin administration	1 (0.03%)	(0–0.2)

ALS = advanced life support.

Cardiac Arrest

A total of 127 transports (3.4%) were for patients with STEMI who had suffered cardiac arrest prior to transport, either in the prehospital setting or in the ED of the sending facility. Of these 127, seven (5.5%) suffered from recurrent arrest in transport to the receiving facility. Only one of the 127 (0.8%) had received fibrinolytic therapy prior to transport.

Cardiac arrest occurred in transport in another 41 patients (1.1%) who had no history of antecedent arrest (bringing total in-transport arrests to 48 [1.3%]). One of these patients had received or was receiving fibrinolytic therapy during transport. None had received fibrinolytics prior to transport. Return of spontaneous circulation was reported in 14 of 48 patients (29%), but the outcome of resuscitation was missing in 11 cases (23%). In another 48 cases (1.3%), an arrest occurred, but the location and timing of the arrest could not be determined based on the clinical record. Thus, the proportion of transported STEMI patients who suffered from cardiac arrest in this cohort may range from a low of 1.3% (95% CI 0.9–1.7%) to a high of 2.6% (95% CI 2.1–3.1%).

Advanced Life Support Interventions

The frequency of selected critical advanced life support (ALS) interventions is given in Table 3. A single intervention, usually the administration of antiarrhythmic or vasopressor medications, was required in the majority (79%) of cases, while 17% received two of the predefined interventions, and 4% received three.

Clinical Decompensation

Clinical decompensation in transport, defined previously as cardiac arrest or the receipt of a critical ALS intervention, occurred in 182 of 3,767 transports (4.8%, 95% CI 4.2–5.6%). Results of multivariate model fitting are presented in Table 4. Three thousand six

hundred sixty-five complete cases were used for the primary analysis. Covariates such as age, gender, ethnicity, flight program, treatment with fibrinolytics, or administration of nitroglycerin or beta-blockers were not found to be important predictors of clinical decompensation in transport, nor did they improve model fit. In the finalized model, increasing pretransport times were associated with an increasing risk of clinical decompensation in transport, in graded fashion. A history of diabetes was also somewhat predictive of the outcome of interest. Prior cardiac arrest or the receipt of critical ALS interventions prior to transport had the highest association with in-transport decompensation, with an odds ratio of 12.3 (95% CI 8.0–19.0).

Multiple imputation methods to account for missing data (transfer times [2.2% missing] and history of diabetes [2.5% missing]) did not result in substantial changes to estimates of association, and are reported in Table 4. When the 48 arrests in which the location was unknown (sending facility vs. in flight) were reclassified as arrests during transport, the odds ratio for pretransport times (where Q1 is the lowest pretransport time quartile) were not substantially changed: Q4 vs. Q1 = 2.3 (95% CI 1.5–3.7); Q3 vs. Q1 = 1.7 (95% CI 1.1–2.7); and Q2 vs. Q1 = 1.4 (95% CI 0.7–2.6). When they were reclassified as arrests prior to transport, the odds ratios were unchanged. The odds ratios were likewise unchanged when a single outlier with a value of 1,500 minutes in the highest quartile (which did not experience the outcome of interest) was censored from analysis.

DISCUSSION

Our exploratory analysis of this large number of interfacility air ambulance transports for patients with STEMI resulted in several findings of potential importance to those vested in regionalized and referral-based systems of STEMI care. First, air ambulance transfer for time-sensitive reperfusion therapies of STEMI patients occurred within two to three hours in the majority of cases reviewed. Second, cardiac arrest and other types of clinical deterioration during transport are uncommon events. Third, we found a potential association between delays to transport and the advent of cardiac arrest or the need for a critical ALS intervention in flight.

While benchmarking and quality assurance measures for the treatment of STEMI are common in the ED and hospital settings, the prehospital and interfacility transfer components are only recently being scrutinized. In this analysis, air ambulance transfer of STEMI patients resulted in a total transfer time of two hours or less by rotor wing in the majority (85%) of patients and in less than three hours in almost all patients (97%). Additional time spent in the sending facility ED prior to the call to dispatch is unaccounted for in the database, as is potential time spent in the receiving ED prior to cardiac catheterization. Previous trials have demonstrated the benefit of transfer for primary PCI over on-site fibrinolytics,[18] especially when a two-to-three-hour transfer can be achieved.[12–17] Fixed-wing transports involve longer pretransport intervals by their very nature, as they require additional legs to and from an airport hangar, whereas most rotor-wing flights require no such triangular transport pattern. The 1,439-minute activation to liftoff time for one fixed-wing flight (1,551-minute total transfer time) was extreme, but such prolonged delays are not outside the realm of possibility when one considers prolonged weather patterns that can delay liftoff for extended periods. Nevertheless, exclusion of this outlier had no effect on calculated outcome measures.

A paucity of patients in our review (1.6%) received fibrinolytics prior to or during transport. This finding, if not due to underreporting, suggests that a

TABLE 4. Results of Logistic Regression in Which the Log-Odds of the Combined Outcome of Cardiac Arrest or the Administration of Critical Advanced Life Support Interventions during Transport Is Modeled as a Function of the Variables Listed

Variable	Coefficient (β)	Standard Error	p-Value	Odds Ratio	95% CI
Intercept	–4.0627	0.31	—	—	—
Pretransport times					
Q4 (82–1,500 min)	0.9094	0.33	0.007	2.48	1.29–4.78
				2.37*	1.43–3.95*
Q3 (64–81 min)	0.6403	0.33	0.0499	1.90	1.00–3.60
				2.02*	1.20–3.39*
Q2 (51–63 min)	0.3736	0.39	0.3371	1.45	0.68–3.12
				1.60*	0.93–2.77*
Q1 (6–50 min)			*Reference Category*		
Arrest or administration of ALS intervention prior to transport	2.5110	0.22	< 0.0001	12.3	8.00–19.0
				11.9*	8.47–16.8*
History of diabetes mellitus	0.3720	0.17	0.0254	1.45	1.05–2.01
				1.35*	0.91–1.99*

*Estimates obtained by multiple imputation methods, by which missing values are replaced with a predicted value, based on other covariates.
ALS = advanced life support; CI = confidence interval; Q = quartile.

primary PCI strategy was followed in the majority of patients transferred. Issues of resource utilization, transport safety, the potential role of facilitated PCI, and the most efficient mode of transport (i.e., by air or ground) are important considerations not addressed with these data.

Cardiac arrest during transport was an uncommon event in this analysis, occurring in only 1.3% to 2.6% of transports. Most arrests complicating STEMI are believed to occur within the first two hours after symptom onset[1] and, thus, a survival effect may account for this result. Early experience in the 1980s with air ambulance transport of STEMI patients prior to widespread use of PCI revealed variable rates of in-transport complications. Bellinger et al. found that five of 250 patients (2%) required cardiopulmonary resuscitation in flight and 14 of 250 (5.6%) required vasopressor therapy when transported within a 150-mile radius. Most patients had received fibrinolytics prior to transport; however,[19] Kaplan et al. reported an air ambulance STEMI cohort transferred without prior reperfusion in which 13% had either hypotension or dysrhythmias requiring treatment in transport.[20] In the last decade, Giglioli et al. found that 5.5% of STEMI patients required defibrillation in the prehospital setting, with another 5.5% requiring defibrillation during PCI.[21] Aguirre et al. reported no hemodynamic compromise or death occurring in 151 rural air ambulance transports, but the maximum travel time was only 95 minutes between hospitals.[22] And in the recently completed TRANSFER-AMI trial, complications requiring treatment in transport, including one death, occurred in approximately 3% of patients, all of whom had received fibrinolysis with delayed transfer for PCI, compared with a 2.4% complication rate and no deaths in patients transferred for PCI following on-site fibrinolysis. While complications were not explicitly defined, hypotension was given as the most frequent event.[23]

It is uncertain how referral bias might affect the proportion reporting clinical deterioration in our sample. For example, if sicker patients are deemed too ill to withstand transport, they may be admitted to presenting community hospitals rather than transferred,[24] even though a primary PCI strategy is probably most beneficial to high-risk patients,[23] including those in cardiogenic shock,[8,25] and there is evidence that PCI for post–cardiac arrest patients can result in favorable long-term outcomes.[26,27] Straumann et al. observed that patients transferred to a PCI facility, when compared with those presenting primarily to the PCI facility, had much higher rates of cardiogenic shock and need for resuscitation, yet had similar in-hospital outcomes.[28] It is thus alternatively possible that sicker patients were selected for transfer by air ambulance transport because of a perceived benefit of this transport modality by referring providers.

This study is the first, to our knowledge, to associate delays in transfer of STEMI patients to clinical decompensation during air ambulance transport. The finding has some intuitive appeal and a degree of biologic plausibility, in our opinion, in that we expect prolonged time to transport, in the absence of on-site reperfusion, to correlate with a prolonged period of ischemia and its attendant complications. It is known that long-term outcomes are affected by time to reperfusion in the setting of STEMI. However, we believe this is the first study to suggest its importance in the transport setting. This may simply add impetus to the "protocolization" of efforts to avoid delay in the transfer of these patients.

The influence of diabetes on the outcome measure has some prior support, given reports of worse in-hospital and long-term outcomes in these patients.[29–32] Diabetes and cardiac arrest on presentation were also found to be important predictors in the 48,023-patient Global Registry of Acute Coronary Events (GRACE) (which also included non-STEMI myocardial infarctions), with the latter variable (cardiac arrest) having the highest odds ratio for in-hospital death.[33] Cardiac arrest or the administration of critical ALS interventions prior to transport was the single most important predictor of in-transport clinical decompensation in our analysis and probably merely accounts for a particularly unstable population.

LIMITATIONS

The influence of selection bias, missing data, misclassification, and residual confounding is a threat to the validity of any study based on observational and retrospectively obtained data, including ours. This analysis could not include patients diagnosed with cardiac arrests prior to transport that were not also classified as STEMIs in the database. It is possible that the etiology in a considerable proportion of these patients is STEMI, although it was not identified as such or mentioned as a secondary diagnosis in the clinical records. We did not have reliable data on Killip classification or infarct territory, both of which might have helped to gauge acuity and serve as important predictors in multivariate modeling. In-hospital outcomes were also unavailable to us. We did not attempt to verify the appropriateness of ALS interventions administered by providers through secondary means. The necessity of such interventions was assumed in our study.

Furthermore, we did not have information on the ED length of stay prior to initiating transfer, which is likely to have an important effect on the outcome of interest. Finally, these results should be interpreted with caution since the exact timing of cardiac arrest and critical ALS interventions was not reliably available and could only be categorized as occurring prior to or during transport. We would prefer to have analyzed the

data using a Cox proportional hazards model to better understand the role of transfer times in this outcome, but this would require prospective data acquisition on a large scale given the rarity of the outcome of interest and the need for meticulous record keeping.

CONCLUSIONS

Most air ambulance transfers of STEMI patients reviewed occurred within two hours, a time period shown to benefit patients in whom a primary PCI approach is taken. Clinical decompensation of STEMI patients during air ambulance transport is an uncommon event, but one that occurs more frequently in patients with diabetes and with delays to transport. Because most of the total transfer time is spent in preparation for transport and because delays during this period are associated with patient decompensation, efforts for quality improvement should be directed at reducing these times.

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