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Factors Influencing Ambulance Usage in Acute Coronary Syndrome

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Abstract

Aims

The aims of this study are to identify the proportion of ACS patients using an ambulance to transport to hospital and to explore the factors influencing mode of transport.

Methods

A retrospective, observational cohort design was utilised in this study. Data concerning cases of ACS in a university hospital over a 9-year period was obtained from the Coronary Heart Attack Ireland Register. Descriptive statistics were used to detail demographic and clinical data, as well as to establish the proportion of ambulance usage among ACS patients. Chi-square and t-tests were used to differentiate between groups at baseline. Factors influencing mode of transport were analysed by binary logistic regression.

Results

4,229 cases were obtained. Exclusion and inclusion criteria were applied, leaving 1,964 cases for overall analysis. 533 (27%) patients directly used an ambulance, 1,098 (56%) patients presented initially to their GP while 333 (17%) went directly to A&E. Logistic regression showed that age, clinical factors, smoking status and diagnosis each had a statistically significant effect on ambulance usage.

Conclusions

Ambulance services are underutilised by ACS patients, despite clear benefits of their use. Several factors impacted patients' mode of transport. Knowledge of these is essential in guiding future awareness campaigns to promote ambulance usage in ACS.

Introduction

Heart disease is among the top three causes of death worldwide[1] and the leading cause in the U.S.[2]. Acute Coronary Syndrome (ACS) is an umbrella term referring to clinical symptoms of acute myocardial ischaemia; comprising unstable angina pectoris, non ST-elevated myocardial infarction (NSTEMI) and ST-elevated myocardial infarction (STEMI)[3-6]. It is recommended by the Irish Heart Foundation, American Heart Association and many other medical bodies to activate emergency medical services (EMS) in instances of suspected ACS[5, 7-9]. EMS play a major part in the chain of survival[10, 11]. It allows for quicker first medical contact as well as earlier administration of treatment- reducing morbidity and mortality[3, 12, 13].

Despite this, emergency medical services appear to be underutilized[14-19]. With the many benefits of ambulance use, self-transportation is still the preferred choice for most patients. Therefore, examination of factors influencing patients' mode of transport in ACS is warranted.

The aims of this study are to identify the proportion of ACS patients using an ambulance to transport to hospital and to explore demographic and clinical factors influencing their mode of transport.

Methods

A retrospective, observational cohort design was utilised in this study. Data concerning 4,299 confirmed or suspected cases of ACS in a large university hospital over a 9-year period was obtained from the Coronary Heart Attack Ireland Register (CHAIR). Following the implementation of inclusion criteria, the final sample consisted of 1,964 cases. These inclusion criteria were: 1) patients were 18+ years 2) patients had a confirmed diagnosis of ACS 3) the event occurred outside of the hospital 4) patients' mode of transport was recorded. Comprehensive demographic and clinical data regarding cases of ACS in CUH was received from CHAIR. All aspects of demographic and clinical data used in this study can be seen in tables 1 and 2. Patients' mode of transport was divided between 'ambulance' and 'self-transport', with the latter consisting of all methods of transport outside of an ambulance.

Data was analysed using SPSS Version 24. Descriptive statistics were used to detail demographic and clinical data, as well as to establish the proportion of ambulance usage among ACS patients. Chi-square and t-tests were used to differentiate between groups at baseline. Factors influencing mode of transport were analysed by binary logistic regression. Ethical approval for this study was obtained from the Clinical Research Ethics Committee at University College Cork.

Results

Demographics & Clinical Characteristics

A total of 1,964 patients with an average age of 68.9±11.8 years were included in this study. Seventy-two percent were male (n=1416) with a mean age of 67.7±11.6 years. There were several significant differences between the baseline clinical characteristics of the ambulance and self-transport groups, outlined in table 1 below.

ECG Findings

Patients' initial ECG findings on arrival are outlined in table 2. Ambulance patients had a significantly higher probability of ECG abnormalities, which included: atrial fibrillation; left and right bundle branch block (LBBB and RBBB respectively); pathological T-waves; ST-depression and elevation; as well as "other" abnormalities in each category.

	Overall N=1964(%)	Ambulance n=1041(%)	Self n=923(%)	p
Demographics				
Mean Age ± SD, Years	68.9±11.8	70.6±12.1	67±11.1	<.0005
Male	1416 (72.1)	730 (70.1)	686 (74.3)	<.05
GP Presentation	1098 (55.9)	508 (48.8)	590 (63.9)	<.0005
Smoking Status				<.05
Never	627 (31.9)	330 (31.7)	297 (32.2)	
Former	833 (42.4)	416 (40)	417 (45.2)	
Current	504 (25.7)	295 (28.3)	209 (22.6)	
Predominant Presenting Complaint				<.0005
Chest Pain	1624 (82.7)	801 (76.9)	823 (89.2)	
Dyspnoea	163 (8.3)	103 (9.9)	60 (6.5)	
Syncope	46 (2.3)	39 (3.7)	7 (0.8)	
Cardiac Arrest	37 (1.9)	36 (3.5)	1 (0.1)	
Other	94 (4.8)	62 (6)	32 (3.5)	
Clinical History				
Previous MI	800 (40.7)	439 (42.2)	361 (39.1)	.17
Unstable Angina	332 (16.9)	142 (13.6)	190 (20.6)	<.0005
Stable Angina	514 (26.2)	280 (26.9)	234 (25.4)	0.47
Hypertension	1377 (70.1)	722 (69.4)	655 (71)	0.47
Hypercholesterolaemia	1412 (71.9)	710 (50.3)	702 (49.7)	<.0005
Family History of CAD	783 (39.9)	375 (36)	408 (52.1)	<.0005
Diabetes Mellitus	477 (24.3)	262 (25.2)	215 (23.3)	.36
Vitals				
Mean HR ± SD	78.3±20.9	80.7±23.4	75.6±17.3	<.0005
Mean SBP ± SD	138.8 ± 26.4	134.6 ± 28.6	139.2±23.6	<.0005
Mean DBP ± SD	78.1 ± 16.9	76.5 ± 17.4	79.9±16	<.0005
Discharge Diagnosis				<.0005
Unstable Angina	659 (33.6)	203 (19.5)	456 (49.4)	
NSTEMI	960 (48.9)	589 (56.6)	371 (40.2)	
STEMI/ LBBB	345 (17.6)	249 (12.7)	96 (4.9)	
Survival Status				<.0005
Alive	1832 (93.3)	928 (89.1)	904 (97.9)	
Deceased	132 (6.7)	113 (10.9)	19 (2.1)	

Table 1: Demographic and clinical characteristics according to mode of transport.

	Overall N=1964 (%)	Ambulance n=1041(%)	Private n=923(%)	p
Overall ECG Rhythm				.001
Sinus Rhythm	1688 (85.9)	866 (83.2)	822 (89.1)	
Atrial Fibrillation	202 (10.3)	128 (12.3)	74 (8)	
Other	74 (3.8)	47 (4.5)	27 (2.9)	
QRS Complex				.001
Normal	1705 (86.8)	878 (84.3)	827 (89.6)	
LBBB	156 (7.9)	106 (10.2)	50 (5.4)	
RBBB	85 (4.3)	45 (4.3)	40 (4.3)	
Other	18 (0.9)	12 (1.2)	6 (0.7)	
ST-Segment Changes				<.0005
Normal	671 (34.2)	293 (28.1)	378 (41)	
Pathological T-Wave	558 (28.4)	261 (25.1)	297 (32.2)	
ST-Depression	330 (16.8)	198 (19)	132 (14.3)	
ST-Elevation	343 (17.5)	254 (24.4)	89 (9.6)	
Other	62 (3.2)	35 (3.4)	27 (2.9)	

Table 2: Initial ECG findings according to mode of transport.

Proportion of Ambulance Usage in ACS

Results show that only 27% of patients directly contacted emergency medical services. A minority (17%) transported themselves directly to hospital. Over half of patients (56%) presented initially to a GP (fig1a). More GP patients (53.6%) continued to hospital by self-transporting than by employing the ambulance services (46.4%; Fig1b.).

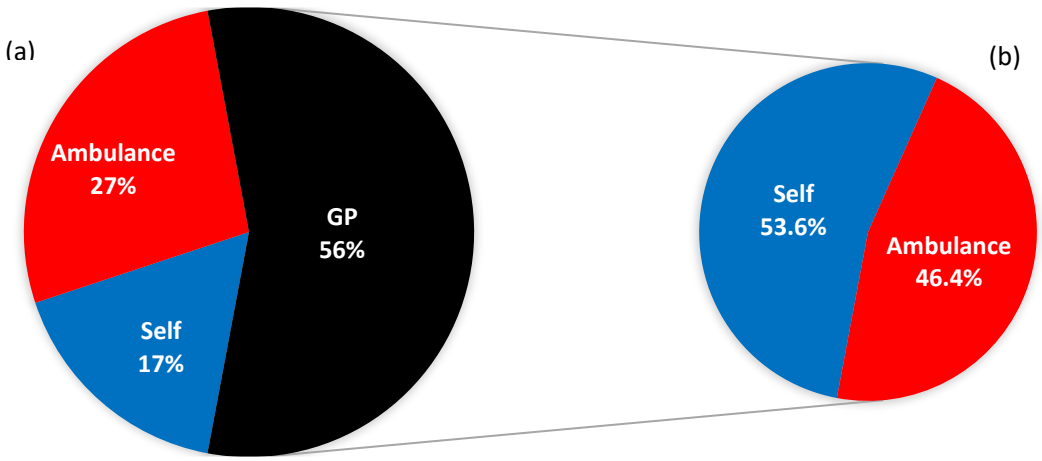

Figure 1: (a) Patients' initial presentation to healthcare by mode of transport including GP presentation. (b) Patients' mode of transport to hospital after presenting to a GP.

	B	S.E.	Wald	df	p	Odds Ratio (OR)	95% C.I. for OR	
							Lower	Upper
Age	.024	.005	20.606	1	.000	1.024	1.014	1.035
GP	-.636	.104	37.085	1	.000	.529	.431	.650
Predominant Presenting Complaint								
Cardiac Arrest	3.174	1.062	8.926	1	.003	23.894	2.979	191.638
Syncope	1.324	.498	7.070	1	.008	3.759	1.416	9.976
Clinical History								
Stable Angina	.388	.123	9.873	1	.002	1.473	1.157	1.876
MI	.379	.112	11.424	1	.001	1.461	1.173	1.821
Hypercholesterolaemia	-.275	.131	4.409	1	.036	.759	.587	.982
Current Smoker	.345	.145	5.639	1	.018	1.411	1.062	1.876
Vitals								
Heart Rate	.008	.003	8.061	1	.005	1.008	1.003	1.014
Diastolic BP	-.012	.004	7.423	1	.006	.988	.98	.997
ST-Elevation (ECG)	1.220	.252	23.401	1	.000	3.387	2.066	5.552
Diagnosis								
NSTEMI	.992	.124	64.452	1	.000	2.696	2.116	3.434
STEMI	.751	.254	8.755	1	.003	2.119	1.288	3.484
Constant	-1.857	.593	9.791	1	.002	.156		

Table 3: Significant results of binary logistic regression predicting the likelihood of ambulance usage.

Factors influencing mode of transport

Binary logistic regression was used to analyse the impact of factors on the probability of patients using an ambulance in cases of ACS. Table 3 details the independent variables that exerted a unique and statistically significant influence on ACS patients' mode of transport to hospital.

Presenting complaints were the strongest predictors of ambulance usage. Cardiac arrest had the most marked effect, making patients over 23 times more likely to utilise an ambulance than self-transport. Syncope recorded an odds ratio of 3.759. ST-segment elevation on an ECG had a similar effect. STEMI and NSTEMI increased likelihood of using an ambulance, when compared to unstable angina. Aspects of patients' medical history also augmented transport choice. Being a current smoker, having a history of previous MI, or stable angina each made ambulance usage approximately 1.4 times more likely. Patients' age and their heart rate on admission individually exerted minimal effects.

However, some variables were inversely proportional to probability of taking an ambulance to hospital. A lower diastolic blood pressure was present more often in ambulance patients. A history of hypercholesterolaemia was associated with a lower probability of being transported by ambulance. Presenting to a GP had the largest bearing on self-transportation, making it 1.89 times more likely than ambulance usage.

Discussion

Results of this study show that there is an underutilisation of ambulance services in ACS patients and highlight several factors that influence patients' mode of transport.

Although over half of patients ultimately transported to hospital via ambulance, only 27% contacted emergency services directly; a finding that is consistent with most previous research. Instead of using an ambulance, most patients travelled in potentially unsafe conditions either directly to the emergency department or to their GP. Over twice as many patients initially presented to their GP as those directly contacting emergency services. Patients presenting to a GP were then more likely to continue to hospital by self-transporting, further prolonging potentially dangerous circumstances. Mooney et al.[19] reported comparable results, concluding that general practitioners do not encourage ambulance usage in these patients. Further research on this is needed.

It was found that ambulance patients were much sicker overall when compared to self-transporting patients, as indicated by a multitude of previous research. They were more likely to present with debilitating presenting complaints[5, 12]. Cardiac arrest and syncope increased the likelihood of ambulance usage- the former by a factor of 23. Thirty-six of the 37 patients with cardiac arrest were transported by ambulance. Other presenting complaints did not significantly impact mode of transport. Ambulance patients were also more likely to have ischaemic changes on ECG and to be diagnosed with a STEMI or NSTEMI; which has also been seen in studies done in the USA and Asia[9,17]. When they reached the hospital, they also had higher heart rates and lower diastolic blood pressures. Ambulance patients also incurred a higher mortality rate than those that travelled by other means to hospital.

As with many other studies[2,9], older individuals favoured using an ambulance when experiencing ACS. It has been previously hypothesised that this is due to a possible accumulation of comorbidities over time[5, 11]. With regard comorbidities in this population, a history of stable angina or a previous MI increased the probability of patients availing of ambulance services. Being a current smoker had a similar effect.

Chest pain was the most common symptom on presentation, with over 82% of patients experiencing it. However, outside of severity of chest pain[5], many studies- including this one- show it is not associated with transportation [2, 11, 23]. This could be because it frequently occurs in many other conditions and possibly patients may not attribute it to cardiac pathology [5].

Contrary to previous findings, there was no relationship between mode of transport and patients presenting with dyspnoea or an atypical presentation of ACS [18]. Diabetes mellitus has been implicated before as a strong predictor of self-transport [11, 23]. One explanation for this is because diabetics tend to present atypically with ACS [3]. No relationship was identified here between diabetes and patient transport.

When developing awareness campaigns surrounding this issue, it is imperative to know how many ACS patients use an ambulance and knowing the factors that influence patients' mode of transport. Insights into all of these will allow one to compile information on how best to tackle the underutilisation of ambulance services in acute coronary syndrome. It is not feasible for everyone with chest pain to call for an ambulance, as it is one of the main reasons for a person to present to the emergency department[34]. Therefore, it could prove pertinent to educate the public and at-risk individuals on the symptoms of an acute myocardial infarction and the significance of contacting emergency medical services directly without delay. Patients that have a greater understanding of risk factors for coronary artery disease and the importance of calling an ambulance when experiencing ACS increases the probability of them contacting EMS[5]. As seen here and in previous research[31], GPs may not always encourage ambulance usage in cases of ACS which could be improved upon.

Concerns may be raised with regard the strain that these interventions may have on the Irish ambulance service through inappropriate use, increasing costs and growing demand. However, other studies concluded that such difficulties did not arise from endeavours to increase ambulance use[35, 36]. Further research is warranted in this area.

The retrospective design of this study did not allow for the collection of socioeconomic factors, such as patient's distance from the hospital or access to specific methods of transport, that may have a bearing on ACS patients' mode of transport. Future research that incorporates a prospective design could rectify this. The retrospective design also allows for the possible introduction of selection bias. This research also only included patients from one hospital in Ireland. While it is a large urban centre of care, the results may not be generalised to the rest of Ireland due to variations in different urban and rural regions. A larger nationwide study would help capture these areas and give greater insight into the topic.

It is clear there is an underutilisation of ambulance service in patients that experience ACS. ACS patients that self-transport do so in possibly unsuitable conditions and repudiate both the pre- and in-hospital benefits that come with ambulance usage. The majority of patients presented initially to their GP. This may possibly lead to delay in receiving care in an appropriately equipped facility. Knowledge of the factors that influence patients' mode of transport can help guide awareness campaigns with the aim of increasing the appropriate uptake of emergency medical services in the future.

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Declaration of Conflicts of Interest:
There are no conflicts of interest.

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