Location of Acute Myocardial Infarction and Associated Arrhythmias and Outcome

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ABSTRACT

Background: Cardiac arrhythmias and conduction abnormalities complicating acute myocardial infarction (AMI) have been associated with adverse prognosis in numerous reports. Small studies have frequently associated different arrhythmias with various distributions of myocardial infarctions. We analyzed a nationally representative hospital discharge database to evaluate the relationship between the location of AMI and the associated arrhythmias and conduction abnormalities and their impact on in-hospital mortality.

Methods: We searched the National Hospital Discharge Survey database for patients with a diagnosis of AMI and collected data on the associated arrhythmias and conduction abnormalities. In-hospital death was used as end point for analysis.

Results: A total of 21,807 patients, representing 2,632,217 hospital discharges in the United States, with a primary diagnosis of AMI from 1996 to 2003 were included in this analysis. Patients with inferior or posterior AMI were more likely to develop complete heart block compared to those with anterior or lateral AMI (3.7% vs 1.0%, hazard ratio [HR] = 3.9, $p<0.001$), but less likely to die prior to hospital discharge (7.7% vs 11.3%, HR = 0.65, $p<0.001$).

Conclusions: Patients with an inferior or posterior AMI are more likely to develop conduction system abnormalities when compared to patients with an anterior or lateral AMI. On the other hand, anterior or lateral MI is a significant predictor of in-hospital death.

Introduction

Cardiac arrhythmias and conduction abnormalities complicating acute myocardial infarction (AMI) have been associated with adverse prognosis in numerous reports.[1–6] The incidence of both ventricular tachyarrhythmia and high degree atrioventricular (AV) blocks following AMI has been reported to be as high as 20% in several studies,[7–8] with an associated increase in short-term mortality.[3,9–17]

Small studies have frequently associated different arrhythmias with various distributions of myocardial infarctions.[8,18–19] While most studies have suggested an association between inferior myocardial infarction[8] and AV blocks, the data on the incidence of ventricular tachyarrhythmia have been controversial.[18–19] These findings are further supported by cardiac anatomy. While the right coronary artery supplies the AV node in 90% of individuals, the left ventricle is supplied by both the right and left coronary systems.[7]

In this study, we analyzed a nationally representative hospital discharge database to evaluate the relationship between the location of AMI and the associated arrhythmias and conduction abnormalities. In addition, we investigated the impact of these arrhythmias on in-hospital mortality following AMI.

Methods

Data Source

The National Hospital Discharge Survey collects data on approximately 1% of all discharges from nonfederal US hospitals. Public use files contain demographic data (age, sex, race, marital status); 7 diagnostic codes from the International Classification of Diseases Clinical Modification (ICD-9-CM), ninth revision; 4 procedural codes; dates of hospital admission and release; sources of payment; and disposition at discharge. These files were collected and merged from 1996 to 2003. Patients with a primary diagnosis of AMI were selected using ICD-9-CM code 410 and included in the study database. AMI was further classified as anterior, lateral, posterior, or inferior using ICD-9-CM codes: 410.0, 410.1, 410.2, 410.3, 410.4, 410.5, 410.6. In addition, we evaluated the occurrence of first degree AV block, second degree AV block type I (Mobitz I), and type II (Mobitz II), complete AV block, as well as the incidence of ventricular tachycardia and ventricular fibrillation using ICD-9-CM codes: 426.11, 426.13, 426.12, 426.0, 427.1, and 427.4, respectively.

Data on comorbid conditions were abstracted from the database. These included a diagnosis of diabetes mellitus (ICD-9-CM codes: 250.00, 250.01, 250.02, 250.03, 250.70, 250.71, 250.72, 250.73), or of hypertension (ICD-9-CM codes: 401.0, 401.1, 401.9, 402.00, 402.01, 402.11, 405.11). The outcome of interest was the AMI associated arrhythmia or conduction abnormality and in-hospital death, as determined from the discharge status entry in the study database.

Statistical Analysis

All continuous variables are expressed as mean±SD. Study end points were defined as death and cardiac arrhythmias or conduction abnormalities. Univariate analyses were used to

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assess the influence of each clinical variable on the study end points. Multivariable binary logistic regression models were used to assess the independent influence of AMI location on mortality after correcting for all other significant clinical variables. A two-tailed p value of <0.05 was considered significant. All analyses were performed using SPSS 14.0 version (SPSS, Inc., Chicago, Illinois, Ill.).

Results

General Characteristics of Study Population

A total of 21,807 patients, representing 2,632,217 hospital discharges in the United States, with a primary diagnosis of AMI from 1996 to 2003 were included in this analysis. The mean age of the study population was 64.66±14.07 years. Patients were more likely to be men (63.4%) of white ethnicity (58.8%). The breakdown of AMI by location was 41.2% for anterior AMI, 52.9% for inferior AMI, 1.6% for posterior, and 4.2% for lateral AMI. The prevalence of hypertension and of diabetes mellitus in this population was 22.3% and 20.2%, respectively. Other characteristics of the study population are shown in Table 1.

Table 1. General Characteristics of Study Population (n = 21, 807)

Variable		
Age (years)		64.66±14.07
Gender (% male)		63.4%
Race (% white)		58.8%
Hypertension		22.3%
Diabetes mellitus		20.2%
AMI location	Anterior	41.2%
	Lateral	4.2%
	Inferior	52.9%
	Posterior	1.6%
First degree AV block		0.8%
Mobitz I		0.7%
Mobitz II		0.1%
Complete AV block		2.5%
Ventricular tachycardia		7.6%
Ventricular fibrillation		8.5%
Death		9.3%

Abbreviations: AMI, acute myocardial infarction; AV, atrioventricular.

Incidence of Cardiac Arrhythmias by Site of AMI

A higher incidence of conduction abnormalities was associated with inferior and posterior AMI, compared to anterior and lateral AMI. While 3.7% of patients with inferior or posterior AMI developed complete heart block, only 1.0% of those with anterior or lateral AMI exhibited this same conduction abnormality (HR = 3.9, $p<0.001$). Similarly, diagnoses of first degree AV block (1.1% vs 0.6%, HR = 1.7, $p<0.001$), second degree AV block types I (1.1% vs 0.4%, HR = 2.7, $p<0.001$) and II (0.2% vs 0.0%, HR = 4.3, $p = 0.004$) were more common in the context of inferior or posterior compared to anterior or lateral AMI. There was no difference in the incidence of ventricular tachycardia by AMI location (7.3% in inferior or posterior AMI vs 7.9% in anterior or lateral AMI, HR = 0.89, $p = 0.064$) while ventricular fibrillation was marginally more frequent among patients with an anterior or a lateral AMI (9.0% vs 8.1%, HR = 0.65, $p = 0.023$). Table 2 shows the results of the univariate analyses.

Incidence of In-Hospital Mortality by AMI Site

Patients with anterior or lateral AMI were more likely to die prior to hospital discharge than patients with an inferior or posterior AMI (11.3% vs 7.7%, HR = 0.65, $p<0.001$).

The association of in-hospital death and AMI location was evaluated in a multivariate logistic regression model. After correcting for age, gender, diabetes mellitus, and hypertension, the incidence of complete heart block (HR = 1.7, $p<0.001$), of ventricular fibrillation (HR = 4.9, $p<0.001$), and the AMI location (HR = 1.33, $p<0.001$) remained significant predictors of in-hospital mortality. Table 3 shows the results of the multivariate logistic regression analysis. Also, the presence of complete heart block and ventricular fibrillation independently predicted higher in-hospital mortality, when the analysis was performed separately in patients with anterior or lateral AMI locations and in those with inferior or posterior AMI locations.

Discussion

In this analysis of a nationally representative hospital discharge database, we show that patients with an inferior or a posterior AMI are more likely to develop AV nodal conduction abnormalities, while those patients with an anterior or lateral AMI are more likely to develop ventricular fibrillation. In addition, patients with an anterior or a lateral AMI or with evidence of complete heart block were more likely to die prior to hospital discharge compared to patients who did not exhibit these higher risk characteristics.

These findings are consistent with prior studies that evaluated the association of AMI location and different arrhythmias.[7–8] Several reports have shown an association between inferior AMI and various degrees of AV blockade. In a study by Rathore et al., the incidence of complete AV block among patients with inferior AMI was twice as high when compared to patients with an anterior AMI.[8]

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Table 2. Univariate Analysis of Different Arrhythmias by AMI Location

Conduction abnormality	Inferior or posterior AMI	Anterior or lateral AMI	Hazard ration	95% confidence interval	*p* value
First degree AV block	1.1%	0.6%	1.7	1.2–2.3	<0.001
Mobitz I	1.1%	0.4%	2.7	1.9–3.9	<0.001
Mobitz II	0.2%	0.0%	4.3	1.5–12.7	0.004
Complete AV block	3.7%	1.0%	3.9	3.1–4.9	<0.001
VT	7.3%	7.9%	0.9	0.8–1.0	0.064
VF	8.1%	9.0%	0.89	0.80–0.98	0.02
Death	7.7%	11.3%	0.65	0.6–0.7	<0.001

Abbreviations: AV, atrioventricular; VT, ventricular tachycardia; VF, ventricular fibrillation.

Table 3. Multivariate Analysis by Logistic Regression of In-Hospital Death by AMI Location

Variable	Hazard ratio	95% confidence interval	*p* value
Age (per year)	1.06	1.06–1.06	<0.001
Gender (men versus women)	1.3	1.2–1.5	<0.001
Diabetes mellitus	1.2	1.1–1.3	<0.001
Hypertension	0.5	0.5–0.6	<0.001
AMI (anterior or lateral versus inferior or posterior)	1.3	1.2–1.4	<0.001
Complete AV block	1.7	1.3–2.2	<0.001
VF	4.9	4.3–5.5	<0.001

Abbreviations: AV, atrioventricular; VF, ventricular fibrillation.

In the prethrombolytic era, analysis of more than 8,000 patients with an inferior AMI revealed an incidence of complete AV block as high as 16%.[7] Similar associations were obtained in smaller reports after the advances in thrombolytic therapy.[9,16,20]

These findings are also in concordance with coronary distribution. The AV node and the proximal infranodal conduction system receive blood supply from the AV nodal artery, arising from the right coronary in the majority of patients.[21–24] After evaluating the AV nodal and His bundle supply in 72 patients, Kennel and Titus concluded that in 83% of cases, these structures are supplied by the right coronary artery.[25] Acute occlusion of the right coronary artery, resulting in an inferior and/or posterior infarct would therefore also result in AV nodal ischemia and various degrees of AV blocks.

On the other hand, there is no consensus in the literature on the association between AMI location and ventricular tachyarrhythmia. While our data have shown an association between ventricular fibrillation and anterior or lateral AMI, which may be explained on the basis of the larger myocardial mass involved with these AMI locations, a study by Henriques et al., revealed the opposite.[18] In animal studies, vagal stimulation and beta blockade resulted in a lower incidence of ventricular fibrillation.[26] Since vagal tone is often increased in inferior AMI,[26] it may be expected to protect against ventricular fibrillation. Nevertheless, data associating ventricular fibrillation with inferior AMI originates mostly from the postreperfusion era. Whether myocardial reperfusion plays a role in increasing the incidence of ventricular fibrillation in this setting remains unknown.[27–30]

Several reports evaluated the predictors of short-term mortality post AMI. As shown in our data, patients with an anterior AMI were at a higher risk of death in several studies.[8,31] These findings could be explained by a higher incidence of cardiogenic shock complicating anterior AMI as reported by Gacioch and Topol.[29] On the other hand, our results were in agreement with previous studies showing complete AV block after AMI to be a significant predictor of short-term mortality.[1] In a study by Rathore et al., patients with complete heart block were 1.4 times more likely to have a fatal outcome during hospitalization for AMI.[8]

The present study has several important limitations. First, the data are derived from hospital discharges

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from across the US and their accuracy depends on accurate coding. Second, the severity of the AMI and the associated left ventricular dysfunction could not be assessed because of the same coding limitation. Also, the database does not allow the assessment of the impact on outcome of specific interventions such as the use of β-blockers. Last, although the large numbers of patients allows for corrections for major comorbidities, the retrospective nature of the study may introduce potential confounders and biases that cannot be excluded or corrected for.

In this study, we evaluated the different conduction abnormalities and the arrhythmias associated with AMI. Our data confirm findings from previous smaller studies and establishes these associations at a national scale. In addition, our data provide further information on short-term mortality following AMI and helps identify several predictors of in-hospital death in this setting. Whether early interventions after AMI with pacing or the use of antiarrhythmic drugs may alter these outcomes deserves further investigations.

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