ST Deviation Pattern and Infarct-related Artery in Acute Myocardial Infarction

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ABSTRACT

Background: Myocardial infarction (MI) may be classified as ST-elevation MI (STEMI) or non-ST-elevation MI (NSTEMI). There is little data regarding the relationship between the infarct related artery (IRA), clinical characteristics of the patients, and the ST deviation pattern (ie, STEMI or NSTEMI).
Hypothesis: There is a predilection of any coronary artery to a particular ST deviation pattern of acute MI.
Methods: We reviewed our institutional database and selected patients who presented with an acute MI and underwent coronary angiography within 7 days of admission. The analysis included 830 patients of whom 563 had STEMI and 267 had NSTEMI. The culprit lesion was defined by reviewing each patient's angiographic report, electrocardiogram, and echocardiogram. TIMI flow rate was determined.
Results: The IRA in STEMI was most frequently the left anterior descending coronary artery (LAD) followed by the right coronary artery (RCA) and then the left circumflex coronary artery (LCX), a statistically significant difference. In patients with NSTEMI there were no significant differences in IRA. Patients with STEMI and LCX as the IRA were significantly younger and had a higher percentage of TIMI grade 3 flow then patients with STEMI and LAD or RCA as IRAs. These differences were not noted in patients with NSTEMI regardless of IRA.
Conclusions: In STEMI there were significant differences in age and TIMI flow depending on the IRA. These findings were not demonstrated in patients with NSTEMI.

Introduction

Acute myocardial infarction (MI) is classified according to admission ECG, as ST-elevation myocardial infarction (STEMI) or non-ST-elevation myocardial infarction (NSTEMI). This distinction is critical given the different prognostic and therapeutic implications for each of these 2 subtypes.[1,2]

Acute MI is generally the result of severe impairment in blood flow due to ruptured atherosclerotic plaque in 1 of the 3 main coronary arteries. The reasons why some ruptured plaques proceed to complete occlusion and STEMI and some to incomplete occlusion and NSTEMI remain unclear. There is little data regarding the relationship between the infarct related artery (IRA), clinical characteristics of the patients, and the ST deviation pattern (ie, STEMI or NSTEMI). The objective of this study was to determine whether there is a predilection of any coronary artery to a particular ST deviation pattern of acute MI and what clinical features may be associated with this predilection.

Methods

Patient Population

All patients who presented to our institution with acute myocardial infarction and underwent coronary angiography within 7 days of admission from January 1, 2002 to December 31, 2005, were identified via the institutional database. Acute MI was defined as a final diagnosis of an acute MI in the discharge summary with documentation of a positive test for troponin T. STEMI diagnosis required admission ECG demonstrating ST-elevation in at least 2 contiguous leads. All acute MIs not meeting criteria for STEMI were defined as NSTEMI.

Patients were excluded if they had a history of coronary artery bypass surgery, or if the MI was a complication of percutaneous coronary angioplasty (eg, acute or subacute thrombosis or restenosis). In addition, patients who presented with acute MI associated with infection or anemia were excluded. In addition to basic demographics (eg, age, gender, and cardiac risk factors), laboratory values (eg, peak creatine kinase, peak troponin-T) were recorded. The culprit lesion was defined by reviewing each patient's angiographic report, electrocardiogram, and echocardiogram.

Angiographic Analysis

Quantitative coronary angiographic (QCA) analysis was performed off-line by an independent analyst, using TCS Symphony software (Medcon Telemedicine Technology, Tel-Aviv, Israel).

The following standardized angiographic projections were chosen to minimize foreshortening of the arteries: for the right coronary artery the left anterior oblique coronary artery (LAO) straight view; for the circumflex artery the right anterior oblique coronary artery (RAO) caudal view;

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and for the left anterior descending coronary artery (LAD) the RAO view with steep cranial angulation. For each patient studied, the IRA was identified. The thrombosis site was defined as the point of angiographic occlusion or, if TIMI flow grade 1 or greater was present, the minimal luminal diameter within the culprit lesion. TIMI flow rate was determined.

Statistical Analysis

A χ^2 test was used to determine the difference between proportions; a *t* test was used to determine the difference between means. *P* values of $\leq .05$ were considered statistically significant.

Results

A total of 830 patients were included in the study of which 563 had STEMI and 267 had NSTEMI. As compared to the NSTEMI group, patients in the STEMI group were significantly younger, with a lower percentage of hypercholesterolemia, hypertension, and patients with a previous history of MI, and a higher percentage of smokers (Table 1).

The vessel involved in STEMI was most frequently the LAD followed by the right coronary artery (RCA) and then the left circumflex coronary artery (LCX), a statistically significant difference (Table 2). In patients with NSTEMI, both the LAD and LCX were IRAs in equal frequency with the RCA less frequently involved, this difference however, was not statistically significant (Table 3).

Table 1. Patient Characteristics According to ST Deviation Pattern

ST Pattern	STEMI n = 563	NSTEMI n = 267	*P*
Age ± SD	58.3±13	61.1±11	<.01
Male	459 (82%)	201 (75%)	NS
Hypercholest	248 (44%)	154 (58%)	<.02
Hypertension	223 (39%)	136 (51%)	<.03
Diabetes	150 (27%)	75 (28%)	NS
Smoking	345 (61%)	125 (51%)	<.05
Previous MI	60 (11%)	52 (19%)	<.01
Thrombolysis	136 (24%)	0.0 (0%)	<.001
IIb/IIIa	86 (15%)	15 (5%)	<.001
Direct PCI	270 (48%)	0.0 (0%)	<.001
TIMI grade 3	247 (44%)	187 (70%)	<.001
Days to PCI	1.5±2.4	3.4±2.3	<.001

Abbreviations: MI, Myocaroil Infarction; PCI, Percutaneous Coronary Intervention; SD, Standard Deviation.

Patients with STEMI and LCX as the IRA were significantly younger then patients with STEMI and LAD or RCA as IRAs (Table 2). In contrast age was similar in patients with NSTEMI regardless of IRA (Table 3).

The presence of TIMI grade 3 flow rate in the IRA at the time of diagnostic angiography was significantly higher in NSTEMI compared to STEMI (Table 1). A TIMI grade 3 flow rate was significantly more frequent in STEMI when the LCX was the IRA (Table 2). In contrast, a TIMI grade 3 flow was present in similar proportions of patients with NSTEMI regardless of IRA (Table 3).

Time from presentation to percutaneous coronary intervention (PCI) was significantly longer in NSTEMI compared to STEMI patients (Table 1). In STEMI patients, time to PCI was similar when LCX or RCA were IRAs and significantly shorter when LAD was IRA (Table 2). In NSTEMI patients, time to PCI was similar regardless of IRA (Table 3).

Discussion

Patients undergoing STEMI as opposed to NSTEMI are different in many respects. Previous studies have shown that STEMI patients are younger, with a higher percentage of smokers, and less comorbidities as compared to NSTEMI patients.[3] This is the case in the present study as well. As patients with STEMI generally have occlusive thrombus, urgent reperfusion, by thrombolysis or direct PCI, is beneficial. In NSTEMI patients, who generally have nonocclusive thrombus this strategy has no benefit.[1,2] STEMI patients and NSTEMI patients differ by outcome as well.[3,4] We have recently shown that most patients with recurrent MI episodes will have either repeated episodes of STEMI or NSTEMI, but not both.[5] We also demonstrated that seasonal variation in myocardial infarction is limited to patients with STEMI.[6] In the face of all these differences a recent study challenged the notion that STEMI and NSTEMI are 2 distinct entities.[7]

The IRA in STEMI was most frequently LAD and least frequently LCX (Table 2), a finding demonstrated in other studies as well.[8] The present study contributes to the existing literature by demonstrating that there are significant differences in the incidence of IRA in patients with STEMI, but not in patients with NSTEMI. In NSTEMI, all 3 vessels were culprits with a similar frequency (Table 3).

In addition, we demonstrate other differences between these MI types: STEMI patients with LCX as the IRA are younger then STEMI patients with LAD or RCA IRAs (Table 2), whereas age was similar in NSTEMI patients regardless of IRA (Table 3).

The contention is that in STEMI the culprit artery is usually occluded by a thrombus at baseline, while in patients with NSTEMI, the culprit artery is usually patent with a nonocclusive thrombus is supported by studies examining prevalence of total coronary occlusion in patients

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Table 2. Characteristics of Patient With STEMI According to Culprit Vessel

Vessel	LAD	LCX	RCA	*P* LAD vs LCX	*P* RCA vs LCX	*P* LAD vs RCA
n	271 (48%)	93 (17%)	199 (35%)	<.001	<.001	<.01
Age ± SD	58.3±13	54.5±11	60.2±12	<.02	<.001	NS
Male	224 (83%)	81 (87%)	154 (77%)	NS	NS	NS
Hypercholest	113 (42%)	45 (48%)	90 (45%)	NS	NS	NS
Hypertension	108 (40%)	31 (33%)	84 (42%)	NS	NS	NS
Diabetes	73 (27%)	24 (26%)	53 (27%)	NS	NS	NS
Smoking	159 (59%)	64 (69%)	122 (61%)	NS	NS	NS
Previous MI	34 (12%)	7 (8%)	22 (11%)	NS	NS	NS
Thrombolysis	52 (19%)	26 (28%)	58 (29%)	NS	NS	.06
Direct PCI	161 (59%)	32 (34%)	77 (39%)	<.03	NS	<.02
TIMI grade 3	113 (42%)	59 (64%)	75 (38%)	<.05	.02	NS
Days to PCI	1.1±2.1	1.9±2.4	1.8±2.6	<.01	NS	<.01
	n = 219	n = 67	n = 141			
TIMI grade 3[a]	76(35%)	40(60%)	48(34%)	<.04	<.05	NS

[a] TIMI grade 3 flow after excluding thrombolysis treated patients. Abbreviations: LAD, Left Anterior Decendina; LCX, Left Circumflex; MI, Myocaroil Infarction; PCI, Percutaneous Coronary Intervention; RCA, Right Coronary Artery; SD, Standard Deviation.

Table 3. Characteristics of Patient With NSTEMI According to Culprit Vessel

Vessel	LAD	LCX	RCA	*P* LAD vs RCA	*P* RCA vs LCX	*P* LAD vs LCX
n	94 (35%)	99 (37%)	74 (28%)	NS	NS	NS
Age ± SD	62.5±12	60.5±10	59.9±13	NS	NS	NS
Male	67 (71%)	80 (81%)	54 (73%)	NS	NS	NS
Hypercholest	50 (53%)	64 (64%)	40 (54%)	NS	NS	NS
Hypertension	41 (54%)	46 (46%)	39 (53%)	NS	NS	NS
Diabetes	22 (23%)	30 (30%)	23 (31%)	NS	NS	NS
Smoking	38 (40%)	52 (53%)	35 (47%)	NS	NS	NS
Previous MI	24 (25%)	25 (25%)	19 (26%)	NS	NS	NS
TIMI grade 3	71 (76%)	75 (76%)	54 (73%)	NS	NS	NS
Days to PCI	3.4±2.5	3.4±2.4	3.5±2.2	NS	NS	NS

Abbreviations: LAD, Left Anterior Decendina; LCX, Left Circumflex; MI, Myocaroil Infarction; PCI, Percutaneous Coronary Intervention; RCA, Right Coronary Artery; SD, Standard Deviation.

with STEMI[9,10] and NSTEMI.[11] Other studies examined TIMI flow rates in IRAs of patients with STEMI[12,13] and NSTEMI,[14] and showed a TIMI grade 3 flow rate in 20% vs 70% to 80% respectively. Our data support these findings by showing TIMI grade 3 flow rate in 44% and 70% of patients with STEMI and NSTEMI respectively (Table 1). The higher prevalence of TIMI grade 3 flow rate in STEMI patients in our study is probably related to thrombolytic treatment and use of IIb/IIIa inhibitors in significant number of our STEMI patients (Table 1).

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In STEMI patients, TIMI grade 3 flow was seen in a significantly higher percentage of patients with the LCX as the IRA, a pattern unchanged after patients treated with thrombolysis were excluded (Table 2). In NSTEMI patients, however, TIMI grade 3 flow rates were similar regardless of IRA (Table 3).

Given all these differences, we believe that STEMI and NSTEMI are 2 distinct pathophysiological entities, different in patient baseline characteristics, treatment strategies, and outcome. Interestingly it appears that in STEMI, but not in NSTEMI that there is a relationship between IRA and age at the time of acute MI. Increases in coagulation factors with age[15] may explain the fact that patients with STEMI and LCX culprit have higher TIMI grade 3 flow rate at baseline compared to patients with LAD or RCA as IRAs.

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