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Clinical course of patients with Tombstoning ST-Elevation Myocardial Infarction

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Abstract

Introduction: Tombstoning ST- segment elevation is a type of ST-segment elevation with a specific morphology which is observed in the early period of acute myocardial infarction (AMI). We aimed to study the clinical courseof anterior wall AMI patients with tombstoning electrocardiographic (ECG) pattern. *Methodology:* We investigated 46 patients with AMI for tombstoning ECG pattern. Those without tombstoning were also included and compared. Demographic, clinical, laboratory and complications were noted in both the groups of patients. *Results:* Out of 46 anterior wall AMI patients, typical tombstoning pattern in all the anterior wall ECG leads was seen in 19 (41%) patients. The systolic blood pressure was significantly lower in tombstoning group. CK-MB, the biochemical predictor of infarct size, was significantly higher among patients with tombstoning on ECG as compared to those without tombstoning (89.78±56.53 vs 173.01±107.57, p value < 0.001). Left ventricular ejection fractions were significantly lower in the tombstoning group (43.90±11.35) as compared to the non-tombstoning group (52.29±14.01%). The incidence of pre-infarct angina was significantly lower in patients with the tombstoning ECG pattern (21%) compared with those without the pattern (52%). Cardiogenic shock (16% vs 4%), ventricular tachycardia (26% vs 4%), and ventricular fibrillation (16% vs 0%) occurred in a significantly larger percentage of patients with the tombstoning ECG pattern as compared to those without tombstoning on ECG. *Conclusions:* Patients with tombstoningECG patterns had a larger infarction size, lower left ventricular ejection fraction, with higher in-hospital complications.

Keywords: Electrocardiogram; Acute Myocardial Infarction; St Segment Elevation; Tombstoning.

Introduction

Electrocardiography (ECG) has an established role in diagnosing acute myocardial infarction. ST segment elevation is one of the earliest detected changes and is called as ST-elevation myocardial infarction (STEMI). AmongSTEMI patients, variations are observed in the amplitude and morphology of ST segment elevation, T wave variations, the presence or absence of Q wave, and clinical course and final clinical outcome. Tombstoning ST- segment elevation, first characterised by Wimalaratna in 1993, is a type of ST-segment elevation with a specific morphology which is observed in the early period of acute myocardial infarction (TOMB-STEMI) [1]. The author further reported a higher rate of complications during the first 7 days of hospital stay, like cardiogenic shock, arrhythmia, complete atrioventricular block bundle branch block, and a higher mortality rate among patients with a tombstoning ECG pattern during the early stages of acute myocardial infarction. We aimed to study the correlation between clinical findings and the tombstoningECG pattern in patients with first anterior wall acute myocardial infarction.

Methodology

Study Design and sampling

This study was conducted on patients of first

anterior wall acute myocardial infarction admitted to our hospital between April 2017 and November 2017. Patients with first attack of anterior wall acute myocardial infarction were included in the study and were diagnosed when the patient had prolonged chest pain more then 30 minutes duration, a diagnostic increase in creatine kinase-muscle/ brain (CK-MB) and serial ECG changes evolved in two or more than two adjacent precordialleads. Patients were excluded if ECG was not recorded within 12 hours of onset of symptoms, ECG shows bundle branch block, myocardial infarction other than Q-wave anterior anterior wall myocardial infarction, previous myocardial infarction or ECG having a mixed pattern.

Data Collection and Data Analysis

After obtaining approval of the institutional ethics committee, patients fulfilling the study criteria were approached for being included in the study. Patients were explained the purpose of the study and written consent was taken prior to inclusion. Standard l2-lead electrocardiograms (ECG) were recorded at a rate of 25 mm/s and were calibrated at amplitude of 1.0 mV/10 mm. The isoelectrical line was determined by referring to the previous TP segment on ECG. The same investigator conducted all the ECG evaluations; who was not blinded to the patients. All ECG readings were divided into two groups according to the shape of the ST segment: those exhibiting tombstoning pattern and those not exhibiting tombstoning pattern. The definition of tombstoning pattern used by Guo et al. [2]. The criteria of tombstoning ST-segment elevation are as follows: a) Absent R wave or an R wave duration <0.04 s with minimal amplitude, b) convex upward ST segment merging with the descending R or the ascending QS/QR, c) the peak of the ST segment is higher than the R wave and d) the ST segment merges with the T wave.During hospitalization, baseline characteristics, pre-infarct angina, and coronary risk factors were recorded on standard forms. The admission electrocardiograms were obtained for future evaluation. Left ventricular fractions were measured. During hospitalization, death, cardiogenic shock, ventricular arrhythmias (ventricular tachycardia/fibrillation), high-grade atrioventricular blocks (second- and third-degree atrioventricular block), and atrial fibrillation were recorded as in-hospital complications. Data were imported in SPSS statistical software and analysed. Quantitative data were described as means and standard deviation and were compared using t-test. Qualitative data were described as numbers and percentages and were compared using chi-square test. A p value less than 0.05 was taken as statistically significant.

Results

A totalof hundred and eighty four patients of acute myocardial infarction were admitted to our hospital between April 1, 2017 and November 31, 2017; of these 85 were cases of acute anterior wall myocardial infarction. Thirty three cases were excluded as they met various exclusion criteria. Fifty two subjects with first acute anterior wall myocardial infarction satisfied all the inclusion criteria. Four patients were not included as they did not consent to be part of the study. Two patients were referred to a cardiac centre before study protocol could be completed. Out of the study population of 46 patients, typical tombstoning pattern in all the anterior wall ECG leads was seen in 19 (41%) patients. The remaining

Table 1: Baseline characteristics of patients with or without tombstoning

Variables	Without Tombstoning (n=27)	With Tombstoning (n=19)	p value
Mean age	53.89 ± 14.29	54.05 ± 14.27	0.97
Males	20 (74%)	18 (95%)	0.06
BMI kg/m^2	23.77 ± 2.83	25.84 ± 4.64	0.06
SBP	124.96 ± 18.17	111.16 ± 14.51	<0.01
DBP	84.15 ± 11.29	78.42 ± 11.65	0.10
Total cholesterol	195.14 ± 59.45	192.15 ± 42.14	0.85
LDL-C	127.94 ± 47.78	125.92 ± 35.60	0.87
HDL-C	36.74 ± 6.08	38.79 ± 8.56	0.34
CK-MB	89.78 ± 56.53	173.01 ± 107.57	<0.001
Ejection fraction	52.29 ± 14.01	43.90 ± 11.35	0.03
Pre-infarct angina	14 (52%)	4 (21%)	0.03
Smoking	14 (52%)	12 (63%)	0.44
Thrombolysis	22 (81%)	16 (84%)	0.81
Diabetes mellitus	7 (26%)	8 (42%)	0.24

BMI: Body mass index; SBP: Systolic blood pressure; DBP: Diastolic blood pressure; LDL-C: low density lipoprotein cholesterol; HDL-C: High density lipoprotein cholesterol; CK-MB: creatine kinase-muscle/brain

Table 2: In-hospital complications in patients with or without tombstoning

Variables	Without Tombstoning (n=27)	With Tombstoning (n=19)	p value
Death	1 (4%)	3 (16%)	0.152
Cardiogenic shock	3 (11%)	7 (37%)	0.03
Ventricular tachycardia	1 (4%)	5 (26%)	0.02
Ventricular fibrillation	0 (0)	3 (16%)	0.03
Atrioventricular block	1 (4%)	4 (21%)	0.06

27(59%) patients did not exhibit tombstoning ECG patterns. Mean age of patients in both the groups were similar, while the Body Mass lndex tended to be higher in tombstoning but it was not significantlydifferent (Table 1). Systolic and diastolic blood pressures tended to be lower in patients with thetombstoning ECG pattern. The systolic blood pressure was significantly lower in tombstoning group. Though total cholesterol and low density lipoprotein were lower and high density lipoprotein was higher among patients with tombstoning on ECG, the difference was not statistically significant. CK-MB, the biochemical predictor of infarct size, was significantly higher among patients with tombstoning on ECG as compared to those without tombstoning (89.78 ±56.53 vs 173.01±107.57, p value < 0.001).Left ventricular ejection fractions were significantly lower in the tombstoning group (43.90±11.35) as compared to the non-tombstoning group (52.29± 14.01%). The incidence of pre-infarct angina was significantly lower in patients with thetombstoning ECG pattern (21%) compared with those without the pattern (52%). The incidence of diabetes, a major coronary risk factor was similar in those with andwithout the tombstoning pattern. Table 2 compares the in-hospital complications among the patients included in the study. Cardiogenic shock (16% vs 4%), ventricular tachycardia (26% vs 4%), and ventricular fibrillation (16% vs 0%) occurred in asignificantly larger percentage of patients with the tombstoning ECG pattern as compared to those without tombstoning on ECG. Though death and high-grade atrioventricular blocks were seen in a larger number of patients with tombstoning pattern the difference was not statistically significant.

Discussion

This study compared the baseline characteristics and in-hospital complications of patients with an without tombstoning on ECG. ST segment elevation is the earliest detected sign of acute MI. Initially, the ST segment may straighten, losing the ST-T wave angle, after which the T wave becomes broader and the ST segment elevates, losing its normal concavity. With further elevation, the ST segment tends to become convex upwards [3]. In cases with minimum ST segment elevation, it may surpass the peak level of the R wave.Thus, ST-segment elevation surpassing the R wave exhibitssuch a morphological appearance that it reminds a tombstone. Two electrophysiological mechanisms have been proposed to play a role in the formation of a tombstone appearance: delayed transmural conduction and intramyocardial conduction block [4]. However, tombstoning is not specific to an infraction related event; as such ECG patterns have also been observed in pericarditis and hypothermia [5]. Wilmalaratna was the first to characterise this ECG pattern as tombstone [1]. Later on, Guo et al. modified the tombstoning criteria [2]. Huang et al reported reduced left ventricluar function and high mortality in patients with tombstoning ECG pattern [6]. In previous studies, mortality in TOMB-STEMI has been reported between 26 and 38.2% [7]. Though, the present study showed 16% mortality in patients with tombstoning, it was significantly higher than those without tombstoning. As atrial arrhythmias are similar, life-threatening ventricular arrhythmias occur in a larger percentage of patients with TOMB-STEMI. Higher mortality rates may be explained with reduced pump function, life-threatening ventricular arrhythmias, and less reperfusion benefit. We observed a significantly higher proportion of patients with cardiogenic shock, ventricular tachycardia and fibrillation in our patient population with tombstoning.

Since its recognition, tombstoning ST-segment elevation has been associated with poor prognosis. Though the reasons for this observation are not entirely clear, few theories have been proposed. Extremely rapid myocardial damage, poor collateral flow and/or diffuse coronary artery disease, inadequate myocardial protection effect of preinfarct angina, and elevation of wall tension are some of the proposed explanations [8]. Guo and others suggested that tombstoning changes were more strongly associated with anterior rather

than inferior infarction and that patients with tombstoning have severe occlusion of the left anterior descending artery, mostly proximal, and usually involving either the left circumflex or right coronary artery but more often both. Further, they proposed that the lack of adequate collateral circulation and generalized disease elsewhere in the coronary system probably worsens the ischemic insult of the acute infarct and causes the tombstoning pattern [2]. Studies haveconsistently shown that patients with acute myocardial infarction preceded by angina have smaller infarcts and a better in-hospital outcome than patients without pre-infarct angina. At least 3 mechanisms may explain these differences between infarctions that are preceded by angina pectoris and those that are not: coronary collaterals, reperfusion rate, and ischemic preconditioning. The myocardium-protective effects of pre-infarct angina do not appear in patients with the tombstoning ECG pattern. Therefore, the lack of myocardium-protective effects of pre-infarct angina is likely to increase the ischemic damage due to acute myocardial infarction and causes the fast rise time and tall convex ST segment that is so characteristic of tombstoning.

Conclusion

In our study, 41% of first time myocardial infarction sufferers exhibited a typical tombstoning ECG pattern. Left ventricular ejection fractions and systolic blood pressure was lower in patients with the tombstoning ECG pattern. Cardiogenic shock, ventricular tachycardia and venficular fibrillation were more common in patients with tombstoning ECG pattem. The incidence of preinfarct angina was significantly lower in patients with tombstoning ECG patterns compared with those without the pattern.Further studies are required to fully understand the mechanism of tombstoning, the complications patients experience and its effects on long-term prognosis.

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