e-ISSN: 0975-1556, p-ISSN:2820-2643
Available online on www.ijpcr.com
International Journal of Pharmaceutical and Clinical Research 2024; 16(11); 555-559

Original Research Article

Tombstone ECG Pattern in Acute Anterior Wall Myocardial Infarction: Correlation with Risk Factors, In-Hospital Complications, and Prognostic Implications

Abhinav Kumar[1], Upendra Prasad Yadav[2], Jitendra Kumar[3]

[1]Associate Professor, Department of General Medicine, NMCH, Jamuhar, Sasaram
[2]Assistant Professor, Department of General Medicine, NMCH, Jamuhar, Sasaram
[3]Professor & Head, Department of General Medicine, NMCH, Jamuhar, Sasaram

Received: 25-08-2024 / Revised: 23-09-2024 / Accepted: 25-10-2024
Corresponding Author: Dr. Upendra Prasad Yadav
Conflict of interest: Nil

Abstract:

Background and Objectives: The 'tombstoning' electrocardiographic (ECG) pattern is a particular kind of convex ST-segment change, as observed in some patients during the early stages of acute myocardial infarction (AMI). It has been suggested that this specific pattern of ECG changes following AMI predicts a poorer outcome in these patients. The objective is to study the correlation 'tombstoning' electrocardiographic pattern in patients with first anterior wall acutemyocardial infarction with risk factors and in hospital complications

Methods: This study investigated 73 patients with AMI whose ECGs were taken within 12 hours of onset of symptoms. The study population was divided into two groups based on the admission ECGs, 'tombstoning' vs. 'non tombstoning', and their clinical characteristics were compared.

Results: In this study population of 73 patients, 27 (36.9%) had a definite 'tombstoning' pattern on their admission ECG. Compared with the 'non tombstoning' group, the significant differences in the 'tombstoning' group are as follows: infarction size is larger as evidenced by higher CK-MB levels (179.67 vs.90.57 IU); left ventricular ejection fraction is lower (40.56% vs. 47.86 %); periinfarct angina is lower (5 vs. 18.5 %), and in-hospital complications are higher.

Conclusion: This study shows that 'tombstoning' electrocardiographic patterns was associated with lower ejection fraction, left ventricular dysfunction and more in hospital complications. Pattern of the ST elevation has been shown to be a strong prediction factor for LV function in acute anterior MI.

Keywords: tombstone, Electrocardiogram, acute myocardial infarction, left ventricular ejection fraction.

Introduction

Coronary artery disease (CAD) is one of the most common causes of morbidity and mortality in both low- income/middle-income and developed countries. The National Statistical Survey Organisation (NSSO) survey is the largest recent study on the prevalence of CAD in India. In its 60th NSSO survey (2004–2005), a total of 390 913 subjects were evaluated. The prevalence of CAD was foundto be 7% in urban and 3% in the rural population. [1-5]. ECG remains corner stone of diagnostic test for acute myocardial infarction and ST segment elevation is earlysign of AMI and magnitude and extent of ST elevation indicates degree of myocardial wall injury. [6] Wimalaratna [7] used the term tombstoning in 1993 to describe a characteristic shape of ST segment in patients of AMI. He reported that patients with tombstoning ECG pattern during the early stages of AMI had a higher rate of complications during the first 7 days of hospital stay. The complications being cardiogenic shock, arrhythmia, complete atrioventricular block, bundle branch block and a higher mortality rate.[7] The retrospective study was done by Huang and others in 1994 involving a large population of patients with AMI. Their statistical assessment confirmed Wimalaratna's findings. [8] In 2000 the same group published a study concluding that the patients with tombstoning pattern on admission ECG were associated with a high-grade stenosis of the proximal Left Anterior Descending (LAD) artery and that it was predominantly seen in association with anterior infarction. [9] Balci and Yesildag in their study of 106 patients in 2004 showed that CK - MB, the biochemical predictor of infarct size, was higher; left ventricular ejection fraction were lower; the incidence of preinfarct angina was significantly lower; systolic and diastolic blood pressures tended to be lower; and in-hospital complications like cardiogenic shock, ventricular tachycardia, fibrillation and death were higher in patients with the tombstoning electrocardiographic pattern compared with those without the pattern [10]

The objective is to study the correlation between the 'tombstoning' electrocardiographic pattern in patients with first anterior wall acute myocardial infarction with risk factors and in hospital complications.

Material and Methods

The study was carried out on patients with first attack of anterior wall acute myocardial infarction admitted in Narayan medical College and Hospital Jamuhar Sasaram. Study duration is Two years. We included patients with first attack of anterior wall acute myocardial infarction were included in the study and were diagnosed with prolonged chest pain more than 30 minutes duration, diagnostic increase in CK-MB, evolution of serial ECG changes in two or more than two adjacent precordial leads suggesting acute myocardial infarction.

Patients were not included in the study if ECG is not recorded within 12 hours of onset of symptoms, ECG shows bundle branch block, Myocardial infarction other than Q-wave anterior AMI, previous myocardial infarction, ECG having a mixed pattern.

Patients were informed regarding the aim of study and written consent was taken prior to inclusion into the study. During hospitalization, baseline characteristics, preinfarct angina, and coronary risk factors were recorded on standard forms. The admission electrocardiograms wereobtained for future evaluation. 2 D echocardiography is done and Left ventricular ejection fractions were measured for all included patients. 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.

ECG Features

Standard 12-lead electrocardiograms 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. All the electrocardiograms were divided into two groups according to the shape of the ST segment as (group 1) exhibiting tombstoning pattern and (group 2) not exhibiting tombstoning pattern. The definition of tombstoning pattern used by Guo et al, who modified Wimalaratana's definition, was used.

1. The R wave is either absent, or if present, its duration is less than 0.04s with minimal amplitude and there is no trough following the Rwave.
2. The ST segment is convex upwards and merges with the descending limb of the R wave or the ascending limb of theQRS/QRwave.
3. The peak of the convex ST segment is higher than whatever remains of the R-wave.
4. The convex ST segment merges with the ascending limb of the following T-wave.

Results

A total of two hundred and sixty patients of acute myocardial infarction were admitted in our hospital, 182 were cases of acute anterior wall myocardial infarction.92 cases were excluded as they met various exclusion criteria. 90 patients with first acute anterior wall myocardial infarction satisfied all the inclusion criteria. 17 patients were not included as they did not give consent for the study.

5. Out of the study population of 73 patients, typical tombstoning pattern in all the anterior wall ECG leads was seen in 27(36.9863%) patients. The remaining 46(63.01%) patients did not exhibit tombstoning ECG patterns.
6. During hospital stay complications of acute myocardial infarction like ventricular arrhythmias (ventricular tachycardia/fibrillation), high-grade atrioventricular blocks (second- and third-degree atrioventricular block), and atrialfibrillation were recorded as in-hospital complications.

7. Demographic Profile and Risk Factors

8. There were no significant differences between the 2 groups with respect to sex and age. Preinfarct angina ismore common in patients with anterior wall myocardial infarction of nontombstone pattern than in patients with tombstone ECG pattern The p value being<0.05 and is statistically significant. There was no significant difference between the two groups with respect to history of smoking. There was no significant difference between the two groups with respect to history of hypertension and level of blood sugar control and duration of diabetes. So as the BMI increases, significant no of patients in our study presented with tombstone ECG pattern MI (p value is 0.016)

Clinical and Laboratory Parameters

In our study patients with tombstone ECG pattern have significantly lower systolic blood pressure and it shows low systolic blood pressure is a presenting feature of acute anterior wall MI with tombstone ECG pattern. Current study showed patients with tombstone ECG pattern have significantly lower diastolic blood pressure and it shows low diastolic blood pressure is presenting feature of acute anterior wall MI with tombstone ECG pattern

There is no significant difference between the two groups with respect to serum HDL levels but we found significantly higher levels of LDL levels in patients of AMI with TOMB-ST pattern compared non TOMB-ST elevation MI

Patients with tombstone ECG pattern presented with raised levels of CK -MB, the biochemical predictor of infarct size, more than that of patients with non tombstone ECG pattern. The difference between the two groups is statistically significant.

Table 1: Showing demographic profile, and risk factors

	Group	Mean	SD	P Value
Age	TS	56.74	12.221	0.293
	NTS	54.18	10.032	
Male	TS NTS	21 34		0.785
Female	TS NTS	6 12		
Smoking	TS NTS	17(62.96%) 21(45.65%)		0.225
Diabetes	TS NTS	12(44%) 13(28.26)		0.204
BMI	TS NTS	26.1196 24.4489	2.99 2.67	0.016
SBP	TS NTS	113.069 118.78	22.717 20.944	0.000
DBP	TS NTS	71.92 75.61	11.193 13.822	0.001
TC	TS	223.28	45.344	0.119
	NTS	206.78	43.508	
HDL	TS NTS	43.84 42.63	9.677 7.487	0.671
LDL	TS NTS	151.16 130.67	43.109 33.896	0.033
CK	TS NTS	179.69 256.50	68.022 28.991	0.000
EF	TS NTS	40.56 47.95	5.033 6.935	0.000

There is no significant difference between the two groups regarding treatment recieved by patients as per ICCU protocol including thrombolysis .Patients with tombstone ECG pattern myocardial infarction have significantly low ejection fraction (mean is 40.56%) as compared to that of patients with non tombstone pattern myocardial infarction. Significantly higher number of patients with tombstone ECG pattern had developed cardiogenic shock as a in hospital complication as compared to patients with non tombstone ECG pattern. Incidence of VT in patients with non tombstone ECG pattern myocardial infarction is only 4.3% as compared to 29.60% in patients with tombstone pattern myocardial infarction .Fischer's exact test applied to this showed that p value is 0.01. So difference is statistically significant. Incidence of Ventricular fibrillation is around 2.12% in patients having non tombstone pattern MIbutis significantly high (11.1%) in patients withtombstone. ECG pattern MI. F ischer's exact test showed there is significant difference between the two groups. Out of 73 patients with anterior wall myocardial infarction, 2 deaths occurred out of 46 patients with non-tombstone pattern MI, 6 deaths occurred out of 27 patients of tombstone ECG pattern MI. Statistical analysis by Fischer's exact test showed the difference is statistically significant where P value is 0.045(according to chi square , p value is0.018 <0.05)

Table 2: Showing in hospital complications

Parameters	Group	Number	P Value
Preinfarct Angina	TS NTS	5 22	0.014
Thrombolysis	TS NTS	24 36	0.204
Ejectin Fraction	TS NTS	40.56 47.95	0.000
Cardiogenic Shock	TS NTS	10	0.001

		6	
VT	TS NTS	8 2	0.001
VF	TS NTS	3 1	0.009
Death	TS NTS	6 2	0.018

Discussion

Many studies have investigated application of 12-lead ECG for risk stratification. Various ECG variables have been studied such as terminal QRS (e.g.: Sclarovsky- Bimbaumscore), ST segment (e.g.: ST), T wave (e.g.: T wave inversion), and initial QRS developing during ischemia (e.g.: Selvester QRS score). Distortion of the terminal portion of QRS complex (grade III ischemia) is one of the ECG signs that are used to determine patients under high risk. Main criteria applied for terminal QRS distortion include disappearance of S wave in leads with RS morphology and a J point elevation above the lower half of R wave in leads with QR morphology. As patient with grade III ischemia demonstrate poor prognosis and larger final infarct size, they benefit less from thrombolytic treatment and primary angioplasty .Grade III ischemia and TOMB-STEMI display similarities with respect to poor prognosis and less efficient reperfusion therapy [11].

TOMB-STEMI display similarities with respect to poor prognosis and less efficient reperfusion therapy. Morphological changes occurring in the ECG are also included in the risk stratification analysis. Regardless of the total amplitude of the ST- segment elevation, tombstoning pattern has been proposed to be associated with higher mortality and ST elevation pattern has been reported to be a more important factor than quantitative changes (e.g.: ST) in risk stratification. Pattern of the ST elevation has been shown to be a strong prediction factor in acute MI. While concave ST elevation is associated with perfect LV function, convex ST elevation is associated with poor LV function .Along with the quantitative changes in ST segment elevation, inclusion of morphologic alteration in risk stratification may contribute in obtaining more consistentresults. [12]. Wimalaratna in a published letter has described tombstoning pattern in 1993. He used the term tombstoning to describe a characteristic shape of ST segment in patients of AMI. The ST segment is convex up wards and has a fast rise time, and these changes are seen in all the leads that have ST segment elevations. The peak of the convex ST segment is often higher than the preceding R wave, which is of a short duration (often less than 0.04s) and small in amplitude. The ST segment merges with the ascending limb of the following T wave and therefore T wave cannot be identified separately. Inversion of the T wave is not noted in tombstoning tracings. He reported that patients with tombstoning ECG pattern during the early stages of AMI had a higher rate of complications during the first 7 days of hospital stay. The complications noted were cardiogenic shock, arrhythmia, complete atrioventricular and bundle branch block and a higher mortality rate. His study of 63 patients supported the notion that tombstoning may be a sign of bad prognosis in patients with acute myocardial infarction and the awareness of this variation could have helped physicians to save lives by prompt action. It could be argued that tombstoning is merely the presentation of a hyper acute state or early change of the ST segment after acute myocardial infarction. However the fact remains that the patients with these specific ST changes at admissionhad a poor prognosis.[7]The mechanism of this particular ST segment change is difficult to explain. It is likely to represent extensive and rapid myocardial damage after the

ischemicepi-
sode.Thetombstoningpatternmayactuallybeaprolong edRwave. [14] Morphet JA from Ontario also described this unique ECG marker termed tombstoning by Wimalaratana. He underlined the prognostic potential of tombstoning ECG pattern and he suggested that it be used as a cardiac marker for risk stratification along with Troponin T. [15] In 1994 a retrospective study was done by Huang and others involving a large population of patients with AMI. The statistical assessment of the study confirmed Wimalaratna findings. In their study of 605 patients they concluded that patients with tombstoning of ST segment after AMI tend to have reduced LV function and higher mortality. Tombstoning of the ST segment was becoming more recognized as a grave prognostic sign in AMI.[8] Because the tombstoning ECG is predictive of such a poor outcome, an up-to-date presentation was made at NASPE in Toronto, Canada in 1999 as to the cause, associations and implications of this specific pattern of ECG changes. [15]

Epidemiology and risk factors

There are only a few reports available on the effects of the shape of ST segment elevation on the clinical outcome or prognosis in patients with STEMI. Wimalaratna first reported a typical and rapidly progressing convex elevation of ST segment reminiscent of a tombstone. This shape of ST segment was associated with an increased rate

of in- hospital complications. TOMB-ST signs were observed in the study of Wimalaratna [7] in 10% of patients with acute MI, whereas Guo et al [9] reported it in 19% of subjects, and Balci and Yesildag[10] – in 22% of patients with acute Ant MI. Piotrkukla et al studied around 207 patients out of which 55(26.6%) were tombstone pattern. Among them 39% were of anterior wall MI. The present study was conducted in 73 patients who were selected from the cases admitted in ICCU, NMCH jamuhar Out of which 27(36.98%) patients exhibited tombstone ECG pattern and 46 (63.01%) patients had nontombstone pattern. Incidence in our study is comparable with study done by Piotr kuklaetal.

Biochemical Parameters

Our study shows that there is significant difference between the fasting blood levels of LDL between the two groups (150.33+/-40 in patients with tombstone pattern vs130.67+/-33.89 in non-tombstone group).There were no significant differences between the two groups in terms of BMI, HDL, and Total cholesterol. Other studies also showed no relationship between these risk factors and ECGpattern.

In our study it is evident that mean blood levels of CK-MB are higher in patients with tombstone ECG pattern than that of patients without tombstone pattern. These changes indicated extensive and rapid damage to the myocardium which results in low LV ejection fraction. Mean blood levels of CK-MB are 179.67 vs 90.57 in present study, 397vs 290 in study done by Balci et al,1598vs 1575(peak CK) in study by Piotr Kuklaetal.

Conclusions

From present study following conclusions are drawn. TOMB-ST pattern in ECG was observed in 39% of anterior wall MI patients. These patients with TOMB-ST elevation were associated with lower ejection fraction. Pattern of the ST elevation has been shown to be a strong prediction factor for LV function in acute MI.TOMB-STONE ST elevation is associated with poor LV function. Tombstoning' which is an easily ascertainable ECG pattern is related to larger infarct size as indicated by higher CK-MB, and increased in-hospital complications, thus providing a rationale for early and aggressive management of such patients.

References

1. Yusuf S, Rangarajan S, Teo K, et al. Cardiovascular risk and events in 17 low, middle, and high-income countries. N Engl J Med 2014; 371:818–27.
2. Xavier D, Pais P, Devereaux PJ, et al. Treatment and outcomes of acute coronary syndromes in India (CREATE): a prospective analysis of registry data. Lancet 2008;371:143 5–42
3. Dewan BD, Malhotra KC, Gupta SP. Epidemiological study of coronary heart disease in rural community in Haryana. Indian HeartJ 19 74;26:68–78
4. Wander GS, Khurana SB, Gulati R, et al. Epidemiology of coronary heart disease in a rural Punjab population--prevalence and correlation with various risk factors. Indian Heart J 1994; 46:319– 23.
5. Rao KD, Bhatnagar A, Murphy A. Socioeconomic inequalities in the financing of cardiovascular & diabetes inpatient treatment in India. Indian J Med Res 2011; 133:57–63.
6. Yusuf S, Lopez R, Maddison A, Maw P, Ray N, McMillan S, et al. Value of the electrocardiogram in predicting and estimating infarct size in man. Br Heart J.1979;42:286-293
7. Wimalaratna HSK. Tombstoning of ST segment in acute myocardial infarction. Lancet 1993; 342:496.
8. Huang J, Redwood S, Poloniecki J, Guo X, Gang Y, Chen L, et al. Predicting death from "tombstoning" of the ST segment in acute myocardial infarction. Circulation 1994; 90 (SupplI):I500.
9. Guo XH, Yap YG, Chen LJ, Huang J, Camm AJ. Correlation of coronary angiography with "tombstoning" electrocardiographic pattern in patients after acute myocardial infarction. Clin Cardiol 2000.
10. Balci B, Yesildag O. Correlation between clinical findings and the "Tombstoning" electrocardiographic pattern in patients with anterior wall acute myocardial infarction. Am J Cardiol 2003; 92:1316-1318.
11. Prognostic predictive values of the initial electrocardiogram withST-segment elevation acute myocardial infarction in Chinese patients. Hong Kong j. emerg. med. Vol. 13(2) Apr 2006.
12. Tombstoning ST-Elevation Myocardial Infarction BahattinBalci. Current Cardiology Reviews, 2009, 5,273-278.
13. DiDiego JM, Antzelevitch C. Cellular basis of ST segment changes observed during ischemia. J Electrocardiol 2003; 36(supplI):I5
14. Morphet JA. Cardiac markers for decision making- "Tombstoning". ACC Current Journal Review 2000;10:115
15. Kloner RA, Shook R, Przyklenk K, Davies VG, JunioL, Mathews RV, et al. Pre vious angina alters in hospital outcomes in TIMI 4-A clinical correlate to preconditioning? Circulation 1995; 91:37-45.