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Incidence of thirty-day major adverse cardiac event among patients presenting to emergency department with low-risk chest pain in a tertiary care hospital

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ABSTRACT

Current guidelines for low-risk chest pain patients recommend obtaining serial ECGs and serial measurements of cardiac troponin between 6 and 12 hours, thereby requiring prolonged assessment before safe discharge. There is need to identify these patients promptly to reduce time to treatment as well as reduce burden over emergency department (ED). The current study aimed to estimate the incidence of a thirty-day Major Adverse Cardiac Event (MACE) in patients presenting to the ED with low-risk chest pain, and to compare the "Thrombolysis in Myocardial Infarction" (TIMI), "HEART", and "Emergency Department Assessment of Chest Pain Score" (EDACS) among patients having low-risk chest pain. The current investigation was a descriptive follow-up study conducted at a tertiary care hospital (Fortis Memorial Research Institute in Gurugram, Haryana, India). The data collection took place from Jan 2018 to Jan 2019. All patients reporting with low-risk chest pain during study period were recruited. The outcome variable was a MACE (major adverse cardiac event) in 30 days. The study involved a total of 156 individuals. Mean age of participants was 44.1 years. Ten participants (6.4%) reported MACE in 30 days of presentation. We found that HEART and EDACS score had incidence of MACE less than 2% in their low-risk groups and TIMI score had incidence of MACE >2% in its low-risk group. EDACS and HEART score can be used in ED to identify low-risk chest pain patients. This could help in early identification, saving time and other resources.

Key words: Major Averse Cardiac Event, Chest Pain, Emergency, TIMI, EDACS, Heart

Introduction

Chest pain is second most common reasons for the emergency department (ED) visit, accounting for nearly5% of the total ED visits yearly.[1] Given that Asian Indians have a mean onset of coronary artery disease (CAD) 5–10 years earlier than the western world, the burden of chest pain visits to EDs in India is likely much higher.[2] CAD is a leading cause of morbidity and mortality in India, and its total incidence has increased rapidly over the last two decades. In India, patients with Acute Coronary Syndrome (ACS) are younger (mean age, 56.3 years), and ST-elevation myocardial infarction (STEMI) accounts for a greater proportion (60.6%) of ACS than non-ST elevation MI (NSTEMI).[3]

Current guidelines for low-risk chest pain patients[4] advocate getting serial ECGs and (non-high sensitivity) cardiac troponin tests between 6 and 12 hours after the patient's presentation to the emergency department. In situations of dubious ECG results, an expert panel suggested using a troponin test to ensure an accurate diagnosis of STEMI and prompt treatment choice.[3]

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As a result, the majority of patients require prolonged assessment before safe discharge despite that only 15% to 25% of them receive a final diagnosis of acute coronary syndrome.[5] This prolonged assessment leads to increased health care costs[6] and ED crowding, which has been shown to lead to increased adverse events in patients with both acute and non-acute coronary syndrome–related chest pain.[7] The efficient identification of low-risk patients who can be safely discharged after rapid assessment in the ED remains an important issue. And early discharge also has a risk up to 2-5% of patients with ACS are inappropriately discharged from emergency department every year.[8]

Risk assessment scores have been developed for chest pain; among these few are TIMI score[9], Heart score[10], and EDACS score.[11]

Objective: Present study was done with the objective of estimating the incidence of thirty-day Major Averse Cardiac Event (MACE) in patients presenting to emergency department with low-risk chest pain, and to compare the "Thrombolysis In Myocardial Infarction" (TIMI), "HEART", and "Emergency Department Assessment of Chest Pain Score" (EDACS) Scores in patients with low-risk chest pain.

Material and Methods

The current study was a descriptive follow-up study conducted in a tertiary care hospital (Fortis Memorial Research Institute (FMRI)) in Gurugram, Haryana, India. Patients who reported chest pain, discomfort, unease, or heaviness to the FMRI hospital's emergency and trauma departments were eligible to participate in the study if they met the inclusion and exclusion criteria and provided consent.

Inclusion criteria: (a) Patient presents with chest pain, (b) patient age >18 years, (c) patient should be able to communicate.

Exclusion criteria: (a) Refusal to give consent, (b) positive troponin value, and (c) ST segment changes in ECG.

The data collection for the present study was done from Jan 2018 to Jan 2019. Each participant was followed for thirty days of emergency visit via phone or patient's hospital visit. All the patient having low-risk chest pains during the study period were enlisted in the study. Data was collected using semi-structured interview schedule with variables on sociodemographic variable, chest pain, family history of cardiac illness, obesity, smoking tobacco, previous diagnosis of hypertension or diabetic or coronary artery diseases, ECG findings, Troponin I level. Outcome variable was MACE event in 30 days.

Sample size: Complete enumeration was done for the study period from Jan 2018 to Jan 2019. All the participants reporting to the ED with acute chest pain and fulfilling the exclusion and inclusion criteria were recruited in the study after taking written informed consent.

Measures

As per our operational definition, the measures were defined as follows-

a) **Low Risk Chest Pain[12]:** Low risk chest pain is defined as patient complaining of chest pain or chest discomfort or chest uneasiness or chest heaviness with no arrhythmias or no hemodynamic derangements or, a normal or near normal ECG, and negative initial-cardiac injury markers.

b) **Thirty-day MACE[13, 14]**: It is characterized as the occurrence of non-ST-elevation myocardial infarction (NSTEMI), STEMI, emergency revascularization, cardiovascular mortality, cardiac arrest, cardiogenic shock, or high-grade atrio-ventricular block within a 30-day period.

c) **STEMI**: AHA standard definition was used.[15]

d) **TIMI Score[16]** : According to the TIMI score patients are divided into low (score 0-1), intermediate (score 2-4) and high (score 5-7) risk categories. Following criteria constitutes 1 point: a) Age 65 years or more, b) 3 or more risk

factors for CAD (family history of CAD, hypertension, hypercholesterolemia, diabetes mellitus, tobacco use), c) Known CAD (stenosis >50%), d) Aspirin use in the past 7 days, e) Severe angina (≥2 episodes in 24 hours), f) ST deviation ≥0.5 mm, g) elevated cardiac marker level

e) **Heart Score[17] :** Scores are given as 0, 1, or 2 on following points, a) history, b) ECG, c) Age, d) Risk factors, e) Troponin. The HEART score categorizes patients as low (0-3), intermediate (4-6), or high-risk (7-10), with mean event rates of 0.9%, 12%, and 65%, respectively.

f) **EDACS Score[18]**: In EDACS Score low score is identified as score <16.

As few of the scoring systems have questions based on history of participants recall bias can be there. To circumvent this, all these questions were probed and relevant information to confirm these histories based on reports and prescription was done.

Analysis: Data entry was completed in Microsoft Excel. Categorical variables were reported as frequencies and percentages. Continuous variables were presented as means and standard deviations. The incidence of 30-day MACE was given as a percentage with a 95% confidence interval. The statistical analysis was performed with STATA 16 ***(Stata Corp. 2019. Stata Statistical Software: Release 16).***

Ethics approval: Written informed consent was taken from all the participants after informing about the study objective. Ethical permission for the study was taken from Hospitals Ethics Committee (FMRI, Gurugram) ***vide letter no. IEC Code No.: 2018-007TH-22.***

The study's goal was explained to participants, and they were given a Participants Information leaflet in Hindi. They were informed about studying in the local language and given the opportunity to ask questions about it. Each subject provided informed written consent. Participants were also informed that they might withdraw consent and quit participation at any time during the trial. Throughout the operation, the privacy and confidentiality of the collected information were preserved. The article contains no personal information in any form.

Results

Total sample taken from the study location FMRI, Gurugram was 230. Out of this, three participants refused to take part in the study and 71(31.28%) participants were excluded. Reason for exclusion was to have positive troponin value and ST segment changes in ECG. After exclusion, 156 participants were included in the study. The mean age of study participants during the time of interview was 44.12 years. Almost one-third of the participants were of age group 31 to 40 years (52). One twenty-four (79.49%) of study participants were male and 32 (20.51%) were female. **Table- 1** is showing the sociodemographic characteristics of the participants.

Table- 1: Sociodemographic characteristics of participants (N=156)

Characteristics		Male (n=124)		Female (n=32)		Total (n=156)	
		No.	%	No.	%	No.	%
Age group (years)	18-20	0	0	1	3.1	1	0.6
	21-30	18	14.5	7	21.9	25	16.0
	31-40	46	37.1	6	18.8	52	33.4
	41-50	30	24.2	7	21.9	37	23.7
	51-60	13	10.5	8	25.0	21	13.5
	61-70	6	4.8	2	6.2	8	5.1
	71-80	7	5.7	0	0	7	4.5
	81-90	3	2.4	1	3.1	4	2.6
	>90	1	0.8	0	0	1	0.6

Table -2: Distribution of participants according to the prevalence of risk factors (self-reported) (N=156)

Characteristics		Male (n=124)		Female (n=32)		Total (n=156)	
		No.	%	No.	%	No.	%
Smoking	Present	37	29.8	6	18.8	43	27.6
	Absent	87	70.2	26	81.2	140	72.4
Hypertension	Present	28	22.6	7	21.9	35	22.4
	Absent	96	77.4	25	78.1	121	77.6
Diabetes	Present	13	10.5	3	9.4	16	10.3
	Absent	111	89.5	29	90.6	140	89.7
Obesity	Present	30	24.2	23	71.9	53	34.0
	Absent	94	75.8	9	28.1	103	66.0
Dyslipidemia	Present	31	25	9	28.1	40	25.6
	Absent	93	75	23	71.9	116	74.4
Past history of CAD	Present	16	12.9	1	3.1	17	10.9
	Absent	108	87.1	31	96.9	139	89.1
Family history of CAD (At age <65 years)	Present	6	4.8	1	3.1	7	4.5
	Absent	118	95.2	31	96.9	149	95.5

Table 2 is showing the distribution of the participants according to various risk factors.

Fifty participants (32.1%) had diaphoresis, 37 (23.7%) had history of radiation of their chest pain to arms or neck or jaw, 5 (3.2%) had tenderness at the site of their chest pain and 4 (2.6%) had reported worsening in their chest pain with deep inspiration. Fifteen (9.62%) participants reported history of aspirin use within past 7 days but all the participants denied having history of severe angina (≥2 episodes in last 24 hours).

Out of 156 participants, 10 (6.41%) reported major adverse cardiac event (MACE) in 30 days of presentation. All the patient reported MACE within 30 days of presentation to hospital with low-risk chest pain were males. All the patients reported MACE within 30 days of presentation to hospital with low-risk chest pain was above 60 years and majority of them were between 71 to 80 years.

Participants who had hypertension reported higher proportion of 30-day Mace (14.29%) in comparison to the participants who did not have hypertension (4.13%).

High rate of 30 days MACE (18.75%) was reported by Diabetic participants compared to non-diabetic participants (5.00%). Similarly, participants who had CAD reported higher rates of 30 day MACE (29.41%) compared to those who did not had CAD (3.60%).

Participants who were smokers reported with low rate of 30-day MACE (2.33%) in comparison to the participants who were non-smokers (7.96%), which may be due to most patients with smoking were from young age group and had low prevalence of other risk factors.

Participants who had obesity reported with low rate of 30-day MACE (5.66%) in comparison to the participants who did not have obesity (6.80%) which may be due to presence of higher females was proportionately higher in obese patients. In gender wise analysis, the 30-day MACE event rate was higher among smokers compared to non-smokers.

Participants who had dyslipidaemia reported higher rates of 30-day MACE (15.00%) compared to the participants who did not have dyslipidaemia (3.45%)**.** Participants who had family history of CAD at the age <65 years reported with high rate of 30-day MACE (14.29%) in comparison to the participants who did not have family history of CAD at the age <65 years (6.04%)**.**

In this population there was increase in percentage of people who reported 30-day MACE with increase in HEART score. On categorization of HEART score to its low risk (Heart score 0-3) and moderate risk (Heart score 4-6) category as study population did not have participants who can be categorized as per high risk (heart score 7-10); we found that incidence of 30-day MACE was 1.63% in low-risk group (N=123) and 24.24% in moderate risk group (N=33).

With increase in TIMI score in the population there was increase in percentage of people who reported 30-day MACE (Chart 5). On categorization of TIMI score to its low risk (TIMI score 0-1) and moderate risk (TIMI score 2 to 4) category as study population did not have participants who can be categorized as per high risk (TIMI score 5-7), we found that incidence of 30-day MACE was 2.22% in low-risk group (N=135) and 33.33% in moderate risk group (N=21).

With increasing EDACS score there was increase in proportion of people who reported 30-day MACE event. On categorization of EDACS score to its low risk (EDACS score 0-15), moderate risk (EDACS score 16-21) and high risk (EDACS score 22 or above); we found that incidence of 30-day MACE was 0.00% in low-risk group (N=126), 14.29% in moderate risk group (N=14) and 50% in high-risk group (N=16).

The rationale behind comparing these scores in the present study was to explore which score have acceptable incidence of MACE in low-risk category according to the score's value in population. We found that HEART and EDACS score had incidence of MACE less than 2% in their low-risk groups and TIMI score had incidence of MACE >2% in its low-risk group. We also noticed that incidence of 30-day MACE in low-risk group of EDACS score was 0.00% in comparison to low-risk group of HEART score in which incidence of 30-day MACE was 1.63%.

Discussion

Present study was done to estimate the incidence of 30-day MACE in patients presenting to emergency department with low-risk chest pain. Study population was selected by using non-probabilistic sampling. All the patients presented to emergency department with low-risk chest pain have been included in the study. The diagnosis of low-risk chest pain was done on the basis of absence of ST-segment changes in the ECG on arrival and negatives Zero-hour Troponin-I result. Major adverse cardiac event was identified development of non-ST-elevation myocardial infarction (NSTEMI) or STEMI or emergency revascularization or cardiovascular death or cardiac arrest or cardiogenic shock or high-grade atrio-ventricular block within a 30-day period of presentation to emergency department with low-risk chest pain.

All the 30-day MACE events occurred in males. The probable reason of absence of 30-day MACE events in females is very low number of female participants (32) in the study to detect the 30-day MACE events. Elderly people found to have majority of 30-day MACE events in the present study. Incidence of 30-day MACE was 6.41% in patients presenting to emergency department with low-risk chest pain in this study. Present study finds that hypertension, diabetes, dyslipidaemia, known CAD and family history of CAD were associated with higher incidence of 30-day MACE in patients presenting to emergency department with low-risk chest pain.

In patients presenting to emergency department with low-risk chest pain incidence of 30-day MACE events was 6.41%, which was quite high from acceptable level (<2%). Rainer TH et al[14] and other various researchers found 30-day MACE events rate ranging from 5 to 15%. Results of our study are similar to these previous studies and this higher than acceptable 30-day MACE incidence validates that it is not safe to discharge Indian patients with chest pain from emergency department only on the basis of absence of ST-segment changes in the ECG on arrival and negative Zero-hour Troponin-I result.

In present study with increase in HEART score in the population there was increase in percentage of people who reported 30-day MACE. This study further validates the HEART score as a decision-making tool for early discharge for patients with low-risk chest discomfort, as only 1.63% of 30-day MACE events occurred in people with a low HEART score (HEART score 0-3).

Backus BE et al[15] showed that incidence of MACE in low-risk category of HEART score was ≤2% with use of HEART score. Results of this study were similar to these validates use of HEART score in our emergency department. In present study with increase in TIMI score in the population there was increase in percentage of people who reported 30-day MACE.

This study also shows that TIMI score is not good enough to be used as a decision-making tool for early discharge tool for patients with low-risk chest pain as there was only 2.22% incidence of 30-day MACE events in participants falling in low-risk category of TIMI score (TIMI score 0-1) which is higher than acceptable level (<2%).

Chase M et al (16) estimated <2% risk in low-risk category (score 0-1) but few studies showed >2% risk with even TIMI score of 1. This study found results that contradicted most previous Western studies, which could be attributed to variances in the Indian population's food habits, exercise habits, genetic differences, and so on.

In this study, as the EDACS score increased, so did the percentage of patients who reported 30-day MACE. This study validates that EDACS score can be used as a decision-making tool for early discharge of patients with low-risk chest pain as there was only 0.00% incidence of 30-day MACE events in participants falling in low-risk category of EDACS score (EDACS score <16), which is lower than acceptable level (<2%).

Stopyra JP et al[17] estimated risk of 30-day MACE in low-risk category was <2% with use of EDACS score. This study shows similar results but results to be verified with further studies as this study might not have had enough power to detect MACE events.

This study shows that out of all three scores only EDACS and HEART score can be used as a decision-making tool for early discharge as they had incidence of 30-day MACE within acceptable range (<2%).

EDACS score was best to identify the patients who can be safely discharged from emergency department on presentation with chest pain if they are falling in low-risk group as per EDACS score (30-day MACE incidence 0.00%) but results are to be verified with higher sample size as this study might not have had adequate power to detect MACE events. HEART score was next to EDACS score for the same (30-day MACE incidence 1.63%) and TIMI score was found to be poor in identifying the patients who can be discharged safely from emergency department on presentation with chest pain (30-day MACE incidence 2.22%).

Nieuwets A et al[18] showed that HEART score is better than TIMI score for use as a decision-making tool for early and safe discharge of patients with chest pain from emergency department. This study validates the same finding in Indian patients. There are no studies available for comparison of EDACS score with HEART and TIMI score and this study indicates that EDACS score is better than both HEART and TIMI score for use as a decision-making tool for early and safe discharge of patients with chest pain from emergency department until further comparison high power studies with larger sample size are available.

Risk categorization of acute chest pain patient is important as it guides the further management of individual patients. Newer techniques are being developed like Triple rule-out CT angiography that has been tried for assessment of patients presenting with acute chest pain in the emergency department, to rule out substantial CAD in intermediate-risk patients.[19]

Strength and limitations

Study has following strengths. Data collection was done by one investigator. So, there was no inter-observer variation. Response rate was more than 95% (98.7%). Few of the limitations for the study was use of self-reported status for risk factors, this was addressed using verifying the recalled information using probing and checking previous reports or prescriptions. Females were comparatively lower in present study sample (20.5% females compared to 79.5% males). This may restrict the generalize ability of the findings.

Conclusion

In the present study the 30-day MACE event rate was 6.4% among patients presenting to the emergency department at FMRI Gurugram, Haryana, with low-risk chest pain. In the low-risk HEART score category, the 30-day MACE was 1.6%, which was below the permitted range (<2%). With a TIMI score of 0 to 1 (low risk), the associated incidence of 30-day MACE was 2.2%, which was above than the acceptable range (>2%). The incidence of 30-day MACE was 0.0% in the low-risk category of EDACS score (<16), which was lower than the tolerable level (<2%).

In comparison, the EDACS score was the best at identifying patients who could be safely discharged from the emergency department after presenting with chest pain; the HEART score came in second, but the TIMI score could not be used because the associated incidence of 30-day MACE with TIMI score 0 to 1 (low risk) was 2.2%, which was higher than the acceptable level.

The EDACS and HEART scores can be utilized in the emergency room to identify people with low-risk chest discomfort. This may aid in early detection and save time and other resources.

Conflict of Interest: The authors declare no conflict of interest

Author Contribution: SK and RA were involved in the study conceptualization. SK and AJ were involved in the analysis. All the authors were involved in preparing and finalizing the draft.

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Data Sharing: Data will be provided by corresponding author on reasonable request.

Ethical Approval: The Study was approved by Hospitals Ethics Committee (FMRI, Gurugram).

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