MedCrave
Step into the World of Research

Journal of Cardiology & Current Research

Research Article

Open Access

CrossMark

Frequency of ST-segment elevation acute myocardial infarction in patients with Type 2 Diabetes Mellitus

Abstract

Type 2 diabetes mellitus (T2DM) is the most frequent metabolic disease encountered in India. One of the most fearful complications associated with T2DM is acute coronary syndrome (ACS). In contrast to the non-T2DM patients T2DM patients presents with atypical clinical picture and has a worse prognosis. Electrocardiogram (ECG) is a very important tool used to diagnose ACS. The ST-segment elevation (STEMI) pattern in ECG is associated with a significant and prolonged occlusion of the coronary arteries. The aim of this pilot project was to highlight the difference in ECG presentation between T2DM patients and their non-T2DM counterparts (if any). Relevant data was collected from 29 consecutive patients presenting with AMI in the cardiac care center in Nightingale hospital, Kolkata, India, after procuring their informed consent. The data was analyzed using the presence or absence of STEMI as the categorical output and its association with T2DM status as the input. The association was assessed using chi-square statistics. Jupyter notebook was used to perform the statistical analysis. The mean age of the selected population was 61.2 years with a mean blood pressure (BP) of 136/77 mm of Hg. There was a significant association between T2DM and STEMI (P=0.02), as assessed by chi-square statistics. In this small cohort from Kolkata, T2DM was significantly associated with an ECG presentation of STEMI in patients with AMI.

Volume 15 Issue 2 - 2022

Anuradha Ghosal,[1] Samit Ghosal[2]
[1]Class XII student, Delhi Public School, India
[2]Consultant Endocrinologist, Nightingale hospital, India

Correspondence: Samit Ghosal, Consultant endocrinologist, Nightingale hospital, Kolkata, India, Tel +91-9674328281, Email ramdasghosal@gmail.com

Received: April 03, 2022 | **Published:** April 11, 2022

Introduction

Type 2 Diabetes Mellitus (T2DM) is associated with both microvascular and macrovascular complications.[1] The predominant macrovascular complications include cardiac dysfunction, stroke, and peripheral vascular disease. Cardiac dysfunction can be divided into defects related to the pipe (acute coronary syndrome), pump (heart failure), or wire (conduction defects).[2] Acute coronary syndrome (ACS) represents a basket of cardiac anomalies ranging from occlusion of the coronaries by an atherosclerotic plaque resulting in cardiac cell death (acute myocardial infarction) to occlusions not causing cell death (myocardial ischemia).[3] Acute myocardial infarction (AMI) represents the most explosive and fatal cardiac dysfunction associated with T2DM.

In the workup of central chest discomfort ECG along with cardiac enzymes form the backbone of diagnosing AMI. The ECG records the electrical activity of the heart and is displayed graphically as wave and interval patterns. There are five prominent waves in a normal ECG (P wave, Q wave, R wave, S wave, and T wave) associated with corresponding intervals (PR interval, QRS complex, and ST interval).[4] AMI encompasses three distinct patterns based on ECG changes and abnormal cardiac enzymes.[5] The first is ST-segment elevation myocardial infarction (STEMI), which is characterised by a significant and prolonged occlusion of a coronary blood vessel. The second is non-ST elevation myocardial infarction (NSTEMI), characterised by a significant but transient occlusion of a coronary blood vessel.[6] Although the ST segment is not elevated on ECG, NSTEMI is accompanied by elevation of cardiac enzymes. The third is unstable angina (UA) which is neither characterised by STEMI on ECG nor an elevation of cardiac enzymes.[7]

The cornerstone of management of STEMI and NSTEMI is restoring circulation (reperfusion).[8] Depending on the degree and extent of myocardial damage reperfusion therapies can be broadly divided into percutaneous coronary intervention (PCI) or coronary artery bypass graft (CABG).[9] Identifying the condition rapidly is of essence, since earlier recognition and interventions lead to better survival. (10) STEMI is associated with a poorer in-hospital and six months post revascularization survival rates compared to NSTEMI.[11,12] Type 2 Diabetes (T2DM) is an independent risk factor for acute myocardial infarction (AMI). In one study the odds ratio for AMI in T2DM patients was 2.3.[13] Not only is T2DM associated with AMI, but it is also associated with a poorer prognosis.[14] The combination of T2DM and STEMI is a significant and compounding health hazard. In view of this observation, this pilot project was conducted in a cardiac centre to determine the ECG pattern in patients with T2DM with AMI and how it differed from their non-T2DM counterparts.

Methods

Data collection

Consecutive patient data from the cardiac centre of Nightingale hospital Kolkata, India, was collected within a 2 weeks' time span. There were 35 patients who got admitted with AMI within this period. Informed consent could be attained from 29 patients. Baseline demographics, anthropometric measurements and the admission ECG was collected, and the relevant data entered an excel sheet. The final version was saved in coma separated values (CSV) format.

Statistical analysis

The case sheets of patients satisfying the inclusion criteria were collected from the administrative block of Nightingale Hospital, Kolkata, India. All the relevant patient related data were entered in an excel sheet. Having collected all the data, the statistical analysis was planned in a phased manner.

Step 1: It was planned to conduct a preliminary analysis to investigate the basic characteristics of the patients. The mean age, mean systolic

blood pressure, diastolic blood pressure, frequency of T2DM, and the type of ECG changes would be analysed.

Step 2: Since both the output (STEMI) as well as the input (T2DM) were categorical in nature, a chi-square statistic was planned to evaluate their association.

The analysis was conducted using Jupyter notebook version 6.0.3.[15] Since both the input and output variables were categorical in nature, a chi-squared analysis was performed. Using pd.crosstab function a contingency table was created between the input and output variables. In the final step using the function scipy.stats, the chi-square statistic along with the test of hypothesis was performed. All the codes and raw data are available on request.

Ethical committee approval

The Nightingale Hospital Ethical committee approval was attained prior to evaluation of the data.

Results

This pilot project was performed on twenty-nine patients presenting in the cardiac emergency with acute chest discomfort and diagnosed with AMI. To avoid selection bias consecutive patient data over a 2-week span was collected. Since a few patients did not consent to sharing their data, we landed up with 29 patients. Relevant anthropometric, demographic, laboratory, and ECG data was identified, and the findings were entered into an excel sheet. Several important parameters including duration of diabetes and types of baseline therapy were collected but not included in the final analysis due to the small numbers. All the selected patients had T2DM and insulin dependent T1DM were not included. Having identified the inputs and outputs, statistical analysis was conducted in two steps.

Step 1: Descriptive statistics

The mean age of the 29 patients included in the analysis was 61.2 years with mean systolic blood pressure (SBP) and diastolic blood pressure (DBP) being 136 mm of Hg and 77 mm of Hg respectively (Table 1).

Table 1 Descriptive statistics (mean, range, and standard deviation) of clinical parameters (age, systolic & diastolic blood pressure) collected from the 29 patients included in this pilot project

Attribute	Mean	Range	std
Age (years)	61.2	39-82	11.1
SBP (mm of Hg)	136.2	110-170	16.3
DBP (mm of Hg)	77.2	70-90	0.4

There were 15 patients who had a pre-existing diagnosis of T2DM, and 14 patients did not (Table 2).

Table 2 Contingency table. Rows indicating the frequency of T2DM versus non-T2DM and the columns indicating the frequency of STEMI changes on ECG versus NSTEMI changes

	No STEMI	STEMI	Marginal row (totals)
No DM	10	4	14
DM	3	12	15
Marginal column (totals)	13	16	29 (Grand total)

There were 16 patients who presented with STEMI, while 13 did not (NSTEMI or UA) (Table 2).

Step 2: Analytical statistics

The primary hypothesis was tested using specific codes in python. A contingency table in matrix format was prepared (Table 2). Overall, there were 13 patients who did not have STEMI while 16 patients presented with STEMI. Fifteen patients had T2DM while fourteen did not. In the total population of 29 patients, there were 10 patients who did not have either diabetes or STEMI. There were 4 patients who did not have T2DM but presented with STEMI. There were 3 patients who had T2DM but not present with STEMI while 12 patients had both T2DM and STEMI. There is a significant association between a diagnosis of T2DM and the likelihood of presenting with STEMI ($\chi 2 = 7.74$, $p = .02$).

Discussion

Type 2 diabetes mellitus is a polygenic disease associated with several complications.[16] Involvement of the heart is one of the most feared complications associated with T2DM in view of the high fatality rates.[17] Compared to non-diabetic patients, diabetic patients differ in the way they present symptomatically as well as diagnostically.[18] The central difference from a pathophysiological perspective is the degree if insulin resistance associated with T2DM.[19] Insulin resistance precedes significant beta-cell dysfunction in early T2DM.[20] The immediate consequence of insulin resistance is hyperinsulinemia and its associated consequences namely diabetic dyslipidaemia, endothelial dysfunction, hypertension, and vascular inflammation.[21] The combination of abnormal lipid deposition, vascular inflammation, and endothelial dysfunction initiates as well as aggravates pre-existing atherosclerosis.[22] In addition to an accelerated atherosclerosis concomitant autonomic dysfunction in T2DM alters the way a patient presents with AMI.[23] Many patients do not experience the typical central compressive chest pain with radiation along left inner arm or jaw and remain completely silent delaying diagnosis as well as worsening prognosis. This is also sometimes referred to as "silent AMI".[24] In addition, many T2DM patients present with milder or atypical symptoms like epigastric pain, increased sweating, and anxiety.[25] This delay in diagnosis was associated with nearly 75% of T2DM patients presenting to the emergency with a delay exceeding 3 hours.[26] This is of paramount importance since the window of opportunity for effective thrombolysis is within an hour of presentation.[27]

One of the cornerstones of diagnosis of ACS is an electrocardiogram (ECG). In case of suspected ACS, a diagnosis of AMI is dependent on documentation of elevated cardiac enzymes and characteristic ECG changes.[28] It is of paramount importance to identify patients with a persistent (>20 minutes) ST-segment elevation on ECG, since it represents a total or near-total coronary artery occlusion requiring immediate reperfusion.[28]

In view of the exponential growth of diabetic patients in India, a larger proportion of patients with pre-existing T2DM is expected to present with STEMI in the emergency department.[29] In a study from India it was found that nearly 40% of patients presenting in a hospital with AMI had a diagnosis of T2D with nearly 13.6% detected on admission.[30] The reason why a significant number of T2DM patients are expected to present with STEMI is due to the delay in diagnosing resulting in worsening from partial occlusion (NSTEMI on ECG) to near complete occlusion (STEMI on ECG) on presentation. Hence, it is extremely important pre-empting as well as intervening in a timely fashion, since it takes 50% more time to achieve complete resolution in T2DM patients compared to their non-T2DM counterparts.[31] In a study by Masoomi et al it was found that 27.8% of T2DM patients had failed ST-segment resolution in contrast to 9% in the non-T2DM group.[32] This difference was due to the diabetic patients presenting at a much-advanced stage as well as having a lower cardiac contractility (assessed by echocardiography). Many patients with AMI are

incidentally detected with T2DM post admission.[33] The incidence of death was found to be higher in this subset of patients in a 5-year follow up study.[34] In a study from India on 208 patients, 80.77% patients presented with STEMI.[35] Data from India is sparce and extremely heterogenous. In a study from the state of Gujarat, mortality was more in patients with T2DM (23.52%) presenting with STEMI.[36] There was, however, no comparison of adverse cardiac outcomes between the STEMI versus the non-STEMI group.

In view of these observations, this pilot survey was undertaken using data from the cardiac care unit of Nightingale hospital. The hypothesis was to find whether there was any significant difference in the ECG pattern in T2DM patients compared to non-T2DM patients. In this pilot project T2DM patients presented more frequently with STEMI compared to non-T2DM patients.

This pilot project should be followed up with a study on the same end points with a larger population to confirm this hypothesis. This is because a very small number of patients were recruited in this pilot project which liable to statistical error and bias. In addition, there could be other clinical variables like diabetes dyslipidaemia, obesity, and nephropathy which could independently or in combination could explain the difference in outcomes. Subgroup analysis including these variables needs to be conducted in a larger trial.

Conclusion

Patients with T2DM have a propensity to present with AMI at a much-advanced stage compared to their non T2DM counterpart. ECG findings from this pilot project seems to suggest STEMI as a more frequent presentation in T2DM patients. This finding needs to be explored further in a trial recruiting a larger population of patients.

References

1. Fowler MJ. Microvascular and Macrovascular Complications of Diabetes. *Clin Diabetes.* 2008;26(2):77–72.
2. Verma S, Jüni P, Mazer CD. Pump, pipes, and filter: do SGLT2 inhibitors cover it all? *Lancet.* 2019;393(10166):3–5.
3. Eisen A, Giugliano RP, Braunwald E. Updates on Acute Coronary Syndrome: A Review. *JAMA Cardiol.* 2016;1(6):718–730.
4. Becker DE. Fundamentals of electrocardiography interpretation. *Anesth Prog.* 2006;53(2):53–64.
5. Daga LC, Kaul U, Mansoor A. Approach to STEMI and NSTEMI. *J Assoc Physicians India.* 2011;59(Suppl):19–25.
6. Cohen M, Visveswaran, G. Defining and managing patients with non–ST–elevation myocardial infarction: Sorting through type 1 vs other types. *Clin Cardiol.* 2020;43:242–250.
7. Braunwald E, Morrow DA. Unstable Angina. *Circulation.* 2013;127(24):2452–2457.
8. Heusch G. The Coronary Circulation as a Target of Cardioprotection. *Circulation Research.* 2016;118(10):1643–1658.
9. Bagai A, Dangas GD, Stone GW. Reperfusion Strategies in Acute Coronary Syndromes. *Circulation Research.* 2014;114(12):1918–1928.
10. 2021 ACC/AHA/SCAI Guideline for Coronary Artery Revascularization: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *J Am Coll Cardiol.* 2021.
11. Nikus KC, Eskola MJ, Virtanen VK, et al. Mortality of patients with acute coronary syndromes still remains high: a follow–up study of 1188 consecutive patients admitted to a university hospital. *Ann Med.* 2007;39:63–71.
12. Ren L, Ye H, Wang P, et al. Comparison of long–term mortality of acute ST–segment elevation myocardial infarction and non–ST–segment elevation acute coronary syndrome patients after percutaneous coronary intervention. *Int J Clin Exp Med.* 2014;7(12):5588–5592.
13. Tavani A, Bertuzzi M, Gallus S, et al. Diabetes mellitus as a contributor to the risk of acute myocardial infarction. *J Clin Epidemiol.* 2002;55(11):1082–1087.
14. Mukamal KJ, Nesto RW, Cohen MC, et al. Impact of Diabetes on Long–Term Survival After Acute Myocardial Infarction: Comparability of risk with prior myocardial infarction. *Diabetes Care.* 2001;24(8):1422–1427.
15. Anaconda Navigator.
16. Sacks DB, McDonald JM. The Pathogenesis of Type II Diabetes Mellitus: A Polygenic Disease, American *Journal of Clinical Pathology.* 1996;105(2):149–156.
17. Stirban AO, Tschoepe D. Cardiovascular Complications in Diabetes: Targets and interventions. *Diabetes Care.* 2008;31(Supplement_2): S215–S221.
18. Khafaji HA, Suwaidi JM. Atypical presentation of acute and chronic coronary artery disease in diabetics. *World J Cardiol.* 2014;6(8):802–813.
19. Raven G. Insulin Resistance, Type 2 Diabetes Mellitus, and Cardiovascular Disease. *Circulation.* 2005;112(20):3030–3032.
20. Færch K, Johansen NB, Witte DR, et al. Relationship Between Insulin Resistance and β–Cell Dysfunction in Subphenotypes of Prediabetes and Type 2 Diabetes. *The Journal of Clinical Endocrinology & Metabolism.* 2015;100(2):707–716.
21. Galicia–Garcia U, Benito–Vicente A, Jebari S, et al. Pathophysiology of Type 2 Diabetes Mellitus. *Int J Mol Sci.* 2020;21(17):6275.
22. Libby P, Buring JE, Badimon L, et al. Atherosclerosis. *Nat Rev Dis Primers.* 2019;5:56.
23. Canto JG, Shlipak MG, Rogers WJ, et al. Prevalence, Clinical Characteristics, and Mortality Among Patients With Myocardial Infarction Presenting Without Chest Pain. *JAMA.* 2000;283(24):3223–3229.
24. Cohn PF, Fox KM, Daly C. Silent Myocardial Ischemia. *Circulation.* 2003;108(10):1263–1277.
25. Berman Jones MN, De Coster DA. 'Just like a normal pain', what do people with diabetes mellitus experience when having a myocardial infarction: a qualitative study recruited from UK hospitals. *BMJ Open.* 2017;7(9):e015736.
26. Ahmed S, Khan A, Ali SI, et al. Differences in symptoms and presentation delay times in myocardial infarction patients with and without diabetes: A cross–sectional study in Pakistan. *Indian Heart Journal.* 2018;70(2):241–245.
27. ESC Scientific Document Group, 2020 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST–segment elevation: The Task Force for the management of acute coronary syndromes in patients presenting without persistent ST–segment elevation of the European Society of Cardiology (ESC), *European Heart Journal.* 2021;42(14):1289–1367.
28. Mythili S, Malathi N. Diagnostic markers of acute myocardial infarction. *Biomed Rep.* 2015;3(6):743–748.
29. IDF Diabetes atlas. 2021.
30. Murthy P D, Gopal P V. Clinical study of burden of type 2 diabetes mellitus in acute coronary syndromes and their complications. *J Clin Sci Res.* 2021;10:31–34.
31. Zairis MN, Makrygiannis SS, Papadaki OA, et al. Diabetes and ST Elevation Myocardial Infarction. How successful is intravenous thrombolysis for the diabetic heart? *Diabetes Care.* 2002;25(10):1890–1891.

Citation: Ghosal A, Ghosal S. Frequency of ST-segment elevation acute myocardial infarction in patients with Type 2 Diabetes Mellitus. *J Cardiol Curr Res.* 2022;15(2):53–56. DOI: 10.15406/jccr.2022.15.00551

32. Masoomi M, Samadi S, Sheikhvatan M. Thrombolytic effect of streptokinase infusion assessed by ST–segment resolution between diabetic and non–diabetic myocardial infarction patients. *Cardiol J.* 2012;19(2):168–173.

33. D Aguilar, SD Solomon, L Køber, et al. Newly Diagnosed and Previously Known Diabetes Mellitus and 1–Year Outcomes of Acute Myocardial Infarction. *Circulation.* 2004;110(12):1572–1578.

34. Elliott MD, Heitner JF, Kim H, et al. Prevalence and prognosis of unrecognized myocardial infarction in asymptomatic patients with diabetes: a two–center study with up to 5 years of follow–up. *Diabetes Care.* 2019;42:1290–1296.

35. Dar MI, Beig JR, Jan I, et al. Prevalence of type 2 diabetes mellitus and association of HbA1c with severity of coronary artery disease in patients presenting as non–diabetic acute coronary syndrome. *Egypt Heart J.* 2020;72:66.

36. Hathi V, Anadkat M. A comparative study of In–hospital outcome of patients with ST–segment elevated myocardial infarction with and without type 2 diabetes mellitus, after thrombolytic therapy; in Government hospital of Rajkot, Gujarat, India. *JAPI.* 2017;65:22–25.

Citation: Ghosal A, Ghosal S. Frequency of ST-segment elevation acute myocardial infarction in patients with Type 2 Diabetes Mellitus. *J Cardiol Curr Res.* 2022;15(2):53–56. DOI: 10.15406/jccr.2022.15.00551