



Benign Late T Wave Inversion Post CABG: Case Report of Myocardial Reperfusion Sign Appearing Late on ECG

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Case Report

ABSTRACT

Background: T wave inversion (TWI) has been described in a variety of clinical conditions, usually resolving in a timely manner after the index event. TWI has also been considered a robust sign of myocardial reperfusion appearing early after successful revascularization via fibrinolysis or percutaneous coronary intervention in ST-segment elevation myocardial infarction (STEMI) patients.

AIM: To report the late appearance of TWI after revascularization in a patient post-coronary artery bypass grafting (CABG), as a sign of successful myocardial perfusion.

Methods: A case report of a male patient presenting to King Abdulaziz hospital in the eastern region of Saudi Arabia with Non-ST-segment elevation myocardial infarction (NSTEMI) found to have triple vessel coronary artery disease, referred for CABG at King Abdulaziz medical city Riyadh Saudi Arabia with normal perioperative Electrocardiogram (ECG) and Echocardiogram, to revisit two months later with atypical chest pain and new non-ischemic persistent anterior TWI documented later on clinic visits.

Result and Conclusion: Extensive workup for a possible cause of new anterior TWI was conducted, therefore we concluded the new onset of anterior TWI late post CABG, was a benign sign of myocardial reperfusion.

Keywords: Anterior T wave inversion; benign late T wave inversion; persistent t wave inversion; Reperfusion; Coronary artery bypass grafting.

1. INTRODUCTION

The appearance of precordial TWI on ECG is an alarming sign of anterior wall ischemia. However, it is not pathognomonic and may be due to several other nonischemic entities, including cerebral insult, pulmonary embolism, and metabolic disturbances, one of which is reperfusion and restoration of blood flow through an occluded artery. Early TWI after revascularization has been extensively reported following post-fibrinolysis and primary percutaneous coronary intervention (PCI) for ST segment elevation MI [1,2,3,4] No report to date described anterior TWI late post-CABG as a sign of myocardial reperfusion. Herein we report a case of non-ST-segment elevation MI (NSTEMI) with triple vessel coronary artery disease (CAD) and preserved left ventricular function (LVF), who underwent successful revascularization via CABG, with no evidence of myocardial stunning post-reperfusion to present two months later with new nonischemic anterior wall TWI.

2. CASE REPORT

A 44-year-old middle eastern male from Pakistan, medically free apart from dyslipidemia on a trial of diet presented to King Abdulaziz hospital in the Eastern region of Saudi Arabia ,with non-ST-segment elevation MI (NSTEMI). The patient's physical examination was unremarkable, laboratory work-up revealed the following parameters; Troponin I peaked to 8012

pg/mL, Creatine kinase (CK)376U/L, and additional investigations included normal Chest x-ray and Echocardiogram. Coronary catheterization revealed triple vessel disease involving ostial to mid LAD 80% lesion, ostial 80% D1 lesion, ostial 80% OM1 lesion, and diffusely diseased RCA up to the bifurcation of PDA/PLV branches, followed by CABG two weeks later-LIMA to LAD, SVG to D1, OM1 and PDA at King Abdulaziz medica city Riyadh Saudi Arabia.

ECG on presentation was normal, pre and immediately post-CABG till discharge two weeks later (Fig. 1A-B). Two months later, the patient represented with short-lived non-specific chest pain with new TWI in v1-v3, progressed to v4 on the second day (Fig. 2A). There was No troponin leak, and had normal laboratory results including renal,liver profile as wells as normal Complete blood count, Sodium, Potassium, Calcium, and Magnesium. A new Echocardiogram was performed showing normal LV function with no regional wall motion abnormalities (RWMA) on Echocardiogram.

Furthermore, coronary CT angiogram (Fig. 3 A-B) was normal with patent grafts, eventually reassured and discharged home on Metoprolol 50 mg od, Aspirin, and high dose statin.

One month later he was seen for follow-up with same ECG findings.

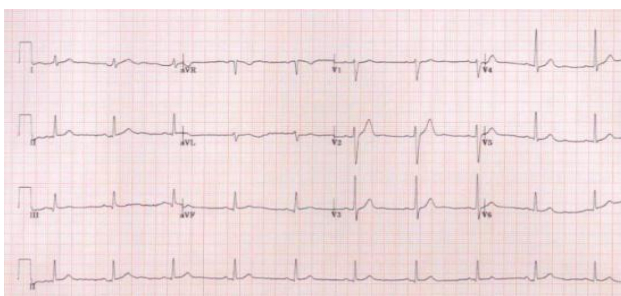


Fig. 1A. ECG NSTEMI first presentation before CABG, normal sinus rhythm-normal ECG

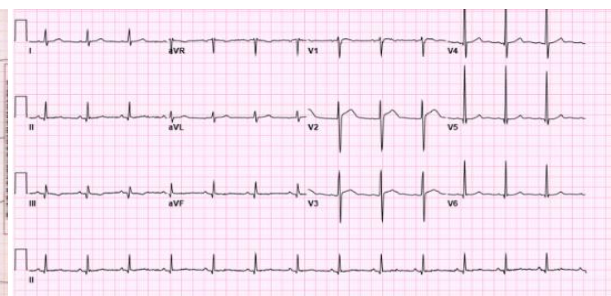


Fig. 1B. ECG 6 days post-CABG NSR with non-specific T wave changes in lead III/AVF

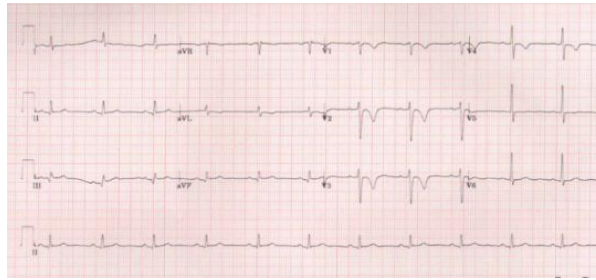


Fig. 2A. ECG two months later after CABG, day 2 NSR, with deep TWI in V1 up to V4, and AVL. Flat TW in V5 and lead I. Indicating reperfusion in LAD and diagonal area

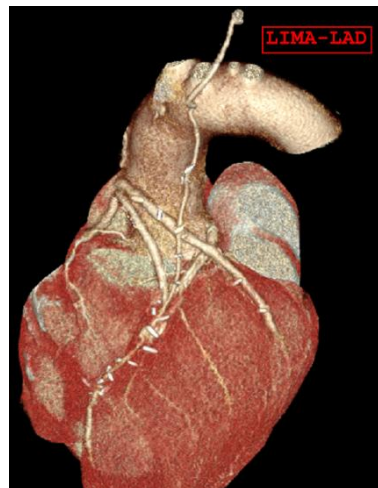


Fig. 3A-B. (Figure 3A) is on the left and (Figure 3B) is on the right. Both figures are showing normal coronary CT angiogram with patent LIMA to LAD graft

3. DISCUSSION

T wave inversion on Electrocardiogram represents altered ventricular repolarization and was first described by Jacobson and Schrire [5]. The differential diagnosis of precordial TWI is vast, ranging from life-threatening to entirely benign conditions including acute coronary syndrome (ACS), pulmonary embolism, central nervous system injury, to benign persistent juvenile TWI.

Early TWI has been considered a robust indicator of successful reperfusion, better prognosis, and improved LV function [1,2,3,4]. Reperfusion ECG changes develop within 4 hours, but no later than 24 hours in STEMI cases, including the normalization of ST-segment, TWI, idioventricular rhythm, and the deeper the negativity of the T waves the greater the effectiveness of myocardial reperfusion [6]. The presentation of our case was NSTEMI followed by CABG. Therefore, we investigated ECG changes related to CABG. A conducted

study regarding CABG-induced ECG changes suggested a marginal increase in TW alternans and improvement in QRS-T angle, while other ECG parameters like QRS amplitude, TW amplitude, and ST-segment deviation were not significantly influenced in the early postoperative period [7]. Newly developed prominent T waves with QT prolongation in the ECG post-CABG may indicate reperfusion injury and myocardial stunning [8]. The apparent presentation of our case does not post CABG related ECG changes, or reperfusion injury and myocardial stunning, he had short-lived atypical chest pain, with no troponin leak, normal LV function with no regional wall motion abnormalities on Echocardiogram and normal CT coronary angiogram indicating patent grafts.

The presence of early TWI in anterior leads with STEMI is associated with patency of the left anterior descending artery (LAD), identical to the distribution of TWI in our case (TWI in V1- V4), the major graft is LIMA to LAD plus three other grafts to diagonal, OM, and PDA.

This relation was not found in other infarct-related arteries, probably because LAD feeds the vast majority of LV mass, the sensitivity of TWI to predict spontaneous reperfusion in anterior STEMI was 30.5% and specificity was 94.2% according to Ernesto Alexis. et al [9].

Another theory that may also be relevant in our case is cardiac memory. Cardiac memory (CM) refers to persistent T wave changes, after abnormal ventricular activation, such as left bundle branch block, ventricular tachycardia, ventricular pacing, and ventricular preexcitation. Initially described by Chatterjee, et al, and was named as “cardiac memory” by Rosenbaum, et al [10,11]. The combination of positive T in AVL, positive or isoelectric T in lead-I, and maximal voltage of TWI in precordial leads > lead III – is 92% sensitive and 100% specific for cardiac memory [12]. Septal bounce or paradoxical septal motion post-CABG is a well-known phenomenon present in our case simulating left bundle branch bounce on Echocardiogram, which may cause abnormal ventricular activation but is not known to cause persistent T wave inversion.

These criteria may not apply to our case, there was no documented aberrant electrical conduction, and TWI was not present in lead III. Thus, CM is unlikely based on the established CM definition and septal bounce with altered ventricular repolarization may not suffice to consider CM. Therefore, we conclude to the best of our knowledge, that precordial TWI two months post-CABG is an ECG sign of myocardial reperfusion presenting late.

4. CONCLUSION

Anterior precordial T wave inversion can present as a late ECG sign of successful myocardial reperfusion in Non-ST segment myocardial infarction after revascularization via CABG.

CONSENT

As per international standard or university standard, patients’ written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Matetzky S, Barabash GI, Shahar A, Rabinowitz B, Rath S, Zahav YH, Agranat O, Kaplinsky, E, Hod H. Early T wave inversion after thrombolytic therapy predicts better coronary perfusion: clinical and angiographic study. *Journal of the American College of Cardiology*. 1994;24(2): 378–383. Available:[https://doi.org/10.1016/0735-1097\(94\)90291-7](https://doi.org/10.1016/0735-1097(94)90291-7)
2. Corbalán R, Larrain G, Nazzari C, Castro PF, Acevedo M, Domínguez JM, Bellolio F, Krucoff M. W. Association of noninvasive markers of coronary artery reperfusion to assess microvascular obstruction in patients with acute myocardial infarction treated with primary angioplasty. *The American Journal of Cardiology*. 2001;88(4):342–346. Available:[https://doi.org/10.1016/s0002-9149\(01\)01676-9](https://doi.org/10.1016/s0002-9149(01)01676-9)
3. Doevendans PA, Gorgels AP, van der Zee R, Partouns J, Bär FW, Wellens HJ. Electrocardiographic diagnosis of reperfusion during thrombolytic therapy in acute myocardial infarction. *The American journal of cardiology*. 1995;75(17); 1206–1210. Available: [https://doi.org/10.1016/s0002-9149\(99\)80763-2](https://doi.org/10.1016/s0002-9149(99)80763-2)
4. Alsaab A, Hira RS, Alam M, Elayda M, Wilson JM, Birnbaum Y. Usefulness of T wave inversion in leads with ST elevation on the presenting electrocardiogram to predict spontaneous reperfusion in patients with anterior ST elevation acute myocardial infarction. *The American Journal of Cardiology*. 2014;113(2):270–274. Available:<https://doi.org/10.1016/j.amjcard.2013.09.018>
5. Jacobson D, Schrire V. Giant T wave inversion. *British heart journal*. 1966;28(6):768–775. Available:<https://doi.org/10.1136/hrt.28.6.768>
6. Nakajima T, Kagoshima T, Fujimoto S, Hashimoto T, Dohi K. The deeper the negativity of the T waves recorded, the greater is the

- effectiveness of reperfusion of the myocardium. *Cardiology*. 1996;87(2):91–97.
Available:<https://doi.org/10.1159/000177069>
7. Crescenzi G, Scandroglio AM, Pappalardo F, Landoni G, Cedrati V, Bignami E, Aletti G, Zangrillo A. ECG changes after CABG: the role of the surgical technique. *Journal of Cardiothoracic and Vascular Anesthesia*. 2004;18(1):38–42.
Available:<https://doi.org/10.1053/j.jvca.2003.10.008>
 8. Hirota Y, Kita Y, Tsuji R, Hanada H, Ishii K, Yoneda Y, Shimiz G, Suwa M, Kawamura K. Prominent negative T waves with QT prolongation indicate reperfusion injury and myocardial stunning. *Journal of Cardiology*. 1992;22(2-3):325–340.
 9. Barrera-Oranday EA, Cortés de la Torre JM, Rodríguez Castillo JM, Arias-Mendoza A. Early T-wave inversion in anterior leads predict patency of the anterior descending artery in ST-segment elevation myocardial infarction. *Revista Mexicana de Cardiología*. 2018;29(3):120-125.
 10. Chatterjee K, Harris AM, Davies JG, Leatham A. T-wave changes after artificial pacing. *Lancet* (London, England). 1969;1(7598):759–760.
Available:[https://doi.org/10.1016/s0140-6736\(69\)91758-9](https://doi.org/10.1016/s0140-6736(69)91758-9)
 11. Rosenbaum MB, Blanco HH, Elizari MV, Lázari JO, Davidenko JM. Electrotonic modulation of the T wave and cardiac memory. *The American Journal of Cardiology*. 1982;50(2):213–222.
Available:[https://doi.org/10.1016/0002-9149\(82\)90169-2](https://doi.org/10.1016/0002-9149(82)90169-2)
 12. Shvilkin A, Ho KK, Rosen MR, Josephson ME. T-vector direction differentiates postpacing from ischemic T-wave inversion in precordial leads. *Circulation*. 2005;111(8):969–974.
Available:<https://doi.org/10.1161/01.CIR.000156463.51021.07>

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