

CASE REPORT

Simultaneous tombstone ST elevations in Anterior and Inferior Leads

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HOW TO CITE THIS ARTICLE:

Mohan Prasad Akkineni, Krishna Prasad Akkineni, Souvik Sardar et. al, Simultaneous tombstone ST elevations in Anterior and Inferior Leads. Indian J Cardiovasc Med Surg. 2025;11(2): 75-78.

ABSTRACT

ECG changes of ST elevation and reciprocal ST depressions are necessary for diagnosis of ST elevation myocardial infarction which requires urgent revascularization. The reciprocal changes are crucial and help to differentiate from other conditions like pericarditis. However, sometimes in myocardial infarction ST elevations can occur in both anterior and inferior leads which are electrically opposite leading to a confounding situation.

KEYWORDS:

• Simultaneous ST elevations • Tombstoning • Localization

INTRODUCTION

ECG is an important tool in localizing the culprit artery during myocardial infarction, which helps us in planning our approach for revascularization and in prognostication. Traditionally ST elevation myocardial infarction (STEMI) is associated with ST elevation in the corresponding leads and reciprocal ST depression in the electrically opposite leads due to the orientation of the injury current.

Simultaneous ST elevation is possible in the anterior and inferior leads (which are electrically opposite) and has been previously been described to occur due to isolated involvement of proximal right coronary artery (RCA) or mid to distal left anterior descending (LAD) artery.¹ Both these patterns of infarction are typically associated with limited left ventricular involvement and have relatively good prognosis.

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➤ Received: 21-07-2025 ➤ Accepted: 12-08-2025



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Rarely patients with simultaneous ST elevations in anterior and inferior leads can have dual culprit lesions which are associated with increased infarct size, worse LV function, and increased mortality risk and conduction disturbances. We describe one such case where a patient presented with cardiogenic shock and dual culprit of the RCA and LAD.

CASE SUMMARY (STUDY)

A male in his early forties, smoker and diabetic, presented to the hospital with severe retrosternal chest pain of 1 hour duration.

Pain was radiating to his left hand and was associated with diaphoresis and nausea. He did not have any family history of cardiac illness. On examination, his blood pressure was 80/40mm Hg, pulse was 40/minute. Auscultation revealed bilateral basilar crepitations. The ECG at presentation (Figure 1) shows atrio-ventricular dissociation and complete heart block. There are significant ST elevations in the form of tombstone pattern in the precordial leads V3-V6 and inferior leads II, III and aVF. There are significant ST depressions in leads aVL and aVR.

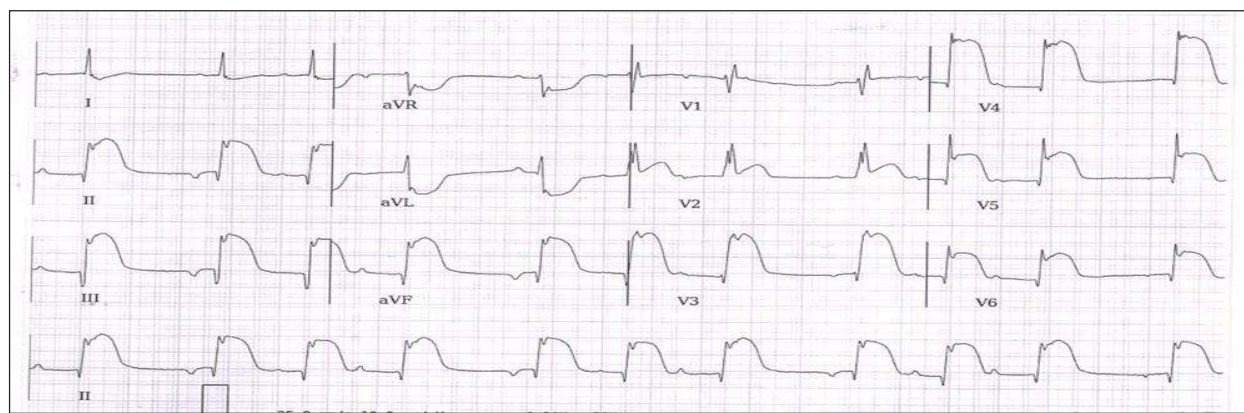


Figure 1: Twelve lead ECG at presentation

He was stabilized with a temporary transvenous pacemaker and started on inotropic support after which hemodynamic status improved. Echocardiography revealed significant involvement of both anterior and inferior territories with severe left ventricular dysfunction. After loading with dual antiplatelets and statin, the patient underwent urgent coronary angiography which revealed complete cutoff of both mid

LAD and proximal RCA with thrombus staining in both arteries (Figure 2A, 2B). There were no collaterals to either artery. Since the patient had 2 culprit arteries they were tackled sequentially. RCA was revascularized with a drug eluting stent. During revascularization of the LAD, patient had refractory ventricular fibrillation, worsening of cardiogenic shock and subsequently succumbed to his illness.



Figure 2: Coronary angiography revealed complete cut-off of mid LAD (Figure A) and proximal RCA (Figure B) with thrombus staining

DISCUSSION

Simultaneous ST elevation in the anterior and inferior leads has previously been described to occur due to isolated involvement of proximal RCA or mid to distal LAD.^{1,2}

The predominant involvement of right ventricle, as represented by leads V1 and V2, due to RV dilatation and limited inferior wall

involvement may explain the simultaneous anterior and inferior ST elevations in proximal RCA occlusion.² Likewise, the involvement of distal LAD, especially the wrap around type supplying the inferior wall, might lead to limited anterior wall involvement and similar ECG findings.¹ The findings from case series including at least 10 patients have been enumerated in Table 1.

Table 1: Case series of 10 or more patients with simultaneous anterior and inferior ST elevations

Author	Number of patients	Important findings	P value
Sadanandan <i>et al</i> ¹	179	• ST elevation in V1≥V3 – likely Proximal RCA culprit • Sum of ST elevation in inferior leads ≥7mm – likely Proximal RCA culprit	0.001 0.0001
Yip <i>et al</i> ⁸	37	• Proximal RCA culprit - Mean ST segment elevation in inferior leads 11mm • Culprit proximal RCA – higher risk of cardiogenic shock	0.0001 0.004
Alzand <i>et al</i> ¹⁰	12	• Tombstone ST elevations in precordial leads – likely Distal LAD culprit • ST elevation in lead III > II – likely proximal RCA culprit	- 0.09
Jim <i>et al</i> ⁹	49	• ST elevation in V6 ≥ 2mm – likely Distal LAD culprit • ST elevation in V2> V3 – likely Proximal RCA culprit • ST depression in aVL > 1mm – Likely Proximal RCA culprit	0.005 0.000 0.002

In our patient, ST elevation in lead V1 is less than that of V3 suggestive of distal LAD involvement (Table 1). But, the ST elevations in the inferior leads are equal to that of precordial leads V3-V6 and are of tombstone pattern.³ The complete heart block further muddles the picture as it can present with both inferior and anterior myocardial infarction.

About 2-3% of STEMI can present with multiple culprit arteries presenting challenges in localisation.^{4,5} The most common combination of multiple culprit arteries is LAD and RCA, and about a third of these patients present with cardiogenic shock.⁴ Causes of

concurrent thrombosis in multiple coronaries include simultaneous plaque rupture, hypercoagulable states, coronary embolism and use of drugs like cocaine. The most common pathological mechanism proposed is the effect of the inflammatory milieu during infarction on multiple vulnerable plaques.⁶ Previous large studies with Intra-Aortic Balloon Pump (IABP) and Extra corporeal membrane Oxygenation (ECMO) have shown no benefit, while the recent DANGER SHOCK study has shown benefit with Impella in cardiogenic shock caused by myocardial infarction.⁷

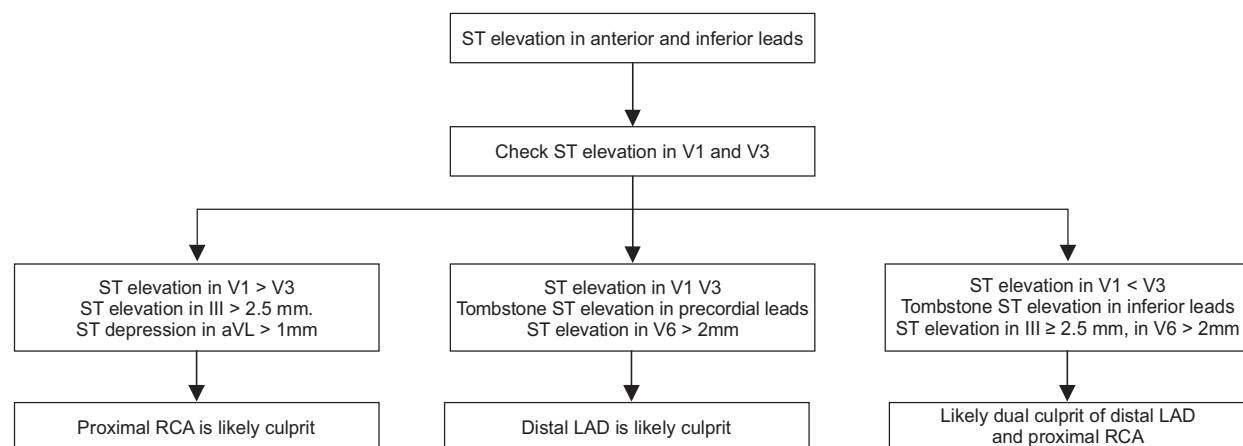


Figure 3: Algorithm to localize the culprit artery in presence of simultaneous anterior and inferior ST elevations

The presence of equal magnitude tombstoning ST elevation in both inferior and precordial leads, significant ST depression in lead aVL and ST elevation in V1 less than V3 suggest the presence of multiple culprit arteries in our case. We propose an algorithm to identify the culprit artery in simultaneous ST elevations in anterior and inferior leads (Figure 3) 1,8,9,10. This case reiterates the importance of ECG in identifying the culprit vessel and shows that even in unusual cases, careful ECG analysis will lead us on the right path.

CONCLUSION

The presence of simultaneous ST elevations in the anterior and inferior leads can occur both with single culprit artery and with multiple culprit arteries. Patients with multiple culprit arteries have worse LV function and prognosis and are more likely to present with cardiogenic shock. ECG is an important tool at our disposal in localizing the culprit artery in these confounding cases. Presence of tombstone ST elevation in the inferior leads, equal ST elevation in both inferior and anterior leads and ST elevation in V1 less than V3 is suggestive of dual culprit lesions. There is limited evidence about the benefit of Impella as a hemodynamic support device in these patients.

Conflict of Interest: None

Funding: None

Ethics Declaration: Informed consent was taken from the patient's family for publication as the patient expired during the course of treatment.

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