



## ECG Findings and Clinical Presentations of Myocardial Ischemia Reported Among Patients with Cardiac Metastasis from Lung Malignancies: A Narrative Review

Swetha Kannan

MBBS student, Gulf Medical University, Ajman, UAE

swethakannan9902@gmail.com (ESID 2442 8854 2023)

### Abstract

Cardiac tumours are substantially infrequent. However, metastasis to the heart from a primary cancer elsewhere in the body is reported often. In addition to its poor prognosis, the diagnosis of a cardiac metastasis is considered tough to establish. Primary lung cancers contribute to the maximum of cardiac metastasis cases. Owing to its predominantly clinically silent nature, myocardial metastasis isn't usually detected until autopsy. This narrative review aims at highlighting the ECG findings that are seen among patients with myocardial metastasis resulting from lung cancer. It also analyses the clinical presentations associated with cardiac metastasis. Although ECG findings are not standard means of diagnosis, characteristic changes were reported, which might suggest further investigations for the same. The studies reported in this review were collected from the databases that include PubMed, Sciondirect, Hindawi, ResearchGate and AHA journals in the period of 1980-2022. The keywords used for searching in the databases included ECG, cardiac metastasis, lung cancer. Articles focusing on lung cancer specifically was included, and studies reporting findings associated with other forms of cancer were excluded. A majority of case reports was used for this review. Literature review showed that ECG findings in a patient with cardiac metastasis imitated that of myocardial infarction. This review article encourages health researchers to decipher and justify the findings reported and develop a quicker strategic outline for diagnosis. It also aims to educate the healthcare professionals on the early detection of myocardial metastasis with the study of the preliminary ECG picture, thereby ensuring a better prognosis.

### Keywords:

*ECG, Cardiac Metastasis, Myocardial Infarction, Lung Cancer.*



## Introduction

Primary cardiac tumours are extremely rare, reporting an incidence of merely 0.002 to 0.3% and mortality rate of 5.9% worldwide [1]. However, metastasis to the heart wall and endocardium is significantly more common, especially among the younger population. Cardiac malignancies have a grim prognosis, with a survival rate of merely 10% for about one year [2].

Cardiac metastasis represent about 14.2% of metastasis that commonly occur [3]. Primary lung and mediastinal cancers are more likely to cause cardiac metastasis than other form of malignancies [3].

Although primary cardiac tumours are believed to possess an underlying genetic etiology, the association, however, is poorly understood [2]. Tumours can spread to the cardiac tissue by several mechanisms. They include by direct extension, via the bloodstream or the lymphatics. Cancers can also spread by intra-cavitary diffusion into the pericardial cavity from pulmonary veins [3].

Lung cancers are known to cause 36-39% of cardiac metastasis [4]. Cardiac metastasis are often difficult to diagnose by itself, and is usually discovered during autopsy procedures.

Although mostly clinically silent, cardiac metastasis often presents with symptoms similar to that of other cardiac manifestations, like chest pain, dyspnea and palpitations. Atrial fibrillation and atrial flutter is also commonly seen [4]. Presentation of these symptoms prompt further cardiovascular investigations, mainly ECG. A CT-scan of a 43 year old man diagnosed with lung adenocarcinoma who presented with complaints of cough, weight loss and anorexia showed multiple pulmonary neoplastic masses and pleuropericardial effusion.

Echocardiography showed multiple masses on the visceral pericardium confirming cardiac metastasis [5]. Out of 151 autopsies done in lung cancer patients, 8 of them elicited myocardial metastasis. ECG readings of these patients showed ST segment elevations. Since identifying myocardial metastasis is extremely strenuous, dedicated observation of ECG can prove to

be cardinal in the early identification [6]. Usually ST segment elevations indicate acute myocardial infarction (MI), which predominantly follows characteristic symptoms of left-sided chest pain and shortness of breath. However, literature has shown certain cases of ECG findings congruent to MI among patients with heart metastasis. A case of small cell lung carcinoma caused a secondary lesion at the apex of the left ventricle, leading to MI-like echocardiographic changes [7]. Similar observations were made in a 71 year old man diagnosed with small cell lung cancer who presented with chest discomfort [8]. Among 1046 autopsies performed from 1981 to 1983, 47 of them showed to have cardiac metastasis. Out of this number, 19 of them had ECG readings similar to that of myocardial ischemia, which included both ST segment elevations and T-wave inversions. However, none reported symptoms of MI [9]. Another rare case of double cancers with myocardial metastasis presented with MI-like ECG findings [10]. Although ECG abnormalities are commonly seen among patients with cardiac metastasis due to lung cancer, there are non-specific in nature [11]. Usually, myocardial invasions do not present with symptoms of myocardial infarction. However, a particular case of squamous cell carcinoma of the lung presented with both ST segment elevation and supraventricular tachycardia [12].

Cardiac metastasis should be considered in lung cancer patients with cardiac manifestations. Cardiac invasions are extremely hard to detect, but report worst prognosis. This review aims to educate healthcare professionals about the ECG findings commonly seen in cardiac metastasis and prompt further work-up using other methods, ultimately leading to its earlier detection. This work also encourages health researchers to decipher and justify the findings reported and develop more effective and quicker strategies for diagnosis. This may be an addition for better prognosis.



## Materials and Methods

Published case reports and articles on the topic were collected by searching various databases that include PubMed, Sciencedirect, Hindawi, ResearchGate and AHA journals. Owing to its rare occurrence, cases reported over a period of over four decades (1981 to 2022) were considered. The keywords used for searching included "ECG", "Cardiac metastasis", "Myocardial Infarction" and "Lung cancer". The studies analysing the ECG findings and presentations of cardiac metastasis resulting from other form of cancers were excluded. Searches were limited to English language. The review was completed within a period of three months. Around 43 articles were extracted after initial search. There were only a limited number of articles on this topic after following the exclusion criteria. A total of 35 articles were finally used. The articles used for this narrative review consisted mainly of case reports.

## Results

A total of 35 studies were included in this review. Assessments of the articles concluded that ECG findings in patients with cardiac metastasis showed ST segment elevation congruent with that of myocardial infarction. Furthermore, though most of the cases do not report any MI-like symptoms at the time of admission, a few reports indicate otherwise. A few case reports reveal patients previously diagnosed with lung cancer to have admitted to hospital presenting with complaints of chest pain, shortness of breath, palpitations and hemoptysis.

## Discussion

Primary lung cancers can spread via the bloodstream and lymphatic system to various sites, such as the liver, adrenal glands, bones, brain, kidney and rarely, myocardium. Myocardial metastasis is clinically unapparent, but evidence shows characteristic ECG findings.

Autopsy procedure showed two rare cases of myocardial metastasis that showed elevation of ST segment with a QS pattern. It suggested that

appearance of ST segment elevation in patients with lung cancer devoid of any cardiovascular symptoms, most likely indicates myocardial metastasis [6].

A case of 71 year old male presenting with chest discomfort, who was previously diagnosed with squamous cell lung cancer showed ECG findings similar to acute myocardial infarction [8]. However, since he did not elicit any obvious classical symptoms of MI and also had normal serum levels of cardiac enzymes, an echocardiography was ordered. A massive hyperechoic mass was found on the left ventricle due to myocardial invasion.

Similarly, a rare case of double cancers (lung adenocarcinoma and gastric adenocarcinoma) showed ST segment and Q-wave elevations on ECG. On subsequent ultrasonic cardiography, a mass lesion was found on the septal part of left ventricle. Invasive adenocarcinoma infiltrating into the cardiac tissue showed MI-like findings [10]. Similarly, a 63 year old man with lung cancer reported giant T-wave inversion on ECG due to metastatic spread into the apex of right ventricle [31].

On the other hand, a study showed MI-like ECG findings (T-wave inversions) in lung cancer patients without cardiac metastasis [13]. The likely explanation for this could be due to the chronic stress and fatigue lung cancer patients are exposed to, and this stress increases the sympathetic activity. Increased sympathetic stimulation increases heart rate and lead to abnormal heart rhythm. Another case of lung cancer showed myocardial metastasis causing ST-segment elevation and other MI-like findings [14]. However, this 78 year old patient with lung cancer presented with chest pain and dyspnea. Similar findings and conclusion was drawn in a patient post 80 years of age, however he had reported chest pain and hemoptysis [35]. A 74 year old male diagnosed with non-small cell lung cancer reported excruciating chest pain, which was followed by identification of a large mass near the interatrial septum of the left atrium [21]. Almost a year following lung cancer diagnoses, a 75 year old man got admitted with a complaint of chest pain, shortness of breath and palpitations. ECG



revealed ST segment elevation but no abnormal cardiac enzyme levels. Subsequent cardiac metastasis was diagnosed [25]. Similar outcome was observed in another case report of a 52 year old man in China [27]. Another case of a 68 year old patient with lung cancer, presented ST segment elevation on ECG without any chest pain [22]. Palpitation was also a reported presentation at the time of admission [33]. Although cardiac tumours does not cause symptoms, there are a few reports in which patients have complained of chest pain on admission. Syncope has also been reported as a symptom of myocardial infiltration from a lung tumour [30]. A case report showed ST-segment elevation myocardial infarction (STEMI) in a patient with lung carcinoma which was eventually diagnosed as pericarditis caused due to metastatic invasion rather than an acute myocardial infarction [15]. A 47 year old male diagnosed with small cell lung cancer reported spread of the malignancy to the heart via the pulmonary veins. ECG findings, were similar to that of STEMI [16]. A 51 year old woman with lung adenocarcinoma presented with ST segment elevation without any cardiac symptoms. Autopsy reports show direct myocardial compression caused by the lung mass [17]. Another case is of a 62 year old male who was diagnosed previously with stage IIIA squamous cell lung cancer, who admitted with complaint of chest pain. ECG pattern showed ST-segment elevation. Urgent coronary angiography was performed suspecting MI, but no stenosis was found in the coronary arteries. Subsequent echocardiography showed direct invasion of the lung mass into the ventricular wall of the heart [18]. Similarly, a 67 year old male diagnosed with lung adenocarcinoma showed signs of heart failure due to large single right ventricular metastasis [32]. In contrast to all these reports, a case of a 63 year old woman with pulmonary epithelioid hemangioendothelioma (PEH) showed ST-segment elevation on ECG and suffered from STEMI due to compression of left coronary artery from PEH [19]. Similar outcomes were reported in a 51 year old female diagnosed with lung adenocarcinoma who suffered from a cardiac arrest. ST segment elevation,

elevated cardiac biomarkers and occlusion of the left anterior descending artery was confirmed, all caused by the primary lung tumour [26]. This emphasizes the need to proceed with additional investigations and imaging following an abnormal finding on ECG among lung cancer patients. Similar results were seen in another case of a 53 year old man with squamous cell lung carcinoma [20]. A 26 year old woman with a tumour recurrence in the lung showed a ST segment elevation on ECG. Reports revealed infiltration into the heart from the lung mass instead of acute blockage of coronary arteries [23]. A 56 year old man previously diagnosed with lung adenocarcinoma admitted with complaint of dull pain radiating to the back. ECG revealed bradycardia and AV dissociation. This AV block was caused due to infiltration of the lung mass into the cardiac tissue and circulatory system [32]. In contrast, a 61 year old man diagnosed with non-small cell lung cancer who reported constrictive pericarditis caused by direct invasion of tumour into the pericardium via super vena cava and right atrium, showed normal ECG findings [28]. Similarly, a case of 55 year old man with cardiac metastasis from primary squamous cell lung carcinoma reported normal sinus rhythm on ECG [28]. Normal rate and sinus rhythm was observed in a 53 year old woman with a cystic endocardial mass from lung metastases [34]. The explanation is unknown. However, it sheds light on the importance of advanced diagnostic procedures such as echocardiography, CT, cardiac MRI and other invasive techniques for arriving at the diagnosis of cardiac metastasis.

### **Conclusion**

Although cardiac metastasis is rare compared to metastases to other sites, early identification is crucial for improving prognosis. Among patients with lung cancers, it is vital to carefully monitor to detect any abnormalities in the heart and the associated vessels, due to its high rate of metastatic progression to the cardiovascular system. According to this review, patients with cardiac metastasis resulting from primary lung malignancy present with ST segment



elevations on the ECG picture with or without any cardiac symptoms. It is essential to include the probability of metastatic progression to the heart from the lung when a patient presents with MI-like findings. Since differential diagnoses from analysis of the ECG picture between an actual STEMI and ST segment elevation due to cardiac metastasis can be difficult, continuous regular monitoring of heart functions through ECG is important in lung cancer patients. This would help catch any discrepancy or disturbance in the normal activity of the heart. Once an abnormality is noticed (ST segment elevation or T-wave inversion), immediate cardiac diagnostic techniques should be adopted to identify cardiac metastasis. This rapid identification and diagnoses can help in quick and effective treatment of the same.

#### Conflict of interest disclosure

N/A

#### References

1. Rahouma M, Arisha MJ, Elmously A, et.al. Cardiac tumors prevalence and mortality: A systematic review and meta-analysis. *International Journal of Surgery*.2020;76:pp178-189. Available from: <https://www.sciencedirect.com/science/article/pii/S1743919120302041>
2. Leja MJ, Shah DJ, Reardon MJ. Primary cardiac tumors. *Tex Heart Inst J*. 2011;38(3):pp261-2. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3113129/>
3. Bussani R, De-Giorgio F, Abbate A, Silvestri F. Cardiac metastases. *J Clin Pathol*. 2007 Jan;60(1):pp27-34. doi: 10.1136/jcp.2005.035105. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1860601/>
4. Goldberg AD, Blankstein R, Padera RF. Tumor metastatic to the heart. *Circulation*.2013;128:pp1790-1794. <https://doi.org/10.1161/CIRCULATIONAH>
5. Cabrera César E, Fernández Aguirre MC, Hidalgo Sanjuan MV. Metástasis cardiacas de una neoplasia pulmonar. *Arch Bronconeumol*. 2017;53:pp80-81. Available from: <https://www.archbronconeumol.org/en-cardiac-metastases-from-a-lung-articulo-S1579212916303299>
6. Shosaku ABE, Naomi WATANABE, Shigeaki OGURA, et.al. Myocardial Metastasis from Primary Lung Cancer: Myocardial Infarction-like ECG Changes and Pathologic Findings. *Japanese Journal of Medicine*.1991;30(3):pp213-218. Available from: <https://doi.org/10.2169/internalmedicine196.2.30.213>
7. Vallot F, Berghmans T, Delhaye F. *et al*. Electrocardiographic manifestations of heart metastasis from a primary lung cancer. *Support Care Cancer*.2001;9:pp275-277. Available from: <https://doi.org/10.1007/s005200000212>
8. Yao NS, Hsu YM, Liu JM, et.al. Lung cancer mimicking acute myocardial infarction on electrocardiogram. *The American Journal of Emergency Medicine*.1999;17(1):pp86-88. Available from: [https://doi.org/10.1016/S0735-6757\(99\)90026-8](https://doi.org/10.1016/S0735-6757(99)90026-8)
9. Cates CU, Virmani R, Vaughn WK, et.al. Electrocardiographic markers of cardiac metastases. *American Heart Journal*.1986;112(6):pp1297-1303 Available from: [https://doi.org/10.1016/0002-8703\(86\)90363-7](https://doi.org/10.1016/0002-8703(86)90363-7)
10. Konishi S, Kojima T, Ichyanagi K. *et al*. A case of double cancers with myocardial metastasis mimicking acute myocardial infarction both on an electrocardiogram and



- on Tc-99m-MIBI myocardial SPECT. *Ann Nucl Med.*2001;**15**:pp381-385  
<https://doi.org/10.1007/BF02988248>
11. Cheon DY, Park KH, Hong SE, et.al. Metastatic Cardiac Tumor Manifested by Persistent ST-Segment Elevation With Coexisting Reciprocal Changes on Electrocardiography. *International Heart Journal.*2014;55(5):pp466-468.  
<https://doi.org/10.1536/ihj.14-050>
  12. Pan KI, Wu LS, Chung CM, et.al. **Misdiagnosis.** *International Heart Journal.*2007;48(3):pp399-405.<https://doi.org/10.1536/ihj.48.399>
  13. Shukla RS, Aggarwal Y. Electrocardiogram in Lung Cancer Patients Envisage as Pseudo-Myocardial Infarction and Ischemic Heart Disease. *Journal of Clinical Engineering.*2018; 43(1):pp48-52.DOI: 10.1097/JCE.0000000000000252
  14. Jung HW. ST-segment elevation due to myocardial invasion of lung cancer mimicking ST elevation myocardial infarction: A case report. *Medicine (Baltimore).*2021;100(20):e26088. doi:10.1097/MD.00000000000026088. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8137083/>
  15. Khurana KV, Ranjan A. ST-Segment Elevation in Conditions of Non-cardiovascular Origin Mimicking an Acute Myocardial Infarction: A Narrative Review. *Cureus.*2022;14(10):e30868. doi:10.7759/cureus.30868. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9708054/>
  16. Guha S, Mookerjee S, Karmakar RN, et.al. Left atrial extension of lung malignancy with ECG changes resembling MI. *Indian Heart J.*2010;62:pp81-83. Available from: <https://pubmed.ncbi.nlm.nih.gov/21180044/>
  17. Shah S, Padaliya B, Mohan SK. Noninfiltrating Adenocarcinoma of the Lung Causing ST-Segment Elevation. *Tex Heart Inst J.* 2015;42(4):pp381-4. doi: 10.14503/THIJ-14-4268. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4567106/>
  18. Kim KH, Jeong MH, Yoon HJ, et.al. A case of myocardial involvement in lung cancer that mimics ST segment elevation in myocardial infarction. *Korean J Intern Med.*2014;29(4):pp525-8. doi: 10.3904/kjim.2014.29.4.525. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4101600/>
  19. Luo X, Song N, He S, et.al. Acute ST-segment elevation myocardial infarction due to extrinsic compression of left coronary artery from pulmonary epithelioid hemangioendothelioma: A case report. *Medicine (Baltimore).* 2019;98(48):e18158. doi: 10.1097/MD.00000000000018158. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6890309/>
  20. Anjum I, Eajaz F, Gaffar M, et.al. Myocardial Invasion of Squamous Cell Lung Carcinoma Presenting as STEMI. *Heart Views.*2022;23(3):pp177-180. doi: 10.4103/heartviews.heartviews\_21\_22. Available from: [ncbi.nlm.nih.gov/pmc/articles/PMC9721171/](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9721171/)
  21. Das A, Das SK, Pandit S, et.al. Bronchogenic Carcinoma with Cardiac Invasion Simulating Acute Myocardial Infarction. *Case Rep. Oncol Med.* 2016;7813509. doi: 10.1155/2016/7813509. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4793133/>
  22. Chen T. Persistent ST-segment elevation due to cardiac metastasis. *BMJ Case Rep.*2017;bcr2017220621.doi: 10.1136/bcr-2017-220621. Available from:



- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5623245/>
23. Tandon V, Kethireddy N, Balakumaran K, et.al. Metastatic squamous cell carcinoma to the heart: an unusual cause of ST elevation—a case report, *European Heart Journal - Case Reports*. 2019;3(2):ytz029. Available from: <https://doi.org/10.1093/ehjcr/ytz029>
24. Zhou R, Prasada S, Roth M. A case report of an STEMI mimicker in a patient presenting with haemoptysis and chest pain with metastatic myocardial infiltration and left ventricular mural thrombi. *Eur Heart J Case Rep*. 2021;5(2):ytaa546. doi: 10.1093/ehjcr/ytaa546. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7954242/>
25. Xu J, Cui F, Wang D, et.al. Profound Anterior ST-Segment Elevation in a Patient with Lung Cancer and Echocardiographic Evidence of Right Ventricle Metastasis. *CASE (Phila)*. 2021;6(2):pp59-62. doi: 10.1016/j.case.2021.11.001. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9050599/>
26. Uribarri A, Villa A, Loughlin G, et.al. Acute myocardial infarction as presentation of an infiltrative lung neoplasia. *J Cardiol Cases*. 2013;7(3):e61-e63. doi: 10.1016/j.jccase.2012.10.013. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6275371/>
27. FANG CF, Geng XU, CHEN YX, WANG, et.al. Acute myocardial infarction mimicking squamous cell lung cancer with bone metastases due to hypercalcemia: a case report. *Chinese Medical Journal*. 2010;123(3):369-371. DOI: 10.3760/cma.j.issn.0366-6999.2010.03.021
28. Guo-wei CHE, Lun-xu LIU, Er-yong Z, et.al. Left ventricular metastasis from a primary lung carcinoma. *Chinese Medical Journal*. 2007;120(24):pp2323-2324. Available from: [https://journals.lww.com/cmj/Fulltext/2007/12020/Left\\_ventricular\\_metastasis\\_from\\_a\\_primary\\_lung.34.aspx](https://journals.lww.com/cmj/Fulltext/2007/12020/Left_ventricular_metastasis_from_a_primary_lung.34.aspx)
29. Joyce NG, Wijayaratna R. A case of solid pericardial metastases causing constrictive pericarditis in a patient with non small cell lung cancer. *Australian Medical Student Journal*. 2013;4(2). Available from: [http://amsj.org/wp-content/uploads/files/articles/amsj\\_v4\\_i2/48.pdf](http://amsj.org/wp-content/uploads/files/articles/amsj_v4_i2/48.pdf)
30. Al-Juburi S, Rafizadeh S, Zeki AA. Heart of the Matter: Syncope as a Rare Presentation of Lung Cancer Invading the Heart. *J Investig Med High Impact Case Rep*. 2021;9:23247096211053709. doi: 10.1177/23247096211053709. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8725212/>
31. Oh J. A Case of Giant Negative T-wave Inversion due to RV Apical Hypertrophy Secondary to Metastatic Lung Cancer. *Korean Circulation Journal*. 2000; 30(11):pp1436-1441. DOI: <https://doi.org/10.4070/kcj.2000.30.11.1436>
32. Oyakawa T, Muraoka N, Iida K, et.al. A Patient with a Massive Single Cardiac Metastasis of Lung Adenocarcinoma, Diagnosed via a Biopsy. *Intern Med*. 2018;57(11):pp1637-1640. doi: 10.2169/internalmedicine.9893-17. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6028669/>
33. Kasai T & Kishi, Kazuma & Kawabata, Masateru & Narui, et.al. Cardiac Metastasis From Lung Adenocarcinoma Causing Atrioventricular Block and Left Ventricular Outflow Tract Obstruction. *Chest*. 2007;131:pp1569-72. DOI: <http://dx.doi.org/10.1378/chest.06-1904>
34. Son JW, Hong GR. Unusual left ventricular endocardial metastasis from primary lung



## Emirati Journal of Future Medicine and Science

Vol 1 Issue 1 (2023) 4 - 11

DOI: 10.54878/EJFMS.276

Available at [www.emiratesscholar.com](http://www.emiratesscholar.com)



cancer. J Cardiovasc  
Ultrasound.2012;20(3):pp157-60. doi:  
10.4250/jcu.2012.20.3.157. Available from:  
[https://www.ncbi.nlm.nih.gov/pmc/articles/  
PMC3498315/](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3498315/)

35. Burazor I, Aviel-Ronen S, Imazio M. *et al.* Metastatic cardiac tumors: from clinical presentation through diagnosis to treatment. *BMC Cancer*.2018;**18**:202.  
<https://doi.org/10.1186/s12885-018-4070-x>.

Available  
from:[https://bmccancer.biomedcentral.com  
/articles/10.1186/s12885-018-4070-x](https://bmccancer.biomedcentral.com/articles/10.1186/s12885-018-4070-x)