

Cardiac Metastasis and Krukenberg Tumor: A Case Report

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Introduction

Primary cardiac tumors are rare, affecting between 0.0017% and 0.28% of the population.¹ Secondary or metastatic tumors, on the other hand, are 40 to 100 times more frequent than primary tumors.² The primary sites that most often metastasize to the heart are the lungs, breast, malignant melanoma, and hematological tumors. Cardiac metastasis secondary to ovarian tumors is infrequent and, in the cases described, mainly affects the pericardium, with no intracavitary lesions described.³ Metastatic neoplasms can reach the heart by these routes: hematogenous, direct extension, lymphatic vessels, and through the pulmonary veins and vena cava.^{4,5}

The term “Krukenberg tumor” is used clinically to designate a metastatic carcinoma of mucin-secreting signet ring cells in the dense fibroblastic stroma of the ovary.^{5,7} It mainly affects premenopausal women, at a mean age of diagnosis of 45 years, with 70% of cases in the stomach as the most common primary site, followed by the colon, appendix, and breast.^{5,6} A history of carcinoma prior to the diagnosis of Krukenberg is obtained in only 20% of cases, and the primary site is often unknown.⁷ The mortality rate is high, and survival is 14 months on average after diagnosis.^{6,7}

This case report describes the case of a patient with a secondary Krukenberg tumor and significant cardiac metastatic involvement, presenting multiple intracavitary tumors assessed by transesophageal echocardiography (TEE), demonstrating the importance of careful assessment of tumor lesions by echocardiographers.

Case report

A 45-year-old woman sought medical attention due to diffuse abdominal discomfort which had started about 9 months earlier. Physical examination revealed a palpable mass in the right iliac fossa. She underwent an outpatient abdominal ultrasound, which revealed an expansive solid-cystic formation presumably in the right ovary. The patient was admitted for surgical treatment in August 2022.

Keywords

Neoplasm Metastasis; Brenner Tumor; Krukenberg Tumor.

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During her admission, the patient had a sudden episode of dyspnea, raising the hypothesis of a pulmonary embolism. The patient was tachycardic and tachypneic, with a heart rate of around 105 bpm, an estimated respiratory rate of 25 bpm, and peripheral oxygen saturation close to 95% on oxygen supplementation via a nasal catheter. No hemodynamic instability or other alterations were seen on the cardiopulmonary physical examination. The extremities were perfused, with no clinical signs of peripheral venous thrombosis. The electrocardiogram showed tachycardic sinus rhythm, with no other alterations.

A transthoracic echocardiogram (TTE) was requested. It was urgently conducted in bed, with acoustic windows that were difficult to see through, but multiple intracavitary mobile lesions could already be seen. Except for a slight increase in the left atrium, the other cavities were normal in size. The valves were morphologically normal, with only mild mitral and tricuspid regurgitation. Her biventricular function was preserved, with an estimated left ventricular ejection fraction of 60% on a two-dimensional scan, with an unfavorable apical acoustic window for using the Simpson Rule. No signs of pulmonary hypertension were seen. We opted for immediate TEE, which showed multiple mobile echogenic lesions, loose inside the cavities, homogeneous, with well-defined contours and varying dimensions inside both atria (Figures 1A and 1B) moving into the ventricles through the mitral and tricuspid valves. Approximately 6 masses were found inside the right atrium, the largest of which came from the inferior vena cava and measured 7.1 × 0.3 cm (Figures 2 and 4). Inside the left atrium, the masses were smaller, multiple and mobile, around 12 in total, and their diameters were difficult to measure. They appeared to originate in the right atrium through a patent foramen ovale (PFO), as one of the masses passed from the right atrium to the left atrium through the PFO during the examination (Figures 3A and 3B). No implants were seen in the topography of the pericardium, which presented its usual appearance, and no pericardial or pleural effusions were seen.

The investigation of the abdominal mass was followed up with a contrast-enhanced abdominal CT scan, which showed a large heterogeneous solid-cystic mass measuring 29.1 × 25.6 × 20.7 cm, and dilatation and filling of the right gonadal vein and inferior vena cava with soft tissue density, extending into the right atrium. A biopsy of the right ovary was performed, revealing the presence of small, isolated cells, with vacuolized cytoplasm like a signet ring, sparse in the middle of the stroma. Upper gastrointestinal endoscopy was also performed and showed no gastric lesions. Cardiac MRI was conducted, describing intracardiac tumor lesions as solid tubular expansive formations, extending from the inferior vena cava to the right atrium and right ventricle, reaching the pulmonary artery, with discrete perfusion of the

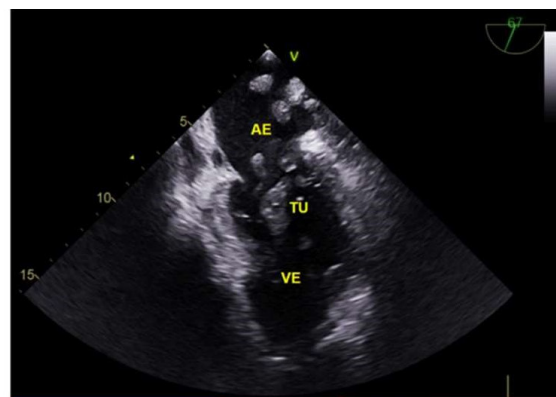
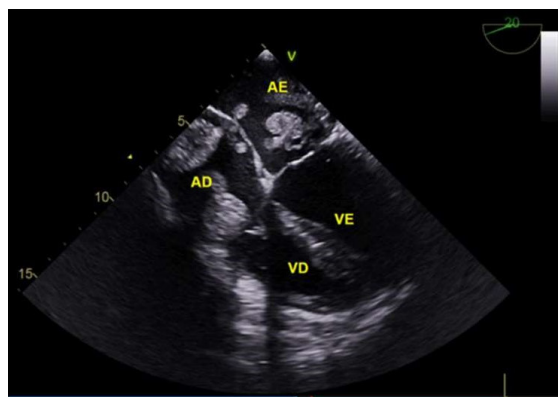


Figure 1A and 1B – TEE images showing the tumors in the heart cavities. In Figure 1A, taken at 20°, we observe the tumors in both atria, with the mass passing through the interatrial septum. Figure 1B, taken at 67°, shows the tumors in the left chambers, passing through the mitral valve.

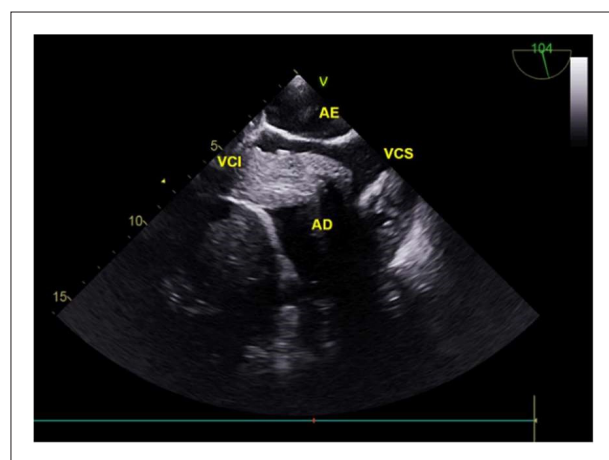


Figure 2 – Image of a bicaval section, taken at 104°, showing the largest tumor inside the right atrium, originating in the inferior vena cava.

lesion in the first pass and uniform late enhancement after contrast injection, compatible with tumor implants.

Clinical cardiology, cardiac surgery, clinical oncology, general surgery, surgical oncology, and palliative care teams assessed the patient jointly. The main diagnostic hypothesis, based on the clinical-imaging cardiac and abdominal symptoms, and the histopathology of the ovary, showing a spindle cell neoplasm with signet ring cytoplasm, which would be Krukenberg tumor, a secondary tumor with no established primary site, associated to multiple cardiac metastases. Biopsies of the heart tumors and invasive procedures to investigate the primary site related to the ovary neoplasm were discouraged by the attending teams, in agreement with the patient and her family, due to the risk of the procedures and the low prospect of resectability of the lesions. So, palliative care prevailed, with no curative proposal. The patient was clinically treated with full anticoagulation and her symptoms

improved. She was discharged from hospital and is currently asymptomatic, being followed up as an outpatient by the palliative care and general surgery teams.

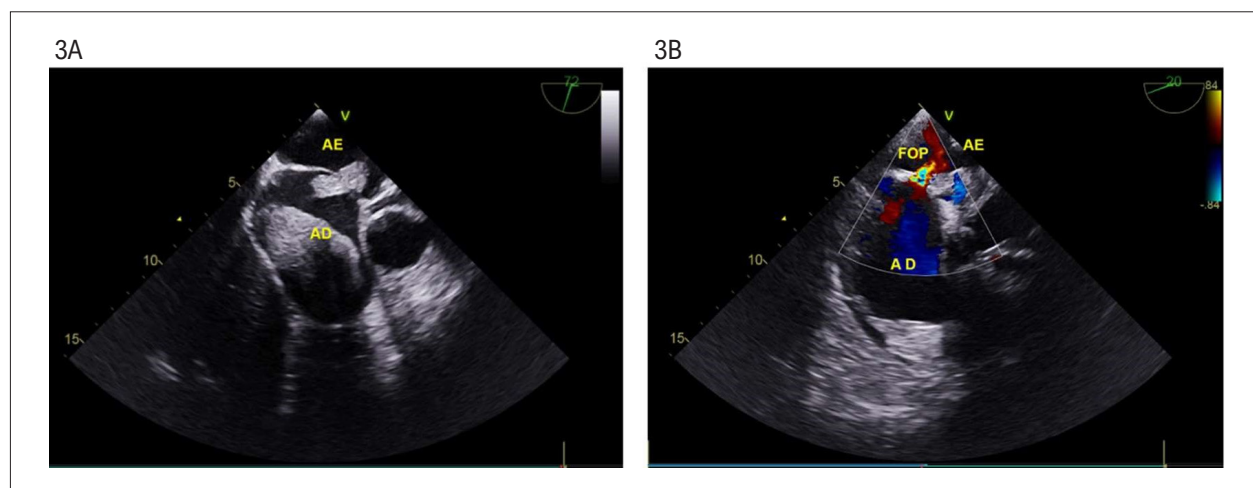
Discussion

Metastatic disease is the most common cardiac neoplasm in adults, with a reported incidence of 0.7% to 3.5% in the general population, and 9.1% in patients with established advanced neoplasia.^{8,1} The increased incidence is due, partly at least, to advances in diagnostic imaging and improved therapeutic interventions in cancer patients. The primary sites that metastasize most frequently to the heart are lung, breast, malignant melanoma, and hematological tumors, probably due to their high prevalence and aggressive nature.¹ Malignant metastatic disease can reach the heart in various ways, including direct extension (lung carcinoma), via the hematogenous route (melanoma and hematological neoplasms), via the lymphatic route (breast carcinoma), and venous extension (renal carcinoma).⁴

The clinical picture of cardiac metastasis is often unspecific, depending mainly on the location of the tumor and the degree of involvement, and it can be asymptomatic, with diagnosis only after autopsy.⁸ Pericardial metastases, which account for more than 60% of cardiac metastases, can cause pericarditis or effusion, resulting in corresponding clinical signs and symptoms.^{8,4} Myocardial metastases account for around a third of cases and can evolve with arrhythmia and chest pain, in addition to contractile dysfunction and a clinical picture of heart failure.⁹ Endocardial involvement is rare, described in 3% to 5% of cases, and can evolve with obstruction and/or embolization. Paraneoplastic phenomena, such as thromboembolic events, can also occur.⁸

The first-line test for the initial assessment of cardiac metastatic lesions is echocardiography, which is a widely available, noninvasive procedure which identifies the presence of masses, and their respective characteristics, location, and relationship with adjacent structures.³

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Figures 3A and 3B – Images of the interatrial septum. Figure 3A reveals a tumor lesion passing through the PFO. Figure 3B, showing right-to-left flow using color Doppler.

Cardiac resonance imaging and computed tomography act as complementary imaging techniques, providing more detailed anatomical images and information on the tumor's vascularization and local invasion.¹⁰

The treatment of cardiac metastases depends on the clinical presentation and is initially aimed at controlling symptoms and complications, such as pericardial tamponade, arrhythmias, and symptoms of heart failure. Other forms of treatment, such as tumor resection, chemotherapy, and radiotherapy, must be individually adapted to each patient.

Currently, no protocol for investigating cardiac metastases in patients with malignant neoplasms is established. However, for screening purposes, some authors suggest performing an echocardiogram on patients with lung and liver cancer who have cardiac arrhythmias. The prognosis of malignant cardiac tumors secondary to metastases is poor, given that patients present with advanced cardiac metastases at the time of diagnosis.¹¹

This report illustrates a case of extensive cardiac metastatic involvement, originating in the inferior vena cava, with multiple intracavitary mobile tumors affecting all 4 heart chambers, associated with the presence of a secondary ovarian tumor, with no defined primary etiology.

Conclusion

In cases of advanced neoplasms, a detailed assessment of the cardiac structures (pericardium, epicardium, myocardium, and endocardium) should be performed in the search for metastases. Echocardiography, in its various forms, enables early diagnosis of cardiac involvement.

Author Contributions

Conception and design of the research, acquisition of data: Cruz JG, Lucena JDL

Cruz JG, Lucena JDL; analysis and interpretation of the data, writing of the manuscript: Cruz JG; critical revision

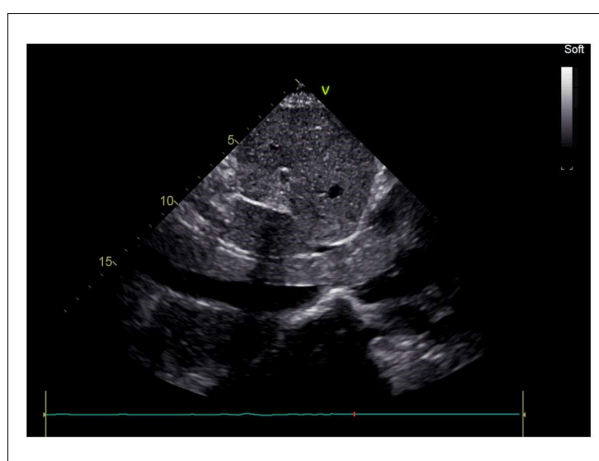


Figure 4 – Image of the inferior vena cava in a subcostal window on TTE, filled with an extensive tumor lesion, up to its entrance into the right atrium.

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Potential Conflict of Interest

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Study Association

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Ethics Approval and Consent to Participate

This article does not contain any studies with human participants or animals performed by any of the authors.

References

1. Goldberg AD, Blankstein R, Padera RF. Tumors Metastatic to the Heart. *Circulation*. 2013;128(16):1790-4. doi: 10.1161/CIRCULATIONAHA.112.000790.
2. Morosin M, Azzu A, Capoccia M, Rosendahl U. Extensive Cardiac Infiltrative Melanoma. *J Card Surg*. 2019;34(9):858-9. doi: 10.1111/jocs.14184.
3. Baba Y, Ishikawa S, Ikeda K, Honda S, Miyanari N, Iyama K, et al. A Patient with 43 Synchronous Early Gastric Carcinomas with a Krukenberg Tumor and Pericardial Metastasis. *Gastric Cancer*. 2007;10(2):135-9. doi: 10.1007/s10120-007-0416-9.
4. Kavanagh MM, Janjanin S, Prgomet D. Cardiac Metastases and a Sudden Death as a Complication of Advanced Stage of Head and Neck Squamous Cell Carcinoma. *Coll Antropol*. 2012;36 Suppl 2:19-21.
5. Lionetti R, De Luca M, Raffone A, Travaglino A, Coppellotti A, Peltrini R, et al. Clinics and Pathology of Krukenberg Tumor: A Systematic Review and Meta-Analysis. *Minerva Obstet Gynecol*. 2022;74(4):356-63. doi: 10.23736/S2724-606X.21.04797-7.
6. Xie H, Erickson BJ, Sheedy SP, Yin J, Hubbard JM. The Diagnosis and Outcome of Krukenberg Tumors. *J Gastrointest Oncol*. 2021;12(2):226-36. doi: 10.21037/jgo-20-364.
7. Zulfiqar M, Koen J, Nougaret S, Bolan C, van Buren W, McGettigan M, et al. Krukenberg Tumors: Update on Imaging and Clinical Features. *AJR Am J Roentgenol*. 2020;215(4):1020-9. doi: 10.2214/AJR.19.22184.
8. Maleszewski JJ, Bois MC, Bois JP, Young PM, Stulak JM, Klarich KW. Neoplasia and the Heart: Pathological Review of Effects with Clinical and Radiological Correlation. *J Am Coll Cardiol*. 2018;72(2):202-27. doi: 10.1016/j.jacc.2018.05.026.
9. Srinivas SK, Subramanyam K, Ramalingam R, Bhat S, Kalpana SR, Manjunath CN. A Rare Case of Left Ventricular Outflow Tract Mass. *Echocardiography*. 2013;30(9):E274-7. doi: 10.1111/echo.12294.
10. Crean AM, Juli C. Diagnosis of Metastatic Melanoma to the Heart with an Intrinsic Contrast Approach Using Melanin Inversion Recovery Imaging. *J Comput Assist Tomogr*. 2007;31(6):924-30. doi: 10.1097/RCT.0b013e31804b213b.
11. Nova-Camacho LM, Gomez-Dorronsoro M, Guarch R, Cordoba A, Cevallos MI, Panizo-Santos A. Cardiac Metastasis from Solid Cancers: A 35-Year Single-Center Autopsy Study. *Arch Pathol Lab Med*. 2023;147(2):177-84. doi: 10.5858/arpa.2021-0418-OA.



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