Metastatic Carcinoma to the Right Heart: The Complementary Utility of Contrast-Enhanced Echocardiography and Cardiac Positron Emission Tomography/Computed Tomography

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INTRODUCTION

Epithelial-myoepithelial carcinomas of the parotid gland are rare low-grade tumors, most seen in postmenopausal women, and they account for approximately 0.4% to 1% of all salivary gland malignancies.[1] These tumors rarely metastasize (<5% chance of nodal or distant spread), and when they do, cardiac spread has been reported in only five such cases.[2] When suspected, transthoracic echocardiography (TTE), transesophageal echocardiography, computed tomography (CT), and cardiac magnetic resonance imaging (CMR) play important roles in the diagnosis and management of cardiac tumors. We sought to add to the current literature by presenting a rare Case of a 59-year-old woman with epithelial-myoepithelial parotid carcinoma metastasizing to the right heart, which was identified on TTE.

CASE PRESENTATION

A 59-year-old woman with a medical history of hypertension and Kidney Disease Improving Global Outcomes stage 5 chronic kidney disease (CKD) was initially diagnosed with epithelial-myoepithelial carcinoma (T3N0M0) of the left parotid gland and primary thyroid papillary carcinoma (T3N1b; Figure 1). She subsequently underwent left total parotidectomy and total thyroidectomy with bilateral neck dissections followed by adjuvant radiation therapy 1 month later. She remained in remission for 4.5 years, following which she presented with an enlarging left-sided neck mass. During this presentation (time 0), positron emission tomography (PET)/CT (PET/CT) demonstrated multiple regions of increased fluorodeoxyglucose uptake concerning for metastatic lesions to the lung and cervical lymph nodes. Two months later, a biopsy of a right lung nodule was performed and showed metastatic epithelial-myoepithelial carcinoma of the salivary gland, consistent with her initial parotid cancer diagnosis. Given the relapse of her parotid carcinoma with metastatic spread, she opted for palliative treatment with carboplatin and paclitaxel.

Two months later, she developed shortness of breath and chest discomfort, prompting hospitalization 2 weeks after beginning her palliative treatment. TTE (parasternal long-axis view) revealed a moderate-sized pericardial effusion, measuring 1.2 cm anterior to the right ventricle and 1.3 cm posterior to the left ventricle, seen during end-diastole. Furthermore, nodular densities were seen along the right ventricular pericardial surface, along with fibrinous strands in the fluid anterior to the right ventricle. She subsequently underwent pericardiocentesis with a pericardial window and biopsy performed by cardiothoracic surgery. Cytology of the pericardial fluid was notable for rare, atypical cells of epithelial origin. The pericardial biopsy was found to have chronic inflammation, fibrin deposition, and reactive mesothelial proliferation. Following drainage of the effusion, her symptoms diminished, and she was discharged from the hospital.

One year later, the patient underwent surveillance PET/CT, which showed further progression of her lung metastasis, a new right ventricular mass, and hypermetabolic lesions in the right atrium (Figure 2). Despite these findings of progression, she remained asymptomatic. As per her oncology team, the plan was to monitor with PET/CT every 6 months. During her surveillance scan (time 0 + 24 months), there was increased uptake of the masses in the right atrium and right ventricle. On physical examination, her first and second heart sounds were normal, with a regular rate and rhythm. There were no murmurs, additional heart sounds, or friction rubs. There was bilateral lower extremity pitting edema to the mid shins but no jugular venous distension. Her complete blood count was significant for white blood count 12 $\times$ $10^3/\mu$L, hemoglobin 8.7 g/dL, hematocrit 29%, and platelet count 251 $\times$ $10^3/\mu$L. Her basic metabolic profile revealed a potassium level of 5.4 mmol/L, blood urea nitrogen of 86 mg/dL, creatinine level of 4.05 mg/dL, and an estimated glomerular filtration rate of 11 mL/min/1.73 m^2. Her laboratory values were otherwise within normal limit. Ideally, CMR would have been best to evaluate the intracardiac lesion, but given the risk for nephrogenic systemic fibrosis from gadolinium exposure with her renal impairment, a decision was made to not proceed with the scan. On this basis, TTE was ordered, which showed a 5.9 $\times$ 4.3 cm mass in the right ventricle

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VIDEO HIGHLIGHTS

Video 1: Apical four-chamber view on TTE showing the large nonmobile cardiac metastatic parotid carcinoma in the right ventricle, filling the lateral free wall and majority of the right ventricular cavity.

Video 2: Subcostal view on TTE showing the large nonmobile cardiac metastatic parotid carcinoma in the right ventricle, filling the lateral free wall and majority of the right ventricular cavity.

Video 3: Apical four-chamber view on TTE with ultrasound enhancing agent showing large nonmobile cardiac metastatic parotid carcinoma in the right ventricle with enhancement.

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that occupied the lateral free wall and the majority of the right ventricular cavity (Figures 3-5, Videos 1-3). The mass was nonmobile and appeared adherent when viewed with ultrasound enhancing agent (Figure 5, Video 3). A second mass, 4.8 × 5.3 cm, was seen in the right atrium along the lateral border (Figures 3 and 4, Videos 1 and 2). Left ventricular systolic function was normal (ejection fraction > 55%), and right ventricular systolic function was reduced on visual assessment. Tricuspid annular plane systolic excursion, pulse Doppler peak velocity at the annulus (S′), fractional area of change, and right ventricular global longitudinal strain were not assessed, because of the lateral location of the mass, which was thought to impede the accuracy of these semiquantitative measurements. There was mild to moderate tricuspid regurgitation on the basis of visual assessment of color Doppler.

The reported TTE is the most recent study performed in the patient's surveillance workup completed to date. The primary care provider was notified of the cardiac findings, and results were discussed with the patient. At that time, the patient reported mild dyspnea on exertion (New York Heart Association functional class II), similar to baseline. She denied paroxysmal nocturnal dyspnea, chest pain, and palpitations. Given the echocardiographic findings, the patient was open to further discussion with her oncologist, palliative care team, and cardiothoracic surgery.

DISCUSSION

We present a rare Case of parotid carcinoma metastasizing to the right heart, which was characterized by TTE. The most common types of malignancies to metastasize to the heart are leukemias (53.9%), melanomas (34%), lung cancers (10.2%), sarcomas (9.2%), and breast cancers (8.3%).[3] Leukemias, melanomas, and sarcomas typically metastasize via hematogenous spread, whereas lung and breast cancers typically metastasize via direct invasion of local tumors.[3] On the other hand, parotid tumors primarily spread locally via direct or lymphatic invasion and only rarely metastasize to distant sites via hematogenous spread.[4] To date, there have been only five previously reported cases of parotid carcinoma metastasizing to the heart, as the

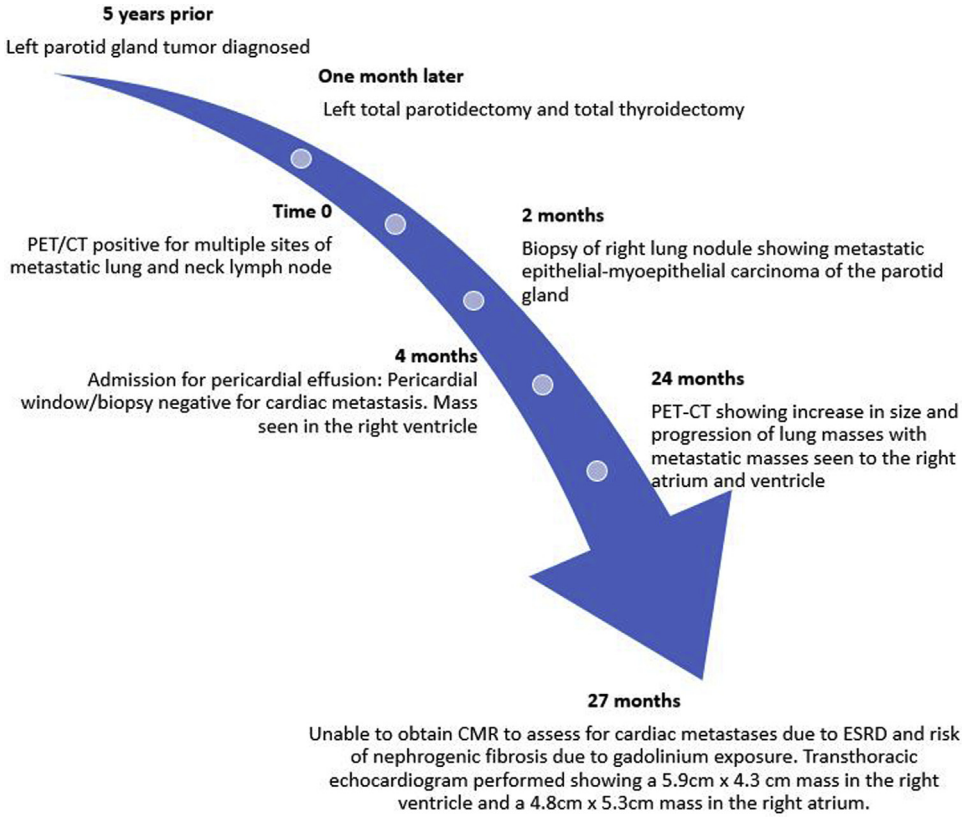

Figure 1 Timeline of events from the patient's initial diagnosis to the detection of her cardiac metastases. *ESRD*, End-stage renal disease.

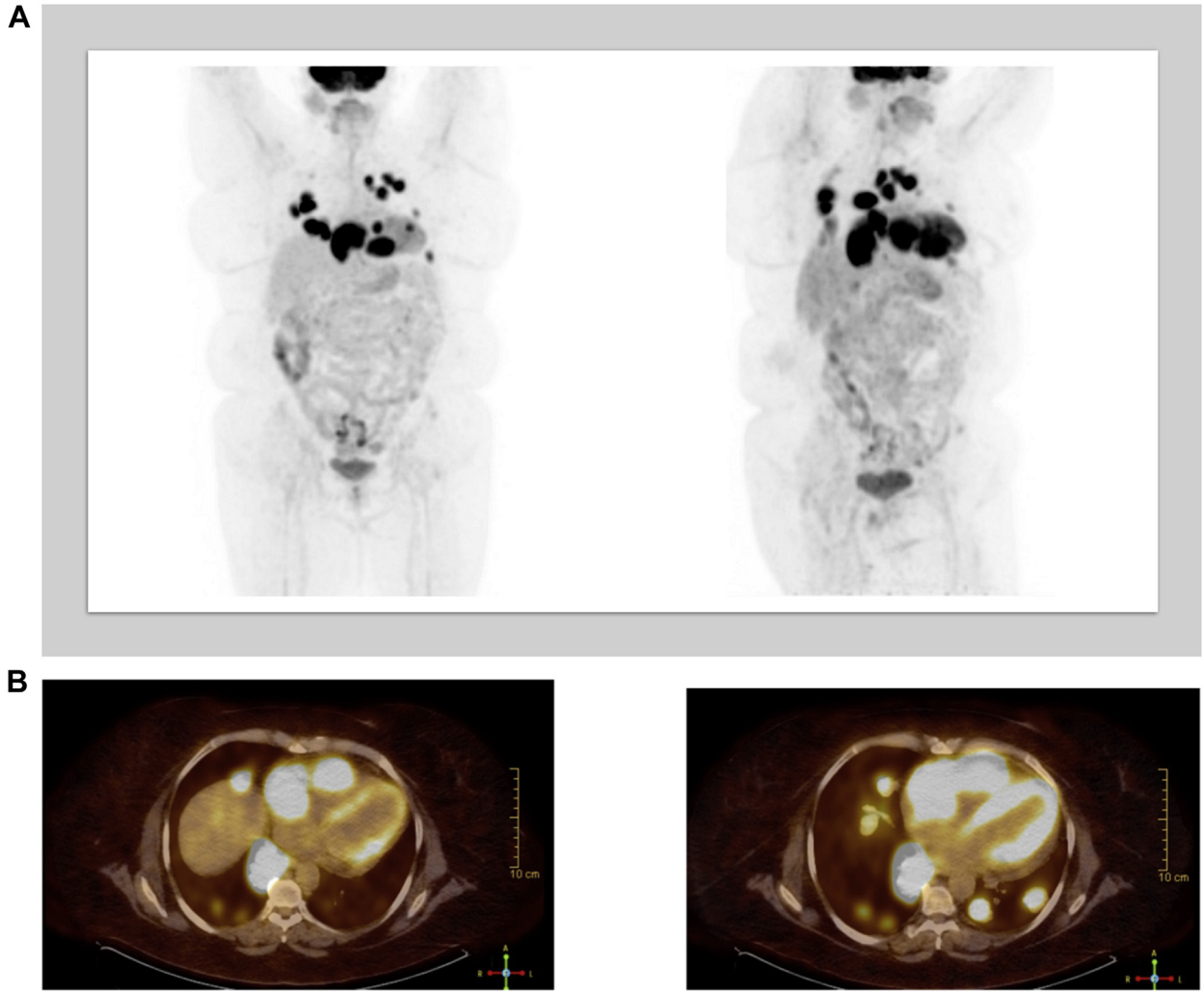

Figure 2 Progression of pulmonary metastatic disease and metastatic lesions in the right atrium and right ventricle over 6 months seen on surveillance PET/CT. Increased fluorodeoxyglucose uptake seen in the left ventricle represents physiologic uptake due to failed myocardial suppression.

most common sites of distant metastases are the lung, bone, and liver.[5-9] Of these cases, four were metastatic spread to the pericardium, whereas only one case reported intracardiac invasion, highlighting the rarity of our patient's presentation.[5-9] In the cases described above, presenting symptoms such as chest pain and dyspnea on exertion prompted further investigations, which enabled diagnosis of the metastatic cardiac tumor.[5,7-9] However, our patient remained asymptomatic, and progression of her tumor burden was diagnosed on surveillance imaging.

New cardiac symptoms in patients with known malignancies or incidental findings concerning for potential cardiac metastasis should prompt further workup for cardiac metastasis. TTE is the initial test of choice in the workup of cardiac tumors because of its low cost, wide availability, and lack of radiation exposure.[3,10] TTE can be performed with intravenous ultrasound enhancing agents that are safe for use in patients with CKD and further differentiate benign and malignant cardiac masses on the basis of enhancement. Malignant cardiac masses are vascular and demonstrate enhancement, whereas benign cardiac masses such as thrombi and myxomas have little to no enhancement. The American Society of Echocardiography recommends complete TTE in all patients suspected of having cardiac tumors.[11]

CT and CMR are additional contrast-enhanced imaging modalities that have higher spatial resolution than TTE, provide better tissue characterization, and can aid in surgical planning.[3,10] First, CMR provides the added benefit of being able to distinguish tumor from thrombus, as well as to evaluate the extent of myocardial and pericardial involvement.[11] Traditionally, patients with late-stage CKD had an increased risk for nephrogenic systemic fibrosis with gadolinium contrast agents. There are newer gadolinium agents that are being safely used in patients with late-stage CKD and end-stage renal disease, but these were not available at our institution.[12] Second, although CT is widely available, venous iodinated contrast is required for optimal tumor evaluation, which increases the risk for contrast induced or associated nephropathy in patients with severely reduced estimated glomerular filtration rates.[13] Given the renal impairment in our patient's Case, both cardiac CT and CMR were avoided because of the risks associated with contrast administration, highlighting the importance of TTE with ultrasound enhancing agents in such cases.

Cardiac imaging provides vital information and further stratifies cardiac tumors, but tissue histology is vital for definitively differentiating malignant versus benign tumors and for planning therapy.[14] Histologic diagnoses can be obtained via open tumor biopsy,

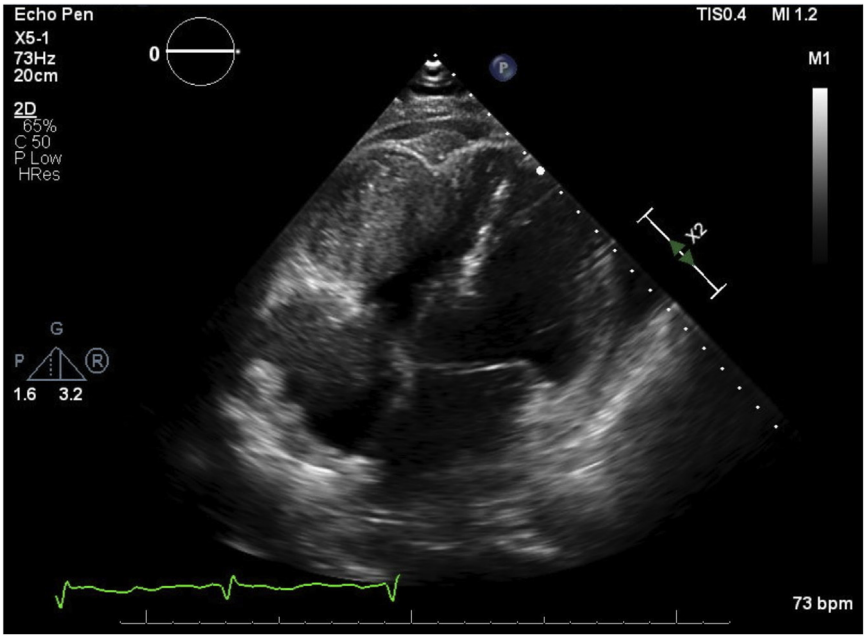

Figure 3 Apical four-chamber view on TTE showing the large cardiac metastatic parotid carcinoma in the right ventricle and atrium.

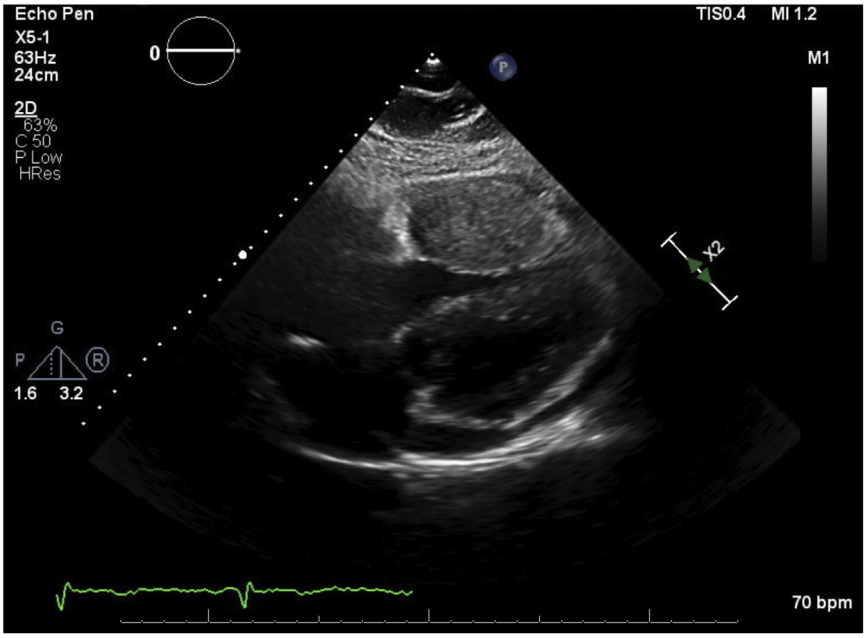

Figure 4 Subcostal view on TTE showing the large cardiac metastatic parotid carcinoma in the right ventricle, filling the lateral free wall and majority of the right ventricular cavity.

endomyocardial biopsy, or cytology of pericardial fluid.[14] The subsequent management of cardiac tumors varies depending on tumor classification (primary vs secondary), location, size, histology, extend of myocardial and pericardial involvement, and presence of distant metastasis.[3]

Parotid carcinoma metastasizing to the heart is extremely rare. Moreover, an intracardiac site of metastasis is even rarer, with only one previously reported Case, to the best of our knowledge. Our patient's care was complicated by advanced CKD. Because of relative contraindications and risks associated with contrast CT or CMR, these studies were avoided. Fortunately, TTE with an ultrasound enhancing agent is safe in patients with severely reduced estimated glomerular filtration rates, is readily available, and was crucial for the evaluation and management of the intracardiac metastases of the parotid carcinoma in our patient. Improved chemotherapy agents, radiation techniques, and operative care for the treatment of primary tumors has led to improved survival and longevity in patients with cancer. With improved longevity, there may be a trend toward the increased incidence of cardiac metastasis. To support this, one study reported a 7.1% incidence of cardiac metastasis in an autopsy case series of patients with cancer after 1970, compared with 3.8% before 1970.[15] Similar cases of cardiac metastasis in patients with advanced CKD

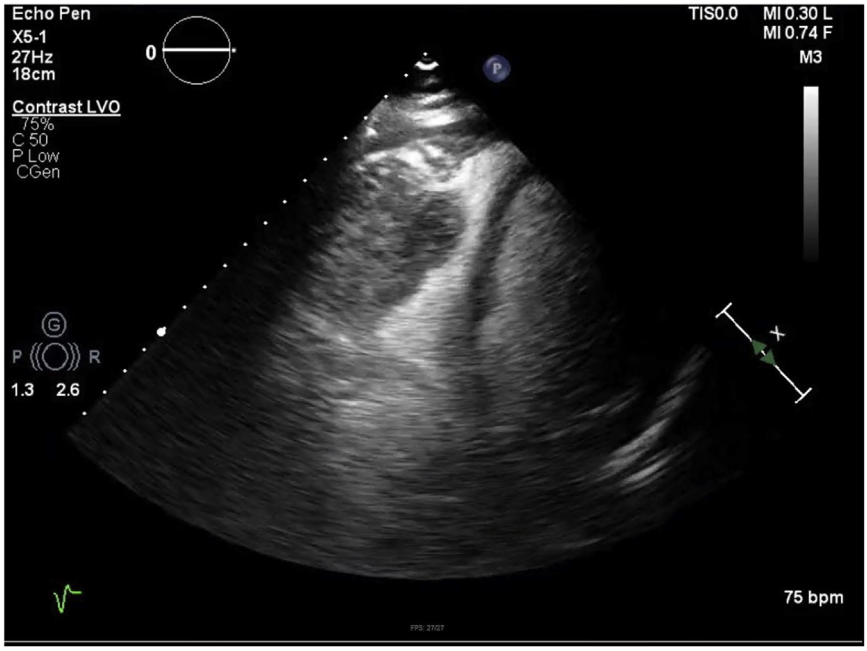

Figure 5 Apical four-chamber view on TTE with ultrasound enhancing agent showing large nonmobile cardiac metastatic parotid carcinoma in the right ventricle with enhancement.

are likely to become more common. Understanding the important role of echocardiography and cardiac PET is of growing importance given that patients are surviving longer after their initial diagnosis of primary tumors.

CONCLUSION

Parotid carcinomas metastasizing to the heart remain rare, but when suspected, TTE with an ultrasound enhancing agent may be useful in differentiating between benign and malignant causes and dictating further management. The utility of echocardiography is further highlighted in patients with relative contraindications to contrast use when undergoing CT or CMR.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found at https://doi.org/10.1016/j.case.2021.09.012.

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