CASE SERIES

When cancer reaches the heart: a case series on rare myocardial and endocardial metastases from squamous cell carcinoma

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ABSTRACT

Cardiac metastases are rare but devastating complications of malignancies. Squamous cell carcinoma (SCC), particularly from non-pulmonary origins, infrequently metastasizes to the heart, making its cardiac involvement an unusual and underreported phenomenon. We present a case series of four patients diagnosed with myocardial and endocardial metastases from SCC at our center over two years. Clinical presentation, imaging modalities, suspected metastatic pathways, management strategies, and outcomes were analyzed. Patients (ages 41–74, three males, one female) had primary SCC in the vulva, tongue, buccal mucosa, and lung. Symptoms varied, including dyspnea, hypotension, chest pain, and stroke. All patients had elevated troponin levels. Echocardiography was crucial for initial detection, while PET/CT confirmed metastases, with one patient undergoing cardiac MRI. Hematogenous spread was likely metastatic pathway in most cases. Treatment was primarily palliative; only one patient received chemotherapy post-diagnosis. Survival post-cardiac metastasis diagnosis ranged from a few days to six months. Myocardial and endocardial metastases from SCC are rare and often indicate advanced disease with poor prognosis. Early recognition through multimodal imaging and biomarkers such as troponin may facilitate timely palliative interventions. Increased collaboration between oncology and cardiology may improve supportive care and symptom management in these patients.

KEYWORDS: Cardiac metastasis; squamous cell carcinoma; vulvar SCC; oral SCC; lung SCC; troponin levels

INTRODUCTION

The heart is an unusual site of cancer. Primary cardiac malignancies are rare (0.002–0.3% prevalence), most cardiac tumors being metastatic [1-3]. The incidence of cardiac metastasis in literature varies significantly between 2.3% and 18.3%. Cancers known to metastasize the heart are cancers arising from the thoracic cavity (primary lung cancers, mesotheliomas), followed by melanoma, breast carcinoma, ovarian carcinoma, and less commonly lympho- or myeloproliferative malignancies, gastric, renal, and pancreatic carcinomas [4].

Cardiac metastasis is one of the most devastating complications related to all types of malignancies, it has an enormous impact on the patient's clinical status and prognosis. Cardiac metastases affect various heart structures, leading to diverse clinical presentations. Metastasis to the pericardium is reported as the most common site (69.4%), with pericardial effusion and its complications being the commonest presentation, followed by epicardial and myocardial metastasis. Endocardial metastases are rare, representing only 5% [4,5].

The mechanisms of cardiac metastasis include direct spread from nearby neoplasms such as breast and lung cancers, transvenous spread (through inferior vena cave as in renal cell carcinomas), lymphatic spread (mainly in lymphomas), hematogenous spread via the coronary arteries and pulmonary veins (melanomas, lung cancers respectively), and tumor thrombus spread [6-9].

Squamous cell carcinomas (SCC) other than those of lung origin are not commonly known to metastasize to the heart, and when they do, it is usually a late event and there is extensive dissemination of cancer rather than just an isolated

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cardiac metastasis. SCC of the head and neck (including oral cancers) rarely metastasize to the heart [10]. Only few cases of oral SCC have been reported [10-13].

Cardiac metastasis usually carries a poor prognosis, in most cases, once the diagnosis is made the treatment is palliative with intent [14,15].

This case series aims to report the cardiac metastasis cases diagnosed at our center over the last two years, focusing on the clinical presentation, the suspected mechanism of metastasis, management, and outcome.

CASES PRESENTATION

This case series presents 4 patients diagnosed with cardiac metastases (Table 1). Their ages ranged between 41 and 74 years (mean age 54.5 years), and included three males and one female, all had SCC at the time of the diagnosis of cardiac metastasis. Patient 1 had Stage IV metastatic vulvar squamous cell carcinoma, while the remaining patients had primary tumors of the tongue (Patient 2), oral mucosa (Patient 3), and lung (Patient 4). None of the patients had significant comorbidities at baseline, allowing the focus of their care to remain primarily on cancer treatment.

Clinical presentations and diagnosis

The clinical presentations varied among the patients but were uniformly severe, underscoring the life-threatening nature of cardiac metastases. Symptoms included shortness of breath (Patient 1), hypotension and tachycardia (Patient 2), unexplained chest pain (Patient 3), and severe confusion with hypercalcemia (Patient 4). Patient 1 (Figures 1, 2), patient 2 (Figure 3), patient 3 (Figures 4, 5), Patient 4 (Figures 6, 7).

All four patients with cardiac metastases had elevated troponin-T at diagnosis level (Normal value 0 – 14 ng/L), ranging from 26 ng/L to 98 ng/L. The lowest level was observed in patient 3 (26 ng/L), who later developed myocardial infarction with a peak troponin of 1,498 ng/L, the highest recorded value. Patient 1, Patient 2, and Patient 4 had troponin levels of 38 ng/L, 23 /L, and 67 ng/L, respectively.

Treatment, complications, and outcomes

Treatment following the cardiac diagnosis was largely palliative, aiming to improve symptoms rather than offer curative outcomes. For example, Patient 1 received palliative care after a prior regimen of carboplatin and paclitaxel, while Patient 2 continued chemotherapy despite his cardiac involvement. Patient 4 was managed with anticoagulation, but no further oncologic treatments were pursued.

Patient 3 initially presented with chest pain, which marked the onset of cardiac metastasis. However, during his cancer, he developed an acute wall motion abnormality anterior wall myocardial infarction and subsequent cardiogenic shock, which ultimately led to his death. Patient 4 had an unusual first presentation of ischemic stroke, which was caused by a thrombus detected on echocardiography on top of a very large endocardial mass. This presentation underscored the systemic effects of cardiac metastases in this patient. The patient passed away a few days after this diagnosis.

Table 1. Summary of the patients' characteristics, tumor characteristics, diagnosis, treatment, and outcomes in patients with cardiac metastases.

	Patient 1	Patient 2	Patient 3	Patient 4
Age	49 years	41 years	54 years	74 years
Gender	Female	Male	Male	Male
Comorbidities	None	None	None	None
Primary Tumor Type	Squamous cell carcinoma (HPV-associated)	Moderately differentiated keratinizing squamous cell carcinoma	Poorly differentiated squamous cell carcinoma (P16 and HPV negative)	Squamous cell carcinoma
Primary Tumor Location	Vulva	Tongue	Right buccal mucosa	Lung
Systemic Metastasis at the time of diagnosis of cardiac metastasis	Lung, liver, adrenal, and lymph nodes	Lung, liver, cervical, mediastinal, and adrenal lymph nodes; peritoneal, and omental involvement	Liver, lymph nodes, adrenal, right chest wall, abdominal lymph nodes	Liver, right posterior chest wall, adrenal gland, lymph nodes
Initial Treatment	Vulvectomy + bilateral inguinal lymph node dissection, followed by carboplatin and paclitaxel	DCF (docetaxel, cisplatin, 5-fluorouracil) x 3 cycles, pembrolizumab	Wide local excision, cetuximab, nivolumab, carboplatin + paclitaxel	Palliative treatment No treatment
Treatment After Cardiac Metastasis Diagnosis	Palliative	Palliative	Chemotherapy (nivolumab, paclitaxel, carboplatin)	Anticoagulation
Clinical Presentation	Shortness of breath (SOB)	Hypotension, tachycardia, Sepsis	First with atypical Chest pain, later presented with Anterior STEMI	Confusion Hypercalcemia
TTE	Figure 1	Figure 3	Figure 4	Figure 6
PET Scan Findings	Figure 2	Figure 3	Figure 5	Figure 7
CMR	N/A	N/A	N/A	Figure 6
Cardiac troponin-T (ng/L)	38	23	26 then 1498	67
Cardiac Metastasis-Related Complications	Unknown	Unknown	Acute wall motion abnormality (AWMI)	Stroke
Mortality	5 days post-diagnosis	4 days post-diagnosis	6 months after diagnosis	4 days post-diagnosis

AWMI: Acute wall motion abnormality, **CMR**: Cardiac magnetic resonance, **ng/L:** nanogram per liter, **DCF**: Docetaxel, cisplatin, 5-fluorouracil, **FDG**: Fluorodeoxyglucose, **HPV**: Human papillomavirus, **MRI**: Magnetic resonance imaging, **N/A**: Not available, **PET**: Positron emission tomography, **SOB**: Shortness of breath, **STEMI**: ST-elevation myocardial infarction, **TTE**: Transthoracic echocardiogram.

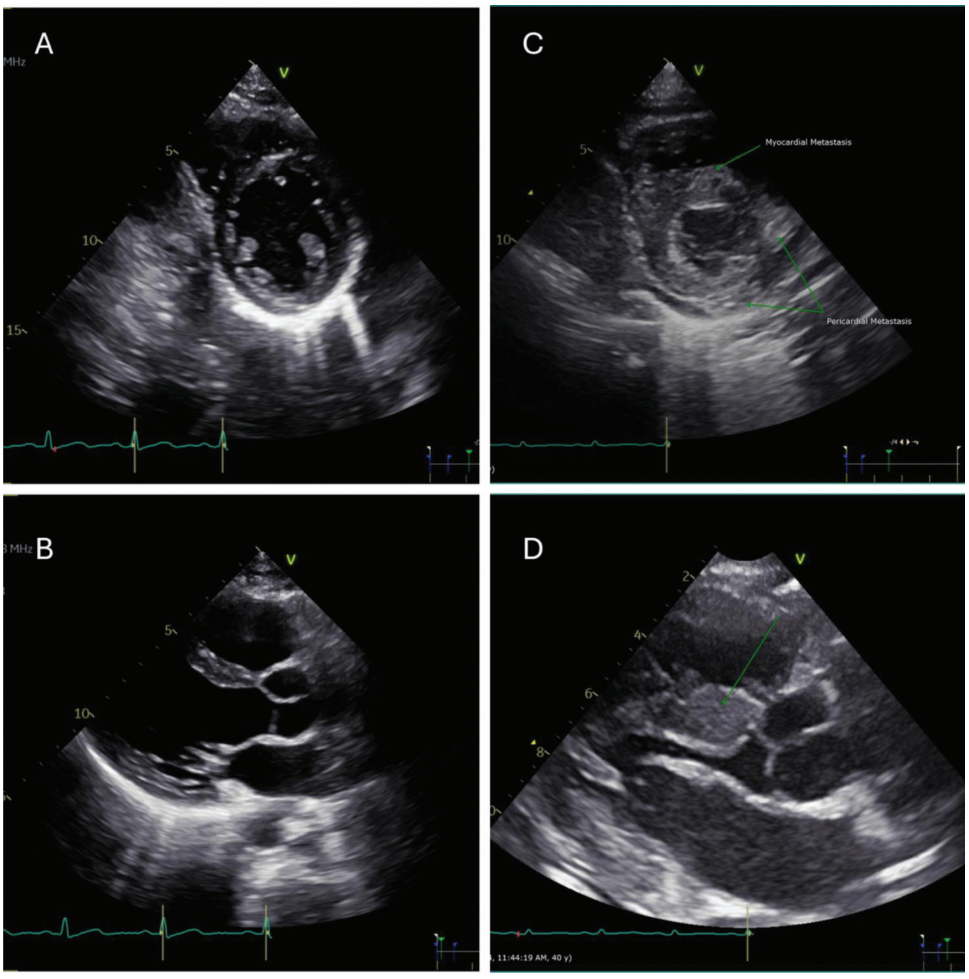

Fig. 1. Patient 1 Echocardiographic images in the parasternal long axis (A, C) and short axis at the papillary muscle level (B, D). Panels A and B depict baseline echocardiography before the onset of cardiac metastasis, demonstrating normal cardiac anatomy. Panels C and D illustrate post-cardiac metastasis findings, highlighting pericardial and myocardial metastases (green arrows).

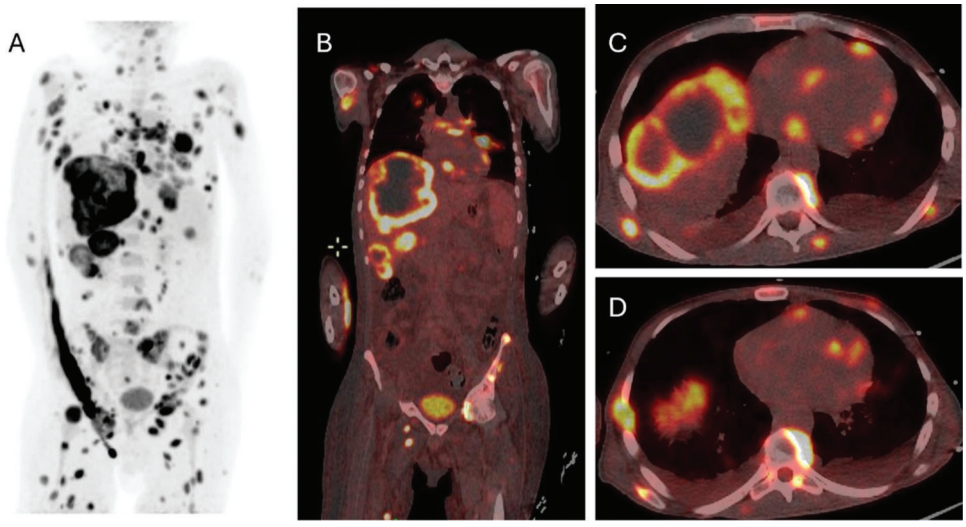

Fig. 2. Patient 1 Whole-body PET maximum intensity projection (MIP) image (A) and fused PET/CT coronal (B) and axial (C, D) images demonstrate extensive FDG-avid metastases involving the liver, lungs, musculoskeletal system, adrenal glands, and peritoneum, along with multiple myocardial metastases.

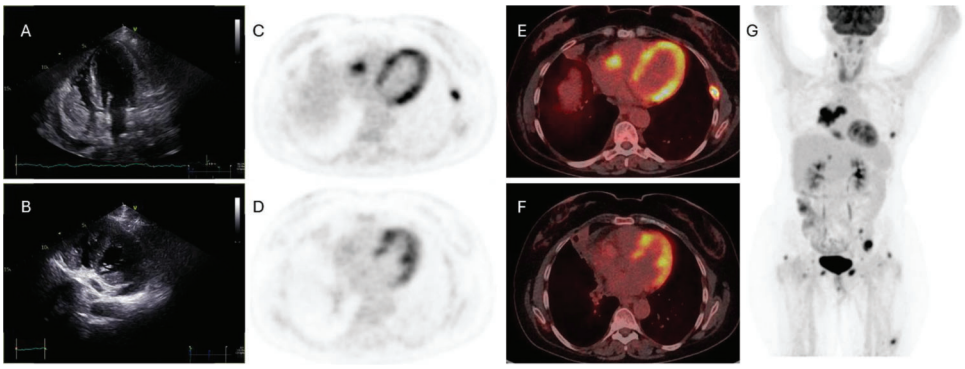

Fig. 3. Patient 2 Multimodal imaging of cardiac masses. **Panel A:** Echocardiography (four-chamber view) showing a mass (*M*) arising from the right ventricle (RV) and right atrium (RA) walls, corresponding to PET/CT findings in **Panels C and E**. **Panel B:** Atypical short-axis echocardiographic view demonstrating multiple masses in the papillary muscle, inferoseptal apical segment, and RV wall, all labeled with an asterisk (*M*). **Panels D and F:** PET scan findings highlighting these cardiac masses. **Panel G:** Whole-body PET maximum intensity projection (MIP) image revealing FDG-avid right lung malignancy with metastatic involvement of the skeletal system, lymph nodes, right adrenal gland, and heart.

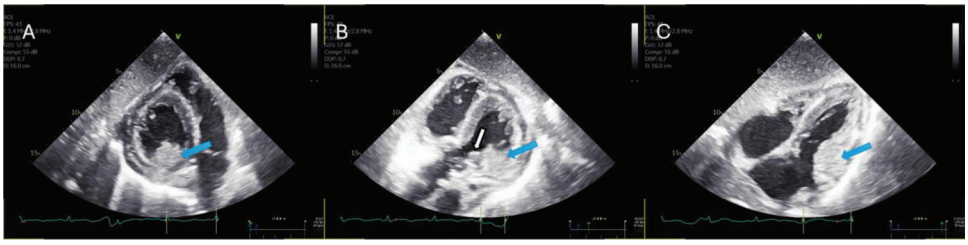

Fig. 4. Patient 3 Echocardiographic images depicting cardiac metastasis. **Panel A:** Short-axis view from the subcostal window showing a subendocardial mass in the anterolateral segments from the basal to mid-myocardium (blue arrow). **Panel B:** Atypical five-chamber view highlighting another mass, likely a thrombus (white arrow), extending into the left ventricular outflow tract (LVOT) and passing through the aortic valve. **Panel C:** Four-chamber subcostal view demonstrating myocardial metastasis (blue arrow).

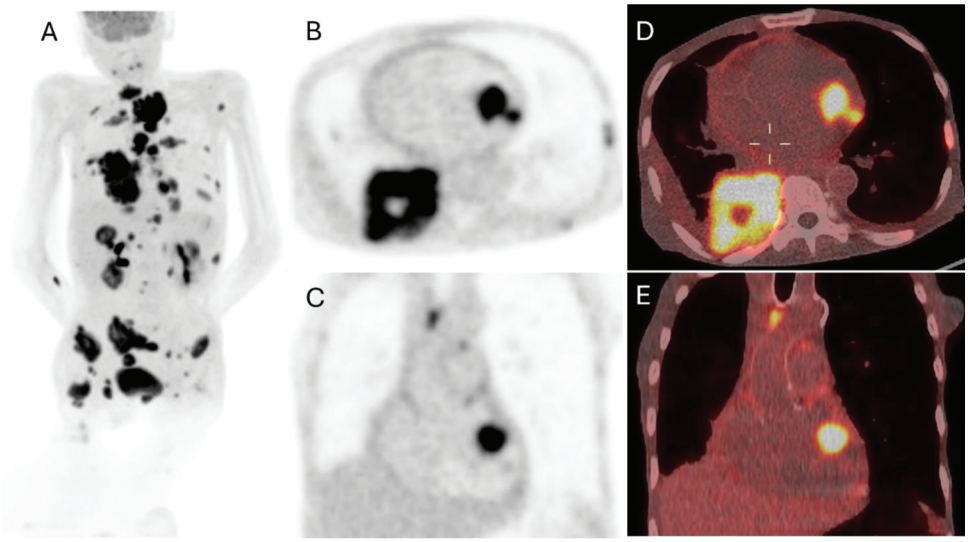

Fig. 5. Patient 3 Panel A: Whole-body PET maximum intensity projection (MIP) image demonstrating FDG-avid right lung malignancy with metastatic involvement of the liver, skeletal system, adrenal glands, lymph nodes, and heart. **Panels B and C:** PET axial and coronal images highlighting myocardial metastases. **Panels D and E:** Fused PET/CT axial and coronal images confirming myocardial metastases at sites corresponding to lesions identified on echocardiography.

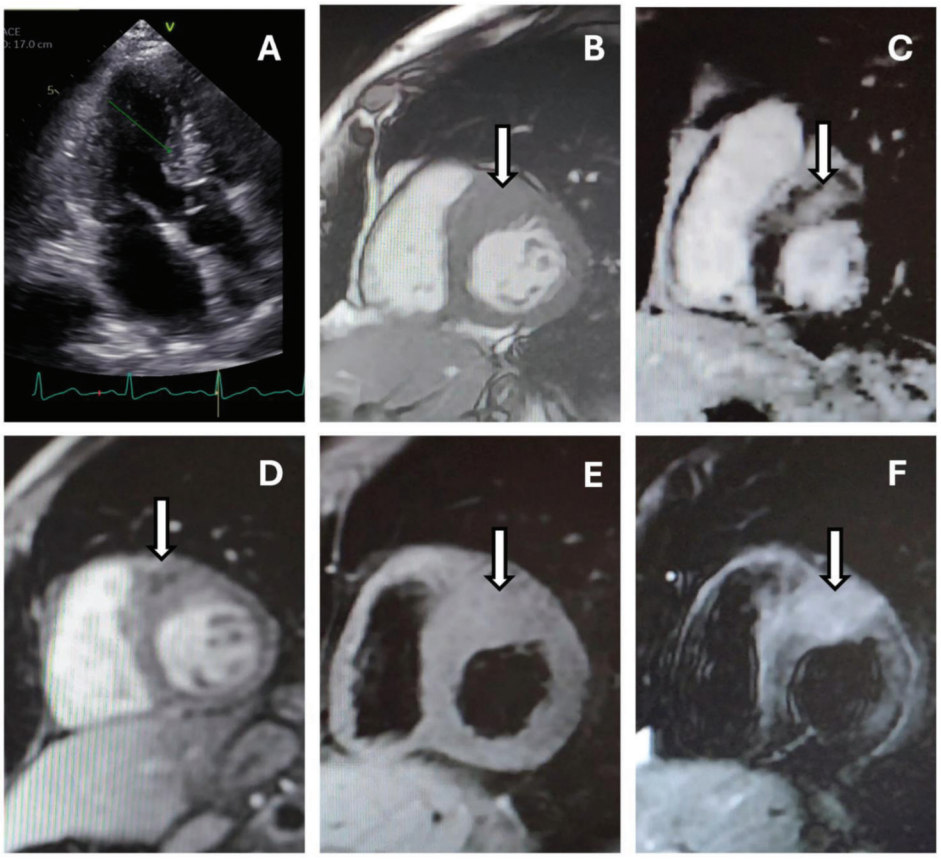

Fig. 6. Patient 4 Multimodal imaging of cardiac metastasis. **Panel A:** 2D transthoracic echocardiogram (TTE), apical three-chamber view, showing a suspected mass (green arrow) in the basal anteroseptal wall. **Panels B–F:** Cardiac magnetic resonance (CMR) sequences. **Panel B:** Cine short-axis view. **Panel C:** Late gadolinium enhancement. **Panel D:** Perfusion image. **Panel E:** T1-weighted sequence. **Panel F:** T2-weighted sequence. All CMR images (white arrow) reveal a well-defined lesion in the basal anterior and anteroseptal wall (28 × 25 × 33 mm), consistent with a metastatic deposit. The lesion exhibits an isointense signal on T1-weighted imaging, a hyperintense signal on T2-weighted imaging, a central non-enhancing component on perfusion imaging, and heterogeneous enhancement on delayed gadolinium enhancement sequences.

All patients experienced rapid clinical deterioration following the diagnosis of cardiac metastasis. Patients 1, 2, and 4 died within few days, while Patient 3 survived 6 months but eventually succumbed to complications from both the primary tumor and the cardiac metastases.

The diagnosis of cardiac metastases in all patients depended on multimodal imaging and cardiac biomarkers which were elevated in all patients. Echocardiographic findings were critical for the diagnosis in all the cases revealing abnormalities indicative of cardiac metastasis, while PET scans confirmed the metastatic involvement, only (patient 3) underwent cardiac MRI.

It was interesting that all four cases were found to be squamous cell carcinomas, although of different tissue origins. Myocardial cardiac metastasis was the most common in these cases, as shown in our observation.

DISCUSSION

Cardiac metastases from SCCs are exceedingly rare, particularly those involving the myocardium. In our case series, all four patients presented with myocardial and endocardial involvement, a finding less commonly reported in the literature, where pericardial metastases are the most frequent (up to 69.4%) [4,5]. In our center, the incidence of cardiac metastases (excluding malignant pericardial effusion) was approximately 1.3 %, underscoring the rarity of this condition.

SCC other than those of lung origin are not commonly known to metastasize to the heart, and when cardiac metastasis occurs, it is usually due to extensive dissemination of the disease rather than just an isolated cardiac spread. Head and neck malignancies, including oral cancers, rarely cause cardiac metastasis [10].

Tumors can reach the heart through four main pathways: arterial dissemination, lymphatic spread, transvenous extension, and direct invasion. Arterial dissemination typically results in metastases to the myocardium or endocardium and is frequently observed in cancers like melanoma, and sarcoma. In contrast, lymphatic spread often leads to pericardial or epicardial involvement, as seen with carcinomas such as those of the lung and breast, and lymphomas. Transvenous extension, as observed in clear cell renal cell carcinoma and hepatocellular carcinoma, can allow tumor growth into the right atrium via the inferior vena cava. Additionally, locally invasive mediastinal and pleural tumors, such as mesothelioma, may invade the pericardial sac directly. In our case series, hematogenous spread was the

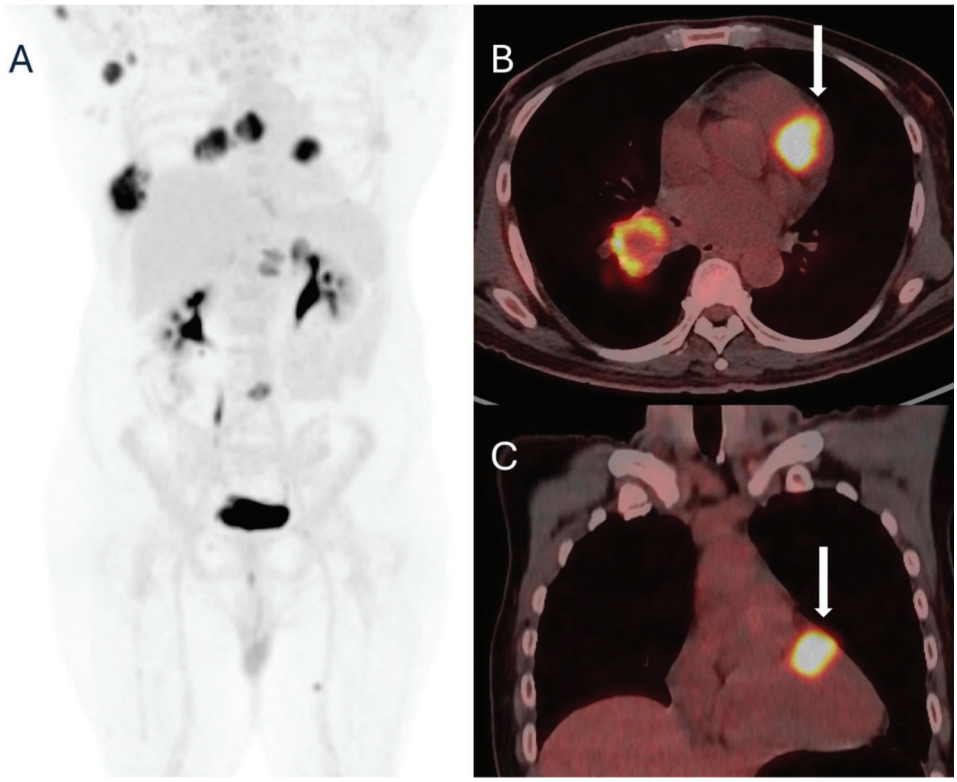

Fig. 7. Patient 4 Panel A: Whole-body PET maximum intensity projection (MIP) image demonstrating FDG-avid lymph nodal, skeletal, adrenal gland, and cardiac metastases. **Panels B and C:** Fused PET/CT axial and coronal images highlighting myocardial metastases (white arrow).

predominant mechanism in almost all cases, these findings underscore the importance of recognizing cardiac symptoms in SCC patients early, as they may be indicative of metastatic involvement [16].

The clinical manifestations of cardiac metastases are often nonspecific and vary based on their location and tumor burden. While many remain asymptomatic and are discovered postmortem, symptomatic cases mimic other cardiovascular conditions. Common symptoms include dyspnea, palpitations, arrhythmias, edema, and chest pain, pericardial effusion, with severe cases presenting as cardiac tamponade from pericardial involvement. Cardiac metastases should be suspected in cancer patients with new cardiac symptoms, especially with distant or thoracic metastases. Physical examination may reveal distant heart sounds, new murmurs, or a pericardial friction rub. ECG changes, such as nonspecific ST-T wave abnormalities, atrial arrhythmias, or low voltage, can suggest cardiac involvement, while findings like prolonged ST elevation in malignancy may have high specificity for metastases [17,18]. In our case series, patients exhibited a wide range of cardiac presentations, including chest pain, dyspnea, and palpitations, as well as more severe manifestations such as ST elevation and distal thrombosis embolization resulting in stroke. Notably, all patients had significantly elevated troponin levels, highlighting its potential as an important biomarker for early detection of myocardial involvement. This aligns with its established role in detecting conditions like myocarditis and chemotherapy-related cardiac dysfunction [19].

Multimodal imaging played a pivotal role in diagnosing cardiac metastases in our patients, with echocardiography being particularly valuable for initial detection. Cardiac imaging techniques, including cardiac magnetic resonance imaging (CMR), computed tomography (CT), and positron emission tomography (PET), offer valuable noninvasive methods for characterizing cardiac masses. CMR provides excellent tissue characterization and can detect intramyocardial masses not visible on echocardiography or CT. CT, with its superior spatial resolution, is useful for detecting tumor extension from adjacent structures and assessing coronary artery involvement. PET/CT, using 18F-fluorodeoxyglucose (FDG), helps differentiate malignant tumors by identifying increased glucose metabolism, though it may require dietary preparation to suppress normal myocardial uptake. PET/CT also enables whole-body imaging for detecting distant metastases. Each imaging plays a crucial role in diagnosing and assessing the extent of cardiac and extracardiac tumors [20-22].

Cardiac metastasis overall usually carries a poor prognosis, head and neck SCCs are not an exception, and in most cases, once the diagnosis is made the treatment becomes palliative, with radiotherapy, chemotherapy, or intervention being tried in only a few cases. Cardiac metastases are typically seen in patients with widespread metastatic disease. As a result, the primary objectives of treatment are symptom palliation and preventing or delaying the recurrence of symptoms. Surgical intervention is generally reserved for cases where the prognosis is favorable, single technically accessible mass, or when intracardiac obstruction is present. Despite this, surgery may be required to relieve obstruction caused by cardiac metastases, though outcomes can be poor. In some cases, radiotherapy and chemotherapy

can provide temporary relief and may help extend survival, though the benefit is often limited [16].

As observed in our case series, the outcomes for all patients were ultimately fatal, with survival ranging from a few days to six months. One patient, who was presented with a single mass in the septum, survived six months after the diagnosis, receiving palliative chemotherapy. Another patient died within days due to distal embolization, which resulted in a fatal stroke.

CONCLUSION

Our findings have important implications for clinical practice. Early recognition of cardiac metastases is critical for optimizing patient care, even if curative options are not available. Increased collaboration between oncology and cardiology teams, along with advancements in imaging and biomarkers, may improve the early detection of such complications, potentially enhancing quality of life through timely palliative interventions. Cardiac metastasis from SCC is rare and typically occurs in the context of extensive disease dissemination, with hematogenous spread being the most common route for SCC to reach the myocardium. Clinical symptoms of cardiac metastasis are often nonspecific, which makes early detection challenging; however, elevated troponin levels may serve as an important biomarker for myocardial involvement. Multimodality imaging, starting with echocardiography followed by cardiac magnetic resonance (CMR), PET/CT, or a combination of these techniques, is crucial for diagnosing cardiac metastasis and assessing the extent of the disease. The prognosis for cardiac metastases is generally poor, with treatment focusing primarily on symptom palliation rather than curative intent.

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Ethical statement

Ethical approval for this study was granted by the Institutional Ethical Committee of the Sultan Qaboos Comprehensive Cancer Care and Research Center in accordance with the principles outlined in the Declaration of Helsinki.

Patient Consent Statement:

Written informed consent for the publication of this case series, including all relevant clinical details and images, was obtained from the first-degree relatives of all deceased patients in accordance with institutional and ethical guidelines. All images included in this publication have been de-identified, and patient names and identities have been removed to ensure privacy and maintain respect for the patients.

Conflict of interest

The authors declare no conflict of interests.

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