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The characteristics of invasive cardiac lipoma: case report and literature review

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Invasive cardiac lipoma is a rare type of primary cardiac tumor that is composed of adipose tissue but infiltrating the adjacent structures. It is a benign tumor that can cause significant morbidity and mortality due to its size and location within the heart. We describe a giant invasive intracardiac lipoma across atrial wall extending to the ascending aorta and the superior vena cava. This review will provide an overview of invasive cardiac lipoma, including its clinical presentation, diagnosis, and management.

KEYWORDS

cardiac, cardiac tumor, cardiac lipoma, invasive cardiac lipoma, cardiac tumor diagnosis

Introduction

Invasive cardiac lipoma is a rare, benign tumor that originates from adipose tissue and can develop within the heart. Although benign, these tumors can pose significant clinical challenges due to their infiltration to adjacent structure causing obstruction, arrhythmias, and hemodynamic instability (1, 2). The incidence of cardiac lipoma is 2.4% of all primary cardiac tumors from the report of Japanese Circulation Society, and the invasive cardiac lipoma is rarer (3). However, due to its potential for adverse outcomes, timely diagnosis and management are critical for optimal patient outcomes.

Despite its rarity, invasive cardiac lipoma remains an important clinical entity that requires prompt recognition and management (1). We report a case of typical invasive cardiac lipoma and provide an overview of the epidemiology, clinical presentation, diagnostic modalities, and management of invasive cardiac lipoma, with a focus on recent advances in surgical techniques and outcomes. By enhancing our understanding of this condition, we can improve patient outcomes and optimize management strategies for patients with invasive cardiac lipoma.

Case report

A 52-year-old female patient was admitted to the hospital due to recurring episodes of palpitations that were relieved by rest. Prior to this admission, the patient had visited a local hospital where echocardiography had suggested right atrial occupancy. Physical examination conducted after admission was non-specific. However, the electrocardiogram indicated frequent premature atrial pulses. Further evaluation by echocardiography revealed a 7.0 cm × 9.0 cm hypoechoic mass with limited motion in the right atrium, attached to the upper part of the interatrial septum with a wide base and partially protruding into the left atrium (Figure 1A). Mild tricuspid regurgitation was also noted. Computed tomography confirmed the presence of a massive intrapericardial mass occupying the interstitial space between the ascending aorta and the superior vena cava, which was

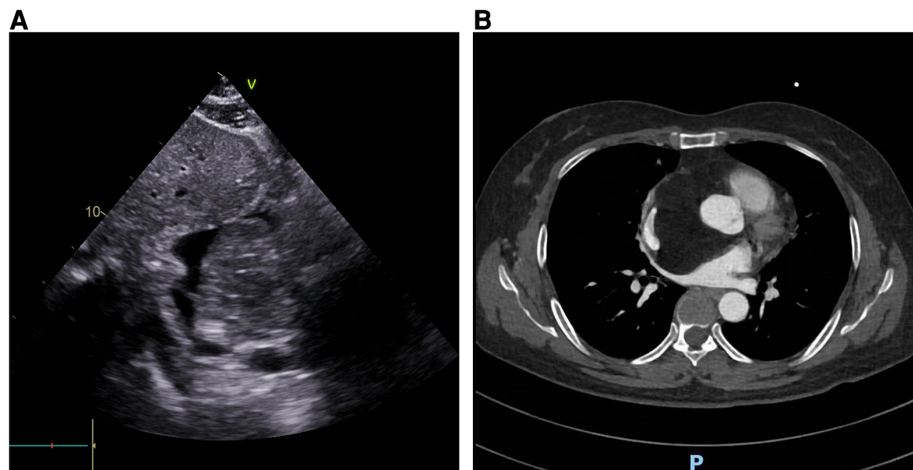


FIGURE 1

The imaging feature of the cardiac mass. (A) Echocardiography revealed a large mass attached to the interatrial septum; (B) CT revealed a low-density mass within the atrium, which compressed the superior vena cava and ascending aorta.

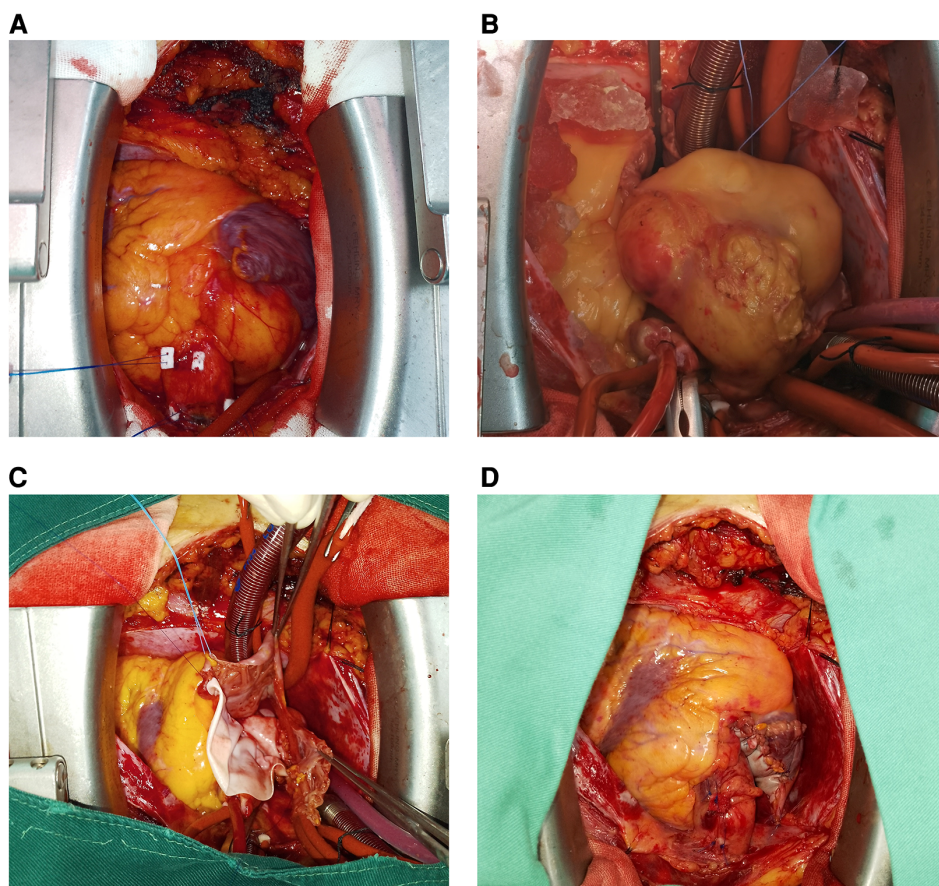


FIGURE 2

The surgical view of the mass. (A) A large yellow mass covering the superior vena cava and the root of the ascending aorta; (B) the mass was dissected by suspending it via surgical sutures; (C) the mass was found to originate from the interatrial septum after exposing the right atrium; (D) the right atrium was sutured.

poorly delineated from the right atrium (**Figure 1B**). The density of the mass was similar to that of subcutaneous fat, and a lipoma was suspected, although liposarcoma could not be ruled out. Due to the patient's symptomatic presentation and the potential for long-term

complications, surgical removal of the mass was decided upon with the consent of the patient and family. During surgery, a large fatty tumor was discovered on the surface of the heart, almost entirely covering the right atrium and aortic root (**Figure 2A**). The mass

was suspended for exposure of right atrium (**Figure 2B**). The right atrium was excised, exposing an intracardiac tumor that was attached to the atrial septum with a wide base, and infiltrated upward, penetrating the right atrial wall to form a large epicardial mass around the superior vena cava-right atrial junction and the aortic root (**Figure 2C**). As extensive resection was required, the defective atrium was patched using bovine pericardium (**Figure 2D**). The excised fatty mass was yellowish and soft, measuring approximately 7.9 cm × 8 cm (**Figures 3A,B**). Histopathological analysis of the specimen showed that the mass consisted predominantly of adipocytes (lipid droplets) with a moderate amount of fibrous tissue (**Figure 3C**). Immunohistochemical analysis revealed that the tumor was CK(-), MDM2(-), CDK-4(-), S-100(+), CD34(+), HNB45(-), Mela-A(-), 1% ki67(1%+), focal Desmin(+), and focal SMA(-), indicating a differentiated mature lipoma with mild fibrosis (**Figure 4**). Following surgery, the patient's palpitations subsided, and she made a rapid recovery, being discharged on the fifth postoperative day. At the six-month follow-up, there was no evidence of recurrence of the lipoma.

Discussion

Cardiac lipomas are rare benign tumors that occur within the heart. They are composed of mature adipose tissue but are invasive like malignant tumor. This invasive lipoma originated from interatrial septum and across atrial wall form a giant lipoma covering superior vena cava and root of aorta (**Figure 5**). Cardiac lipomas are rare tumors that account for 0.5% of primary cardiac tumors from 1976 to 1993 AFIP data (3). Invasive cardiac lipomas are even rarer, with only a few cases reported in the literatures (**Table 1**).

The incidence of invasive cardiac lipomas is difficult to determine, as most cases are diagnosed incidentally during autopsy or surgery. The median age at diagnosis is around 50 years, and there is a slight female predominance (1, 17).

Invasive cardiac lipomas are characterized by their ability to invade the myocardium and infiltrate surrounding structures (6, 10, 15, 22). The mechanism of invasion is not well understood, but it is thought to be related to the ability of the tumor to secrete proteolytic enzymes that break down the

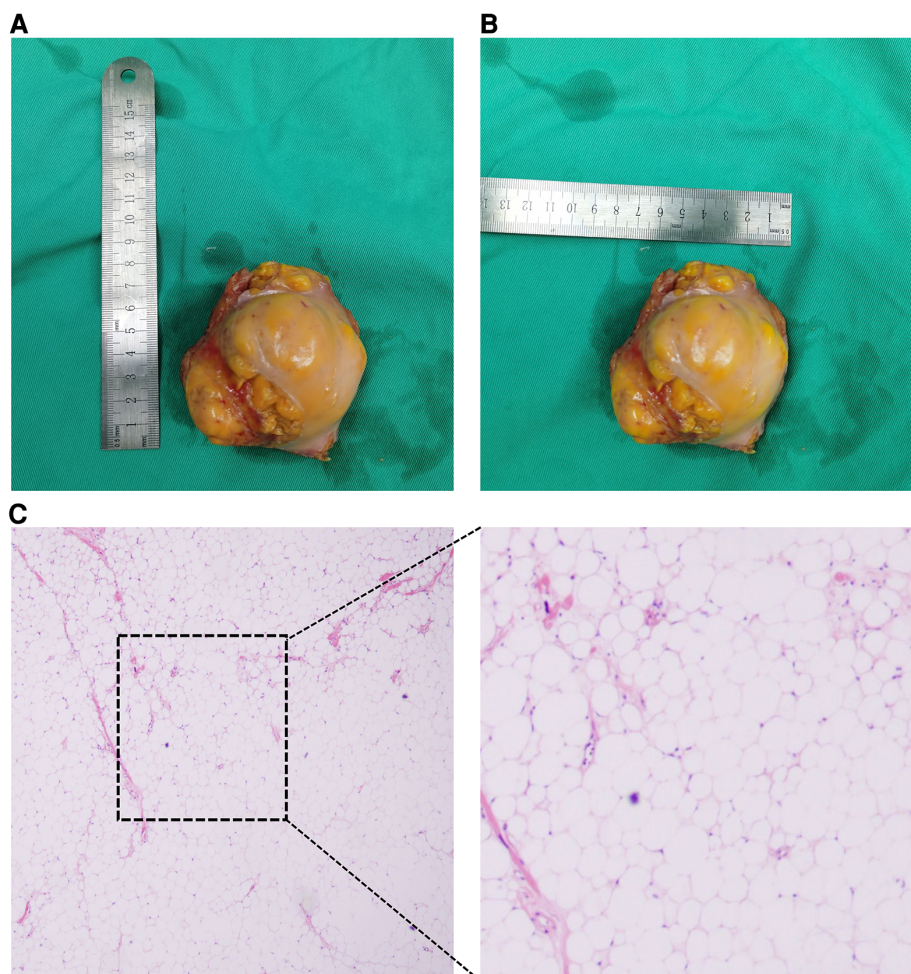


FIGURE 3
The macroscopical view and HE staining of resected mass. (A) Horizontal diameter of resected mass; (B) vertical diameter of resected mass; (C) HE staining result of resected mass.

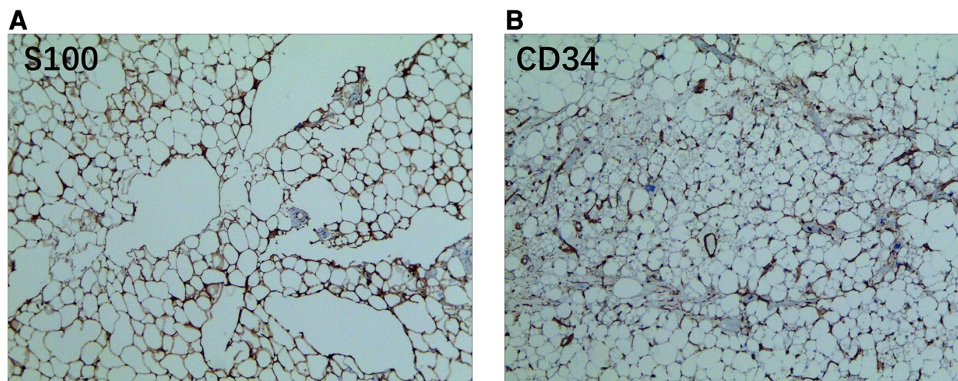


FIGURE 4
The immunohistochemical staining result of resected mass. (A) The mass exhibited a positive reaction to S100 staining; (B) the mass is positive to CD34 staining.

extracellular matrix. Invasive cardiac lipomas may also be associated with a high degree of vascularity, which can facilitate tumor growth and invasion. Based on MalaCards database, invasive lipoma, or infiltrating lipoma, is related to mesenchymal cell neoplasm and well-differentiated liposarcoma. An important gene associated with invasive lipoma is MDM2 (MDM2 Proto-Oncogene) (Figure 6). However, the majority of intracardiac lipoma is negative for MDM2 amplification (12, 39). Among its related pathways are Cellular Senescence and Regulation of retinoblastoma protein (Figure 7).

The clinical presentation of invasive cardiac lipomas is variable and often nonspecific. Patients may present with symptoms such as chest pain, dyspnea, or palpitations, which can be attributed to the tumor's effect on cardiac function (7, 21, 31). Invasive cardiac lipomas can also cause arrhythmias, valvular dysfunction, or obstruction of blood flow, depending on their location within the heart (16). In some cases, the tumor may be asymptomatic and discovered incidentally during imaging studies (32).

The diagnosis of invasive cardiac lipomas is challenging, and a high degree of suspicion is required. The initial workup usually

invasive cardiac lipoma

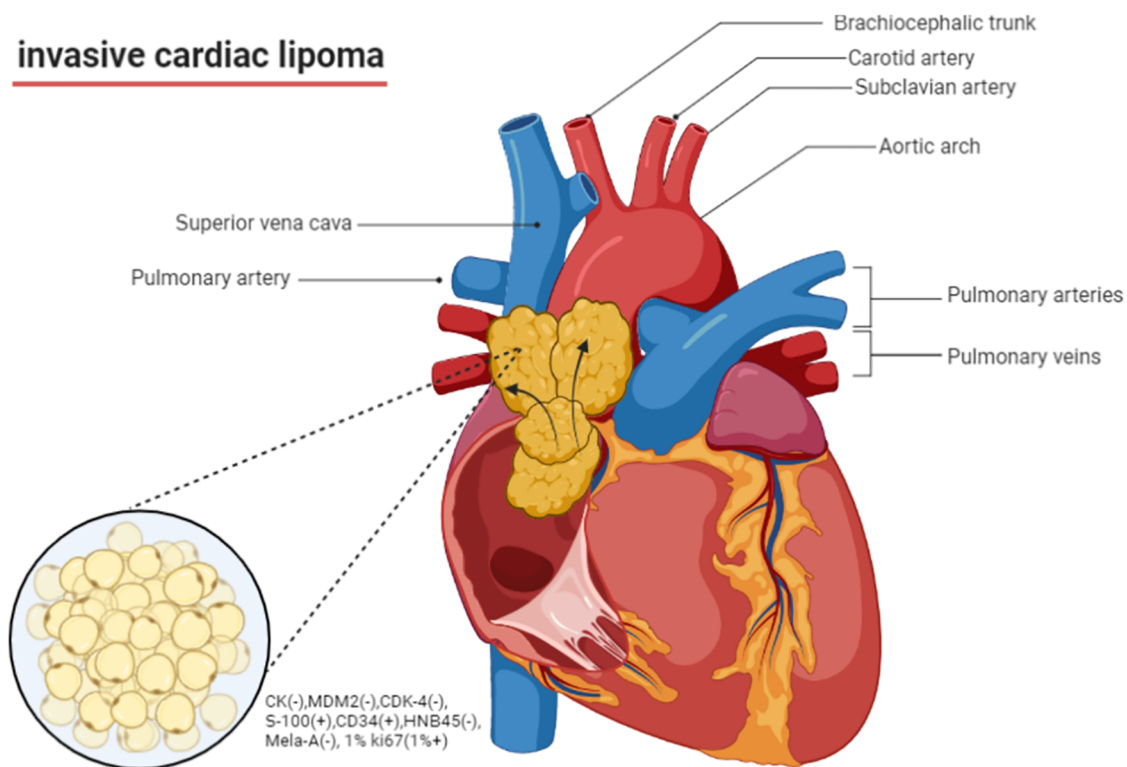


FIGURE 5
The schematic graph of invasive lipoma.

TABLE 1 The literatures of invasive cardiac Lipomas

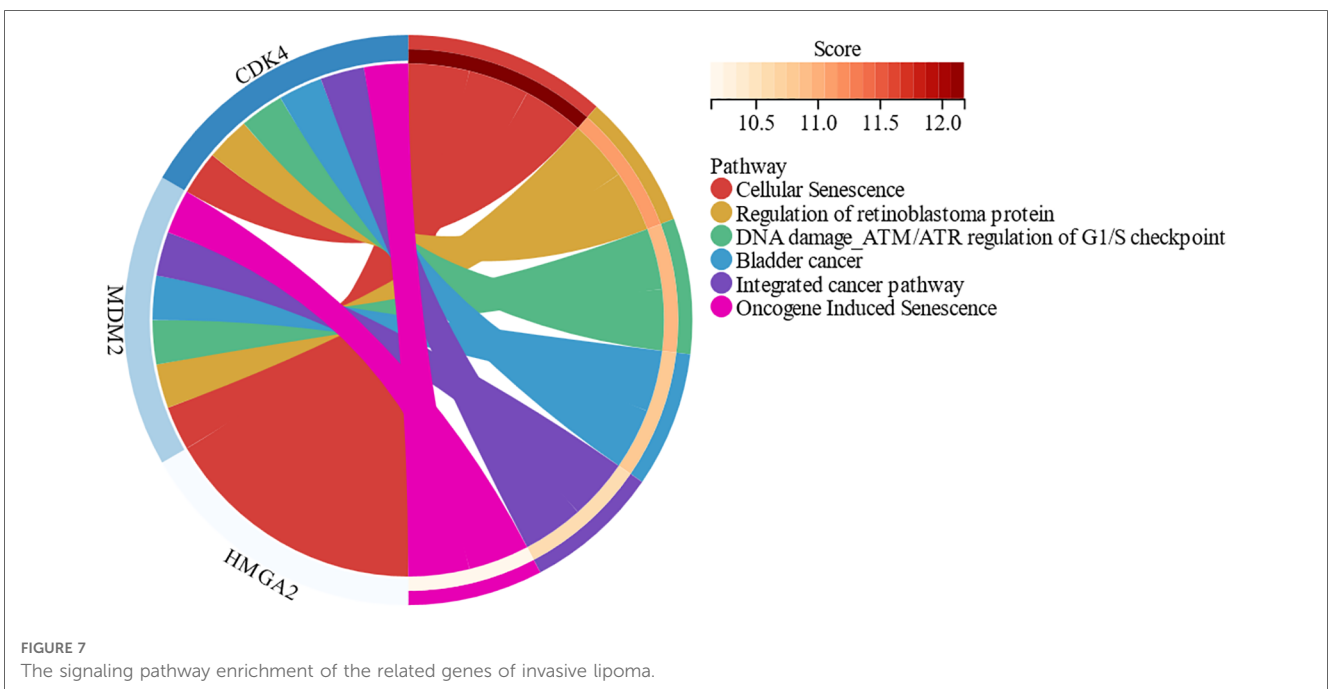
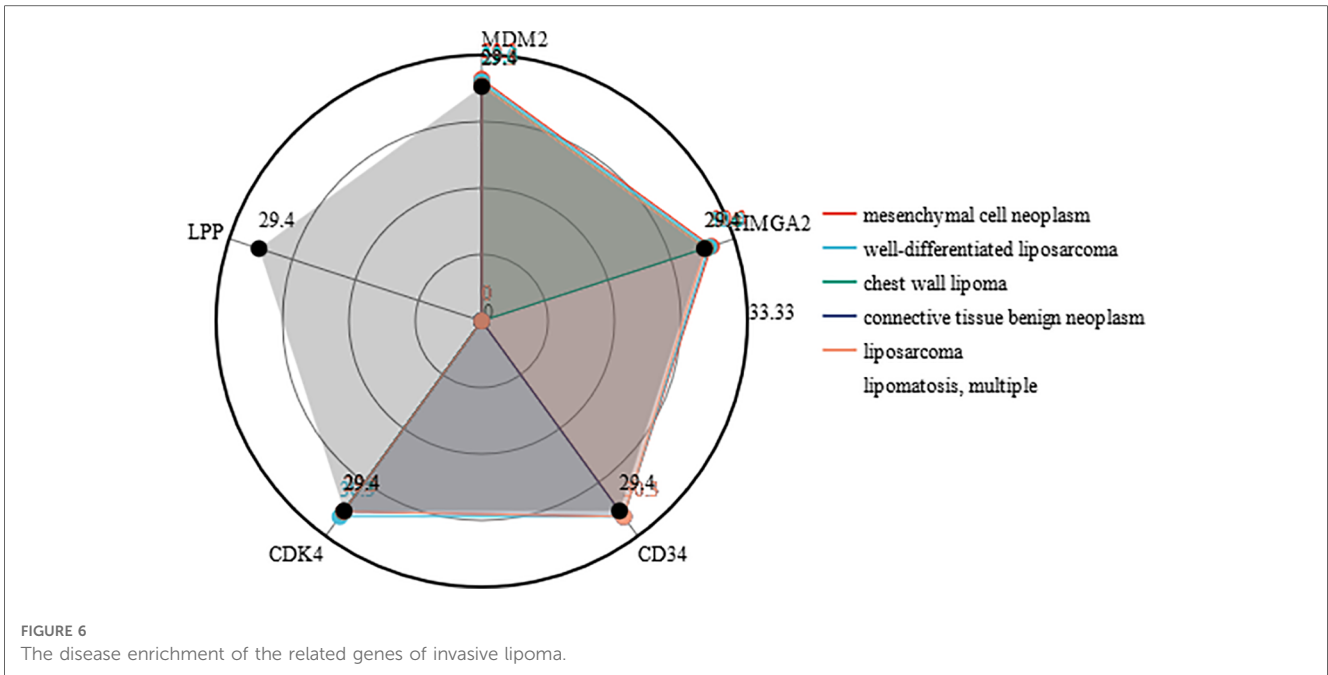
Authors	Year	Age	Sex	Location	Shape	Size	Boundary	Mobility	Echogenicity
Present case	2022	52	F	RA	N/A	UCG: 7.0 cm × 9.0 cm	Well-demarcated	Mobile	N/A
Nepal (4)	2022	50	F	IVS	N/A	N/A	N/A	N/A	Hyperechoic
Fan (5)	2021	44	M	RA	N/A	Surgery: 4.0 cm × 5.0 cm, Surgery: 3.0 cm × 4.0 cm	N/A	Non-mobile	N/A
Bai (1)	2021	25	F	RA	Lobular	UCG: 4.2 cm × 4.6 cm × 4.3 cm	N/A	Mobile	Medial echo
Kadosaka (6)	2020	63	F	LV	N/A	CT: 3 cm	N/A	Mobile	N/A
Vriz (7)	2020	14	M	LV	N/A	/	N/A	N/A	N/A
Shah (8)	2019	61	F	RA	N/A	/	N/A	N/A	N/A
Naseerullah (9)	2018	67	F	RA	Oval	UCG: 4.0 × 5.7 cm	Smooth contours	Non-mobile	Solid
Kong (10)	2018	49	M	RA	N/A	UCG: 16.2 × 10.5 cm	N/A	N/A	Heterogeneous, hypoechoic
Kim (11)	2018	42	M	LV	Round	UCG: 3 × 3 cm	Well-circumscribed	N/A	Homogenous
D'Souza (12)	2017	33	M	RA, IAS	Irregular	UCG: 4.5 × 4.0 cm	N/A	Non-mobile	Heterogeneous
Saito (13)	2016	66	F	LV	Lobular	UCG: 5.4 × 3.5 cm	N/A	Mobile	Hyperechoic
Yuan (14)	2016	60	F	IAS	Round	UCG: 1.6 × 1.2 cm	N/A	N/A	Hyperechoic
Sakamoto (15)	2016	52	F	LV	Oval	UCG: 3.5 × 1.9 cm	N/A	Mobile	N/A
Zhang (16)	2016	49	F	RV	Oval	UCG: 6.1 × 3.1 cm	Ill-defined	N/A	Homogenous
Fang (17)	2016	48	F	RV, IVS	Irregular	UCG: 4.4 cm × 3.0 cm × 2.4 cm, UCG: 4.6 cm × 1.5 cm	N/A	Good mobility	Hyperechoic
Tanaka (18)	2015	77	F	LV	Oval	UCG: 2.5 cm × 2.8 cm	Well-demarcated	Movable	Hyperechoic
Barbuto (19)	2015	66	M	RA	Oval	UcG: 5.3 cm × 2.7 cm	N/A	N/A	Hypoechoic
Kilic (20)	2015	53	F	IAS	Oval	Surgery: 3.5 cm × 3 cm × 3 cm	N/A	Non-mobile	N/A
Zhu (21)	2015	48	F	Four cavities	Denticular	CT: 15 cm	N/A	N/A	Dense-echo
Wang (22)	2015	41	M	RV	Round	UCG: 4.0 cm × 2.5 cm	Regular, well-defined	N/A	Homogenous, hypoechoic
Girrbach (23)	2012	52	F	LA, LV	N/A	Surgery: 6.3 cm × 5.0 cm × 2.5 cm	N/A	N/A	Heterogeneous
Xie (17)	2012	48	F	RV	Oval	Surgery: 10 cm × 10 cm	N/A	N/A	Hyperechoic
Domoto (24)	2010	70	M	LV	Oval	UCG: 2.6 cm × 4.5 cm	N/A	Mobile	Hyperechoic
Joaquim (25)	2009	27	M	RA	Oval	UCG: 3.5 cm	N/A	N/A	Hyperechoic
Reddy (26)	2009	19	M	RV	Oval	UCG: 8.6 cm × 5 cm	N/A	N/A	Hyperechoic
Kitami (27)	2005	57	F	RV	N/A	Surgery: 5 cm	N/A	N/A	Echo-lucent
Agacdiken (28)	2005	18	F	RV, IVS	N/A	CT: 8 cm × 6 cm × 16 cm	N/A	N/A	Hyperechoic
Yoshitatsu (29)	2004	81	F	LV	Lobular	UCG: 1.5 cm × 1.5 cm	N/A	Fluttering	N/A
Courtis (30)	2004	79	F	RA, RV, IAS	N/A	/	N/A	N/A	Hyporrefrangent
Schrepfer (31)	2003	31	F	RV	N/A	UCG: 4.5 cm–5 cm	No clear demarcation to the right ventricular myocardium	N/A	N/A
Chen (32)	2001	43	F	LV	N/A	Surgery: 10 cm × 8 cm × 3 cm	N/A	N/A	Hyperechoic
Bonamini (33)	2000	56	F	RV	N/A	/	N/A	N/A	Echo-free
Cooper (34)	1994	14	M	LA	Oval	MRI: 8.2 cm × 5 cm × 4.2 cm	Clear	N/A	N/A
King (35)	1993	17	M	RA	N/A	Surgery: 25 cm × 15 cm × 8 cm	N/A	N/A	Echo-free
Anderson (36)	1988	54	M	LV	N/A	UCG: 2 cm	N/A	Mobile	Hyperechoic
Zingas (37)	1983	20	F	IVS	Irregular	Surgery: 10 cm × 10 cm	N/A	Non-mobile	N/A
Harada (38)	1980	7	M	RV	Oval	/	N/A	N/A	Dense

involves a comprehensive history and physical examination, including a detailed cardiac evaluation. Imaging studies such as echocardiography, cardiac magnetic resonance imaging (MRI), and computed tomography (CT) can provide valuable information about the size, location, and extent of the tumor (6, 24). In some cases, a biopsy may be necessary to confirm the diagnosis (1, 12, 17).

The management of invasive cardiac lipomas depends on several factors, including the size and location of the tumor, the patient's clinical presentation, and the degree of invasion. In general, small tumors that are asymptomatic and do not invade the myocardium may be monitored with periodic imaging studies. However, larger tumors or those that are causing significant symptoms or hemodynamic compromise may require surgical intervention.

Surgical resection is the treatment of choice for invasive cardiac lipomas (11, 31). The surgical approach may vary depending on the location of the tumor and the degree of invasion. In some cases, a partial or complete excision of the tumor may be possible, while in others, the tumor may need to be debulked to relieve symptoms or prevent further invasion (25). In rare cases, a heart transplant may be necessary if the tumor is unresectable or has caused significant damage to the heart (40).

The prognosis for patients with invasive cardiac lipomas is generally good if the tumor is diagnosed and treated early. However, the prognosis may be poor if the tumor is large, invasive, or has caused significant damage to the heart (40). In some cases, the tumor may recur after surgical resection, and long-term surveillance is necessary (7, 40).



Generally speaking, invasive cardiac lipoma is an infrequent form of primary cardiac tumor, which can give rise to substantial morbidity and mortality. The accurate identification of invasive cardiac lipoma necessitates a heightened level of suspicion, along with comprehensive imaging investigations. Surgical intervention represents the preferred therapeutic approach for managing invasive cardiac lipoma; however, the intricacies associated with tumor localization and the potential for damage to adjacent structures can pose considerable surgical challenges. Consequently,

a meticulous assessment of the potential risks and benefits associated with surgery becomes imperative in the management of patients diagnosed with invasive cardiac lipoma.

Author contributions

Conceived and designed the study: XZ, ZC, SW Analyzed the data: XZ, XC Contributed reagents/materials/analysis tools: XZ,

GL, XL Wrote the paper: XZ. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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