Echocardiography of Cardiac Masses: From Two- to Three-Dimensional Imaging

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Introduction

Tumors involving the heart can cause symptoms and signs due to obstruction of cardiac chambers and great vessels, pulmonary or systemic embolization, complete heart block and arrhythmias, or cardiac tamponade, although they are often also incidental findings. In the past, they were often discovered at autopsy. Nowadays, technologic advances in cardiovascular imaging have led to a substantial increase in antemortem diagnoses. Echocardiography is the imaging technique of choice to detect intracardiac masses in the clinical practice [1, 2]. This tool has the unique advantage of being able to provide a non-invasive dynamic assessment of cardiac masses, to evaluate their hemodynamic impact and the presence of associated abnormalities (Table 8.1). However, current echocardiographic techniques do not allow tissue characterization. In this chapter, we will focus on the echocardiographic characteristics of primary and secondary cardiac tumors.

Both transthoracic and transesophageal echocardiography have shown a good sensitivity to detect intracardiac tumors (93.3 and 96.8%, respectively, in one series of pathologically confirmed tumors) [3], but a lower detection rate for pericardial or paracardiac lesions. Although cardiac tumors can often be seen by two-dimensional transthoracic echocardiography, their location, size, and relationships with surrounding structures are better defined by transesophageal echocardiography.

Visualizing the suspected cardiac mass throughout the cardiac cycle in more than one view, with the appropriate transducer and scanner settings, are important rules for the proper characterization of the mass, avoiding the misinterpretation of artifacts. A thorough knowledge of normal anatomy, physiologic variants, and embryonic remnants, as well as familiarity with structural changes associated with various operative and interventional procedures are crucial and will decrease the likelihood of misdiagnosis. Finally, it is pivotal that clinical and personal information are available at the time of the study, to be used for interpreting echocardiographic findings in context.

Conventional (i.e., two-dimensional) echocardiography is a tomographic technique, and effective interpretation of images requires one to mentally integrate them into a three-dimensional (3D), stereoscopic reconstruction of the heart. For example, an intracardiac tumor may have quite variable site of attachment, shape, and size, requiring the echocardiographer to examine the tumor from a series of two-dimensional images and then to "mentally" reconstruct the tumor to define its size, shape, and attachment. To do this accurately, a clinician should understand the relationship of each two-dimensional tomographic image to one

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C. Basso et al. (eds.), *Cardiac Tumor Pathology*, Current Clinical Pathology,
DOI 10.1007/978-1-62703-143-1_8,

Table 8.1 Echocardiographic assessment of cardiac masses

Characterization of the mass	
Location	Intra- or extracardiac
Relationship with adjacent structures	
Site, mobility, and mode of implantation	
Route of access to the heart	Superior/inferior vena cava Pulmonary veins Uncertain
Shape and size (3D volume)	Largest diameters or maximal area
Hemodynamic/functional consequences	Obstruction and/or regurgitation by interfering with valve function Extracardiac compression Segmental wall motion abnormalities or restrictive disease due to direct infiltration of the myocardium Pericardial infiltration and/or effusion with variable degree of hemodynamic impairment
Vascularization	Contrast
Differential diagnosis	
Benign	
1. Embryonic remnants	Chiari network, Eustachian valve, etc.
2. Thrombi	Free-floating or attached (mural, device or catheter-related)
3. Benign cardiac tumors	
4. Vegetations	
Malignant	
1. Primary	
2. Metastatic	

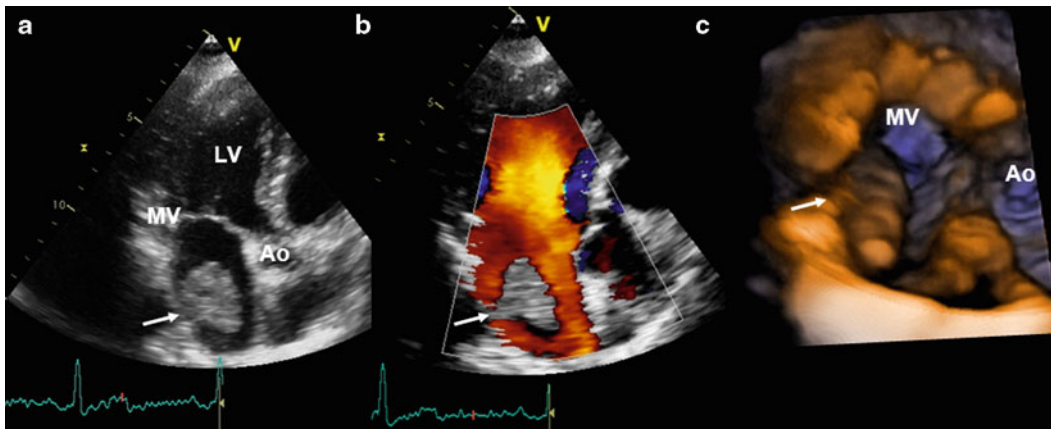

Fig. 8.1 Atypical left atrial myxoma. (**a**) At two-dimensional echocardiography, a large mass is seen attached by a short stalk (*white arrow*) to the left atrial free wall. Echodensity is not homogeneous; echolucencies within the mass represent hemorrhagic areas. A myxoma has been diagnosed at surgical inspection and then proven at histology. (**b**) Color flow two-dimensional echocardiography confirms the attachment of the mass to the left atrial free wall and shows no interference with mitral valve (MV) function. (**c**) Three-dimensional echocardiography showing the shape of the mass, its volume, and irregular surface. Mitral valve is seen in the background. *Ao* aortic valve, *LV* left ventricle, *MV* mitral valve

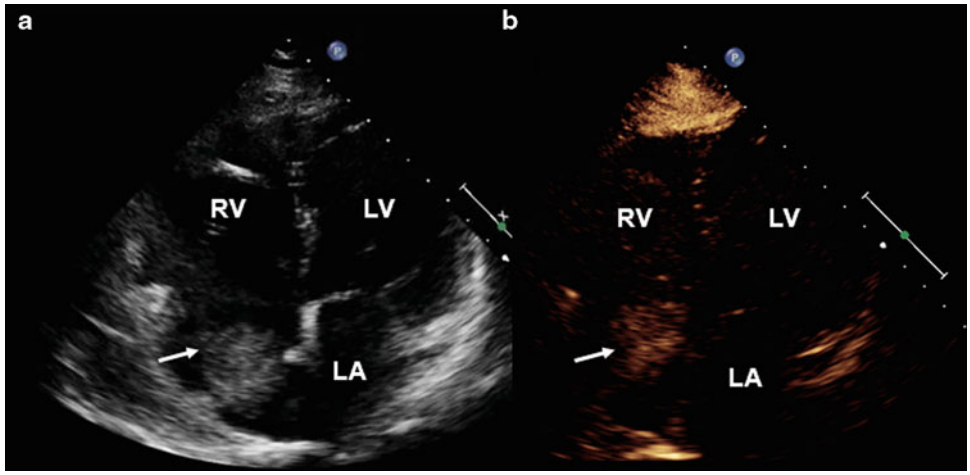

Fig. 8.2 Right atrial myxoma. (**a**) A large, not homogeneous and mobile mass (*arrow*) attached to the interatrial septum is visualized in the right atrium. (**b**). Partial enhancement of the mass tissue after intravenous injection of contrast agent suggesting a poorly vascularized mass (courtesy of Agata Barchitta, M.D., Ospedale CTO S Antonio, ULSS 16, Padova, Italy). *LA* left atrium, *LV* left ventricle, *RV* right ventricle

another. 3D echocardiography eliminates the need for cognitive reconstruction of image planes and use of geometric assumptions about the shape of structures for quantitation. This particularly applies to complex shapes such as intracardiac tumors (Fig. 8.1) [4–6]. Once a 3D data set is acquired, it can be cropped and sliced in many different ways. In addition, the possibility of rotating the data sets in the space allows the observer to obtain planes and views and to align structures in ways that were impossible to achieve with conventional two-dimensional echocardiography. Thus, additional information about mass location, shape, attaching interface, and relationships with adjacent structures can be derived from 3D data sets [7].

Contrast echocardiography is another echo modality which may be used to detect cardiac masses (i.e., in patients with inadequate acoustic window) and/or to differentiate among various types of cardiac masses [8, 9]. Three different echo contrast patterns can be seen in intracardiac masses, i.e., no enhancement at all by the contrast agent, suggesting the presence of thrombi since they are generally avascular; partial enhancement with decreased pixel intensity in comparison with the surrounding myocardium, suggesting a poorly vascularized mass such as myxoma (Fig. 8.2); and complete enhancement with higher intensity than adjacent myocardium, suggesting a highly vascularized tumor which is a characteristic of rapidly growing malignant tumors.

Myxoma

Myxomas can cause obstruction and/or regurgitation by interfering with valve function and frequently embolize, so that their immediate removal after diagnosis is mandatory.

Myxomas are usually solitary and are located most frequently (approximately 75% of the cases) in the left atrium (Fig. 8.1), with the remainder largely arising within the right atrium (Fig. 8.3a). Myxomas arising from the ventricles, mitral valve, as well as multiple myxomas (Fig. 8.3b) within the same cardiac chamber have also been exceptionally described. Therefore, a careful transesophageal echocardiographic study should be conducted preoperatively to be sure that all tumors have been detected and will be removed.

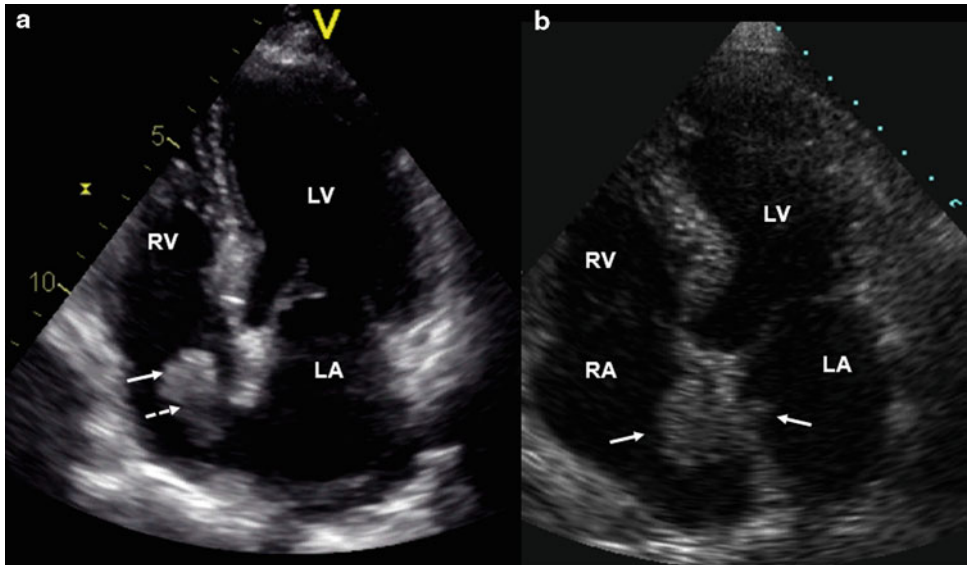

Fig. 8.3 (**a**) A large right atrial myxoma attached to interatrial septum. Areas of calcification (*arrow*) and echolucencies (*dashed arrow*) can be appreciated within this polypoid mass. (**b**) A large right atrial mass (*arrow*) attached to the interatrial septum, associated with a second smaller mass attached to the left side of interatrial septum (*arrow*), that were found to be myxomas at pathological examination. *LA* left atrium, *LV* left ventricle, *RA* right atrium, *RV* right ventricle

The typical atrial myxoma manifests as a single intracardiac homogeneous or finely speckled compact, rounded, or ovoid mass mass, isodense to the surrounding myocardium, attached to the interatrial septum near the fossa ovalis by a stalk-like pedicle. However, echocardiographic appearance can be also that of a polypoid, papillary, friable mass attached to the endocardium of any cardiac structure. Size can vary from less than 1 cm to an extent that virtually fills the whole atrium. The echogenity of myxomas may not be homogeneous, since they frequently contain cystic spaces, and areas of necrosis, hemorrhage, and calcification. Inhomogeneous appearance is useful to differentiate them from large thrombi. Mobility of myxoma depends on its size and the type of attachment; however, prolapsing of the tumor into the ventricles through the atrio-ventricular valves is a common characteristic of atrial myxomas. The attachment may be broad and hence they may also appear as immobile or hypomobile masses. The degree of functional obstruction to ventricular filling caused by the tumor can be qualitatively assessed by color Doppler flow imaging and measured by continuous-wave Doppler sampling of the ventricular inflow which will show, in case of significant obstruction, the typical tracing morphology of functional mitral (or tricuspid, in case of right atrial myxoma) stenosis.

Although transthoracic two-dimensional echocardiography has been found to be highly accurate in providing all relevant information for surgery [8], transesophageal echocardiography has a higher sensitivity in detecting myxomas in comparison with transthoracic echocardiography, especially in the setting of small myxomas, and should be performed in any case with the suspicion of intracardiac tumor or unknown source of embolism. Transesophageal echocardiography, particularly 3D modality, is also useful in very large myxomas nearly filling the atrial chamber, in close contact with large areas of atrial endocardium throughout the cardiac cycle, in which the stalk cannot be clearly visualized.

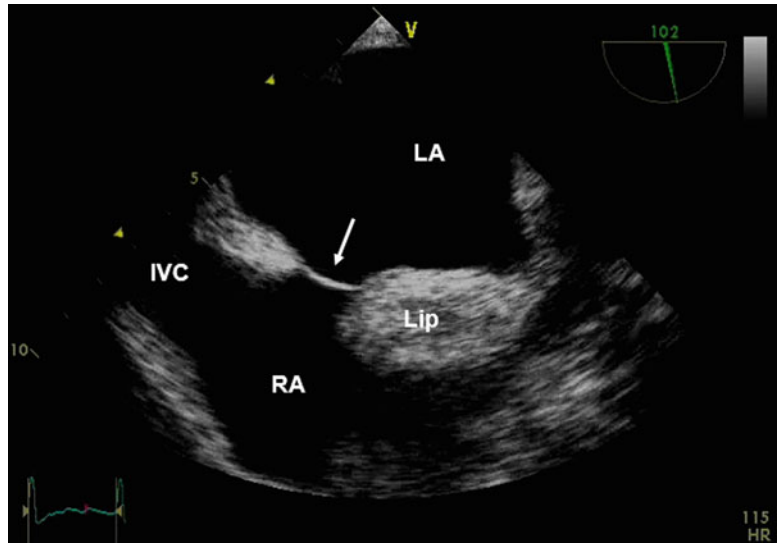

Fig. 8.4 Lipomatous hypertrophy of the interatrial septum. Transesophageal echocardiography shows the typical thickening of the interatrial septum (Lip) that spares the region of the fossa ovalis (*arrow*) giving the classic dumbbell appearance to the interatrial septum (courtesy of Pasquale Gianfagna, M.D., Cardiothoracic Department, Azienda Ospedaliero-Universitaria, Udine, Italy). *IVC* inferior vena cava, *LA* left atrium, *RA* right atrium

Postoperative echocardiography should be performed to document the complete excision of the tumor. Since recurrent myxomas have been reported, long-term follow-up is indicated, particularly in the familial form of the disease.

Cardiac Lipoma and Lipomatous Hypertrophy of Interatrial Septum

Lipomas are encapsulated, hyperdense, homogeneous tumors which can be found throughout the heart, typically in subepicardial or subendocardial location. Rarely, they can arise within the myocardium or from the valve leaflets. Occasionally, they may grow as broad-based, pedunculated masses into any of the cardiac chambers and may reach giant sizes and weigh up to 4.8 kg [10]. Usually, there is no calcification, necrosis, or intratumoral hemorrhage, as opposed to myxomas. Intrapericardial lipomas may cause compression of the heart and pericardial effusion.

Lipomatous hypertrophy of interatrial septum has often been included in reports of cardiac lipomas. Lipomatous hypertrophy of interatrial septum is defined as any deposit of fat in the atrial septum which exceeds 2 cm in transverse dimension (Fig. 8.4) [11]. It is associated with advanced age and obesity and caused by an increase in the number of adipocytes. Lipomatous hypertrophy of interatrial septum typically spares the fossa ovalis (giving rise to the characteristic "*dumbbell*" shape to the interatrial septum) and does not represent a true cardiac tumor [11]. In rare cases, an obstruction of inferior vena cava may occur.

Papillary Fibroelastoma

Papillary fibroelastomas are the most common tumors of the cardiac valves. Echocardiographically, they manifest as small (2–10 mm), usually single, mobile, pedunculated echo masses which can be filamentous, frond-like, or oval in shape, typically attached to the valve leaflets on either side of the heart. Due to their small size, papillary fibrobroelastomas could not be detected by transthoracic echocardiography.

Ninety percent of papillary fibroelastomas occur on valve surfaces, being more commonly found on the aortic valve (29%, where they can arise from both surface, Fig. 8.5) and on the mitral valve (25%, mainly arising from the atrial

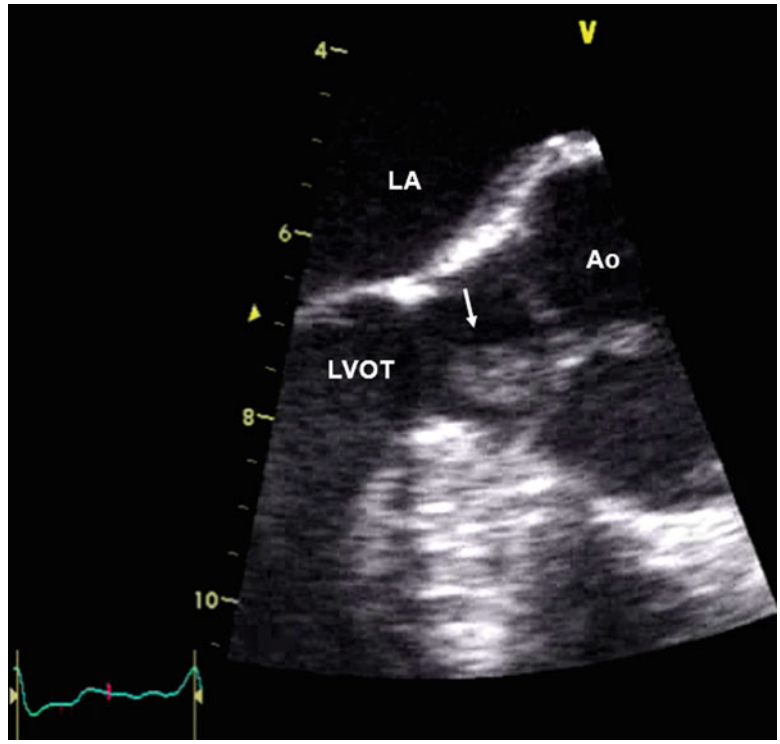

Fig. 8.5 Papillary fibroelastoma of the aortic valve. Transesophageal echocardiogram revealed a small, oval-shaped, highly mobile mass (*arrow*) attached to the body of the right coronary cusp of the aortic valve by a short stalk (courtesy of Pasquale Gianfagna, M.D., Cardiothoracic Department, Azienda Ospedaliero-Universitaria, Udine, Italy). *Ao* aorta, *LA* left atrium, *LVOT* left ventricular outflow tract

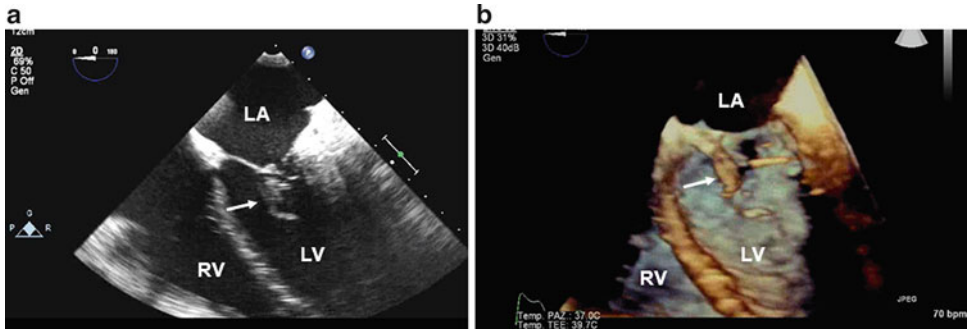

Fig. 8.6 Papillary fibroelastoma of the mitral valve. (**a**) Transesophageal echocardiogram showed a large, highly mobile mass on the ventricular side of the anterior mitral valve leaflet (*arrow*). (**b**) Three-dimensional echocardiography allowed the localization of this mass at the mid portion of the leaflet and a better appreciation of its morphology and size (courtesy of Pasquale Gianfagna, M.D., Cardiothoracic Department, Azienda Ospedaliero-Universitaria, Udine, Italy). *LA* left atrium, *LV* left ventricle, *RV* right ventricle

side, Fig. 8.6), than on the pulmonary (13%) or tricuspid valves (17%) [12]. Sixteen percent of papillary fibroelastomas have been reported to arise from nonvalvular surfaces (Fig. 8.7) and from the subvalvular apparatus of the mitral valve [13].

Papillary fibroelastomas often appear like infectious vegetations or Lambl's excrescences, which makes differential diagnosis difficult. Large mobile vegetations attached to the valves may mimic papillary fibroelastomas, but the clinical context suggestive of infective endocarditis helps

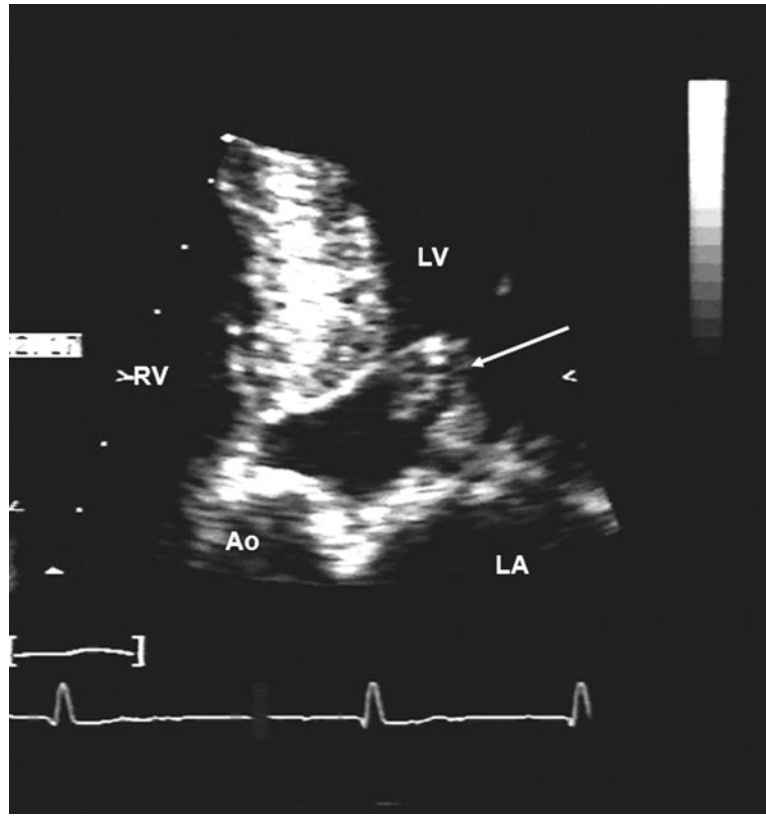

Fig. 8.7 Uncommon localization of papillary fibroelastoma on the endocardium of the interventricular septum. Transthoracic two-dimensional echocardiography, zoomed apical five-chamber view: a frond-like, highly mobile mass is attached to the left ventricular endocardium in the outflow tract (*arrow*). The mass was resected and found to be a fibroelastoma (courtesy of Pasquale Gianfagna, M.D., Cardiothoracic Department, Azienda Ospedaliero-Universitaria,Udine, Italy). *Ao* aortic valve, *LV* left ventricle, *LA* left atrium, *RV* right ventricle

in differentiating between them. Lambl's excrescences, which can be found as normal features in many adults, are filamentous, mobile, and avascular structures that generally arise at the closure line of the valves [14]. Papillary fibroelastomas are not as thin as Lambl's excrescences and, unlike the latter, they do not arise from the leaflet closure line, but from other regions on the valve surface. Fibroelastomas may also be confused with blood cysts, which are unusual, blood-containing, cystic structures that develop within atrio-ventricular valve leaflets. Blood cysts are sessile with a broader base, and thus less mobile than fibroelastomas.

Rhabdomyoma

Rhabdomyomas are the most common primary cardiac tumor in children and up to 50% of them are associated with tuberous sclerosis. These tumors are usually located in the myocardium of both ventricles and multiplicity is common (Fig. 8.8), but intracavitary growths can be found in more than 50% of patients. They may also originate within the atrium or in the atrio-ventricular junction. When occurring intramural, they appear as bright intramural masses with luminal extension. A circumscribed ventricular wall thickening of the left and/or right ventricle can be detected. When intracavitary, rhabdomyomas will more frequently appear as echodense structures, lobulated in shape and ventricular in origin. They may be associated with mechanical complications, such as outflow tract obstruction. Multifocal lesions are common.

Since regression of these tumors with complete resolution during infancy is expected in more than 80% of cases, surgery is indicated only in the setting of severe symptoms and signs and echocardiography is the technique of choice to

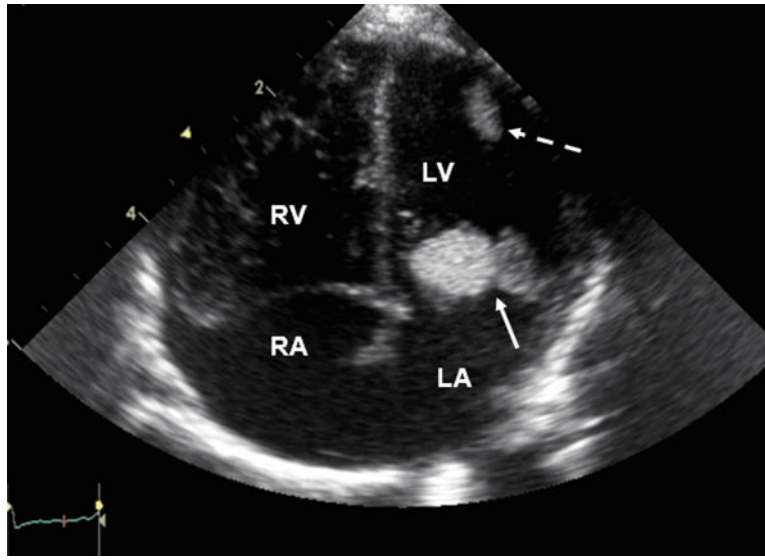

Fig. 8.8 Rhabdomyoma in a child with tuberous sclerosis. Transthoracic apical four-chamber view showing a large, lobulated, and echodense mass localized at the left atrio-ventricular junction (*arrow*). A smaller mass can be seen within the myocardium of the apical region of the left ventricular lateral wall (*dashed arrow*) (courtesy of Pasquale Gianfagna, M.D., Cardiothoracic Department, Azienda Ospedaliero-Universitaria, Udine, Italy). *LA* left atrium, *LV* left ventricle, *RA* right atrium, *RV* right ventricle

monitor the hemodynamic significance of the tumor and its evolution.

Fibroma

Echocardiographic appearance of cardiac fibroma is that of a single intramural (typically occurring in the interventricular septum, less frequently in the left ventricular free wall) hyperechogenic, noncontractile mass [15]. It may be confused with asymmetric hypertrophic cardiomyopathy or infiltrative myocardial disease, but usually its abnormal texture helps in reaching the correct diagnosis. The size of the mass may vary considerably, from 1 up to 10 cm. A pathognomonic echocardiographic feature of large fibromas is the presence of calcifications due to poor blood supply. Strain rate can be used to confirm the noncontractile nature of the mass [16]. In addition to its detection, echocardiography is useful to monitor the growth of the tumor and, postoperatively, to check for its recurrence.

Hemangioma

Hemangiomas can occur in any cardiac location and can arise from endocardium, myocardium, epicardium, or pericardium (Fig. 8.9a). Hemangiomas are typically intramyocardial, although most often involve the base of the heart. They appear as hyperreflective (but not calcific) masses varying in size (between 1 and 8 cm) and are usually associated with pericardial effusion. The vascularized nature of this tumor is difficult to be appreciated on conventional echocardiography. After contrast injection, the tumor is completely enhanced (Fig. 8.9b), showing a greater intensity than the surrounding myocardium [9, 17].

Teratoma

Intracardiac location of teratomas is very rare. They are usually located within the pericardial space, with a non-homogeneous echogenity and multicystic appearance and may present as a large hemopericardium causing hemodynamic compromise [18].

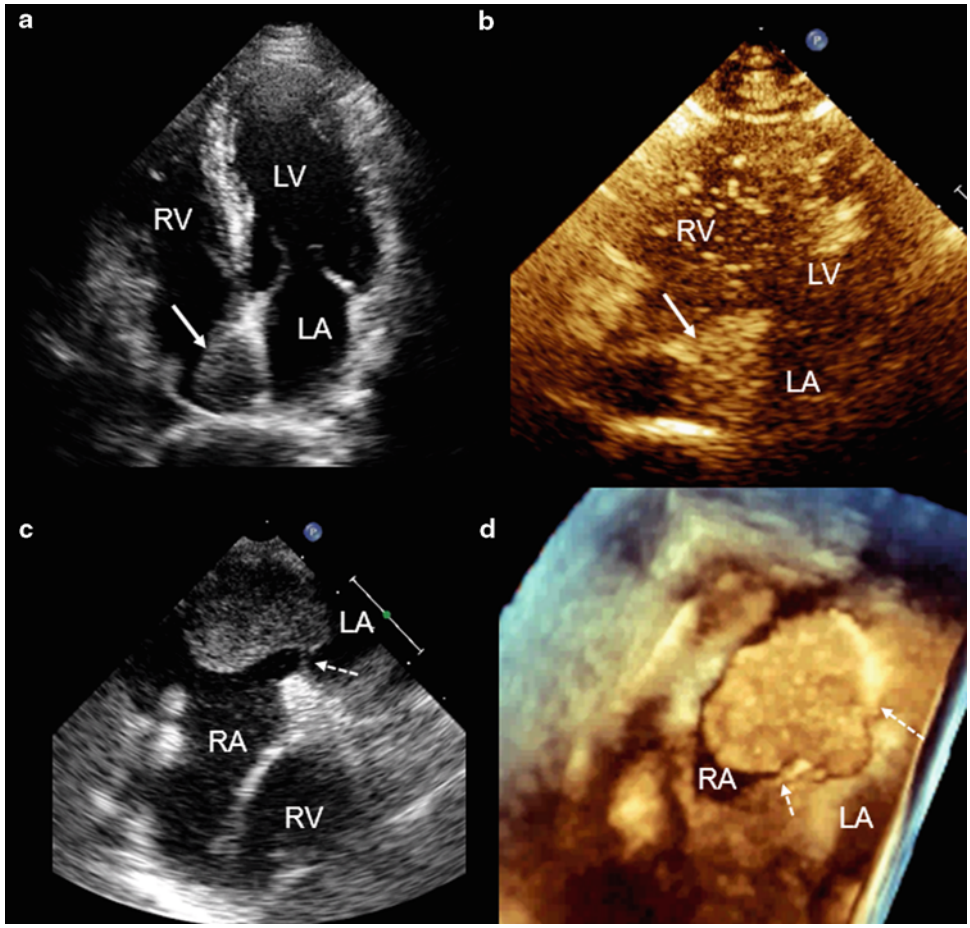

Fig. 8.9 A rare hemangioma of the interatrial septum. (**a**) Two-dimensional four-chamber apical view showing a large mass infiltrating the interatrial septum (*arrow*). (**b**) Complete enhancement of the mass tissue (*arrow*) with higher intensity than adjacent myocardium after intravenous injection of contrast agent, suggesting a highly vascularized tumor. (**c** and **d**) Transesophageal two- and three-dimensional image of the tumor highlighting the infiltration of the interatrial septum (*dashed arrow*). The three-dimensional data set allows a better appreciation of the shape of the mass, its volume, and its relationship with interatrial septum (*dashed arrow*) and right atrial walls (Courtesy of Agata Barchitta, M.D., Ospedale CTO S Antonio, ULSS 16, Padova, Italy). *LA* left atrium, *LV* left ventricle, *RA* right atrium, *RV* right ventricle

Sarcoma

Ninety-five percent of primary malignant tumors are sarcomas. Among these, angiosarcoma is the most frequent and, despite it can arise in any part of the heart, its most frequent location is the right atrium. The main echocardiographic characteristic, that helps to differentiate between benign myxomas and malignant angiosarcomas, is the evidence of infiltration of the cardiac wall and of the pericardium. Sarcomas may cause hemodynamic compromise as a result of obstruction anywhere in the right heart inflow or outflow tract. Angiosarcoma appears as a large, broad-based, mobile, inhomogeneous mass with hypodense necrotic and hemorrhagic zones

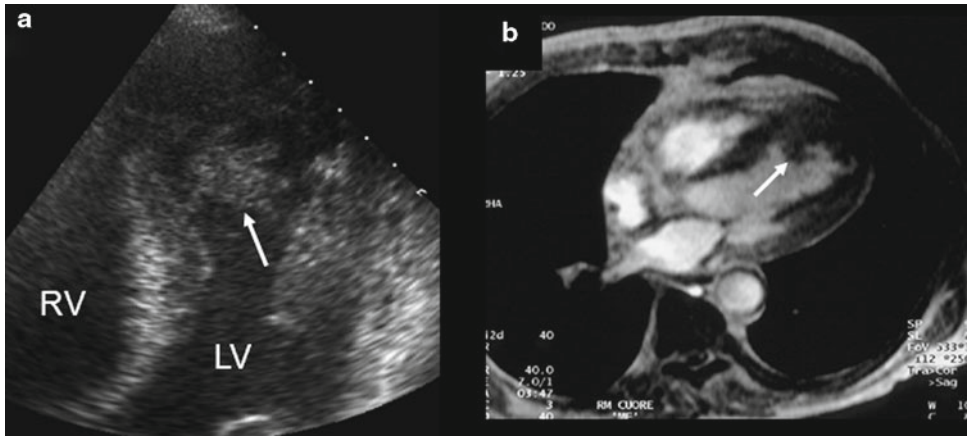

Fig. 8.10 Undifferentiated primary cardiac sarcoma of the left ventricle (localized at the apex and infiltrating left ventricular wall). The large size of the mass seen in this patient is not unusual for this tumor type, given its rapid and aggressive growth pattern. (**a**) Apical five-chamber view of the left ventricle showing an apical large polypoid mass (*arrow*) protruding into the left ventricular cavity. (**b**) Magnetic resonance imaging, four-chamber view, showing the mass infiltrating the left ventricular myocardium of the distal part of interventricular septum and apex (*arrow*). *LV* left ventricle, *RV* right ventricle

and a "cauliflower" shape. Infiltration of the pericardium, tricuspid valve, and vena cava can be frequently visualized. In the setting of a hemorrhagic pericardial effusion, a malignant tumor should be always considered [19].

Undifferentiated sarcoma (Fig. 8.10), malignant fibrous histiocytoma, leiomyosarcoma, rhabdomyosarcoma, osteosarcoma, fibrosarcoma, and liposarcoma are rare primary malignant cardiac tumors. Echocardiographic characteristics of the other cardiac sarcomas are similar to those listed for angiosarcomas, except they are not characteristically located within the right atrium, but elsewhere in the heart, predominantly within the left atrium. In the latter situation, they often originate from the roof of the left atrium or non-septal structures and this serves as a criterion of discrimination from myxomas. They appear as large, mobile, and inhomogeneous masses with zones of necrosis and hemorrhage and are indistinguishable from angiosarcoma. Only osteosarcomas which show typical calcifications within the mass can be differentiated from angiosarcomas.

Infusion of contrast can help in differentiating benign from malignant tumors. Highly vascular tumors like sarcomas become visually hyperenhanced and demonstrate quantitatively more perfusion than the adjacent myocardium [17].

Lymphoma

Primary cardiac lymphomas are defined as non-Hodgkin lymphomas involving only the heart/pericardium or as non-Hodgkin lymphomas with the bulk of the tumor located in the heart [20]. They are very rare in immunocompetent patients [21]. Their incidence is rising with the increasing prevalence of patients with AIDS or heart transplant. At echocardiographic examination, lymphomas commonly arise in the right atrium and appear as large, immobile, sometimes polypoid masses (Fig. 8.11) [22]. They frequently coexist with pericardial effusion.

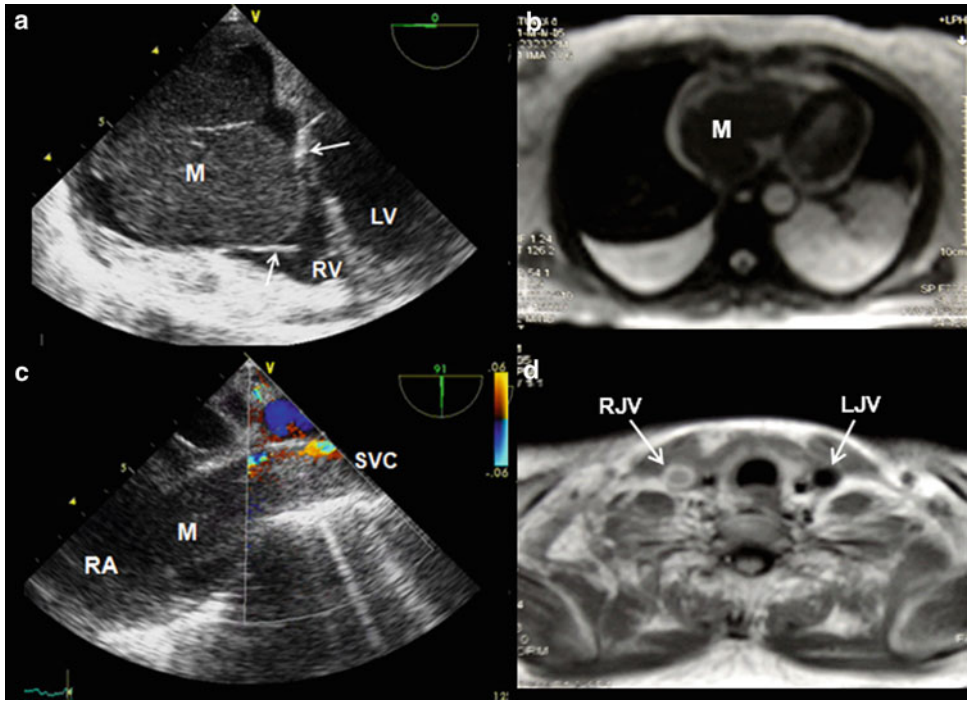

Fig. 8.11 Primary cardiac lymphoma in the right atrium. (**a**) At transesophageal echocardiography, a large mass fills almost completely the right atrium and prolapses through the tricuspid valve during right ventricular filling. (**b**) Magnetic resonance imaging. Four-chamber view showing the size of the tumoral mass (M) and its expansion within the right heart chambers. (**c**) Longitudinal view of the right atrium with superior vena cava at transesophageal echocardiography showing the extension of the tumor within the superior vena cava and the subsequently reduced blood flow through it. (**d**) CT scan showing the occlusion of the right jugular vein by the tumoral mass. *LV* left ventricle, *LJV* left jugular vein, *M* mass, *SVC* superior vena cava, *RA* right atrium, *RJV* right jugular vein, *RV* right ventricle

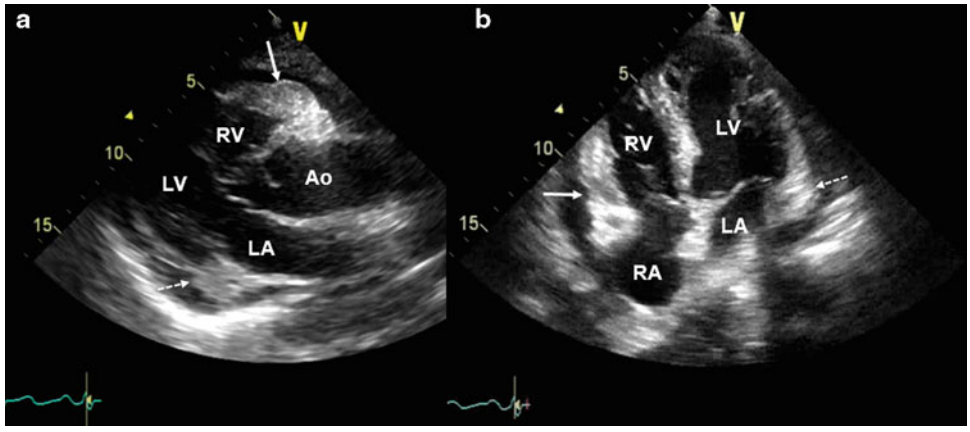

Fig. 8.12 Secondary cardiac lymphoma. At transthoracic echocardiography, the right ventricular free wall (*arrow*) appears thickened and hyperdense in both parasternal long-axis (**a**) and apical four-chamber (**b**) views. An additional intramyocardial, hyperdense, and oval-shaped mass can be appreciated at the posterior left atrio-ventricular junction (*dashed arrow*). Thickened pericardium and diffuse pericardial effusion are signs of pericardial involvement (courtesy of Pasquale Gianfagna, M.D., Cardiothoracic Department, Azienda Ospedaliero-Universitaria, Udine, Italy). *Ao* aorta, *LA* left atrium, *LV* left ventricle, *RA* right atrium, *RV* right ventricle

Secondary cardiac lymphomas show similar echocardiographic characteristics with primary cardiac lymphomas. Echocardiographic findings associated with cardiac metastases include the malignant pericardial effusion, sometimes associated to tumor masses with bizarre surface structures. The infiltrated cardiac walls appear as having a hyperdense pericardium and myocardium (Fig. 8.12). Wall motion abnormalities in these regions are common. Application of echo contrast agents can reveal the tumor perfusion and helps the distinction of the metastasis from the surrounding tissue.

Metastatic Cardiac Tumors

Cardiac metastases have been described in autopsy series in up to 20% of patients with malignancies of other organs (Fig. 8.13) and are up to 40 times more common than primary cardiac tumors [20, 23].

No malignant tumor preferentially metastasizes to the heart; however, melanomas (up to 64% of cases), leukemias, and lymphomas (up to 46%) are the tumors that most frequently manifest cardiac metastasis. Lung, breast, ovarian, and kidney cancer are also frequently involved [15, 20]. Although melanoma can manifest with the detection of intracardiac masses, the most common cardiac manifestation of melanoma is subclinical because it frequently invades the pericardial surface [15]. Indeed, pericardial effusion, with and without tamponade, is overall the most common echocardiographic finding in metastatic heart disease [24]. Solid material adherent to the visceral or parietal pericardium (either tumor or clotted blood) can be visualized within the effusion.

Both benign and malignant tumors can invade the heart through the inferior vena cava. The most common tumor that metastasizes to the heart through the inferior vena cava is the renal cell carcinoma (hypernephroma). Up to 43% of the patients with hypernephroma demonstrate inferior vena cava (Fig. 8.14) and/or right atrial involvement [25]. Among benign tumors, intravascular leiomyomatosis of pelvic or uterine origin can reach the right heart through the inferior vena cava.

Conclusions

Cardiac masses frequently pose a diagnostic challenge. Due to its wide availability and cost-effectiveness ratio, echocardiography is the first choice imaging modality for detection of cardiac tumors.

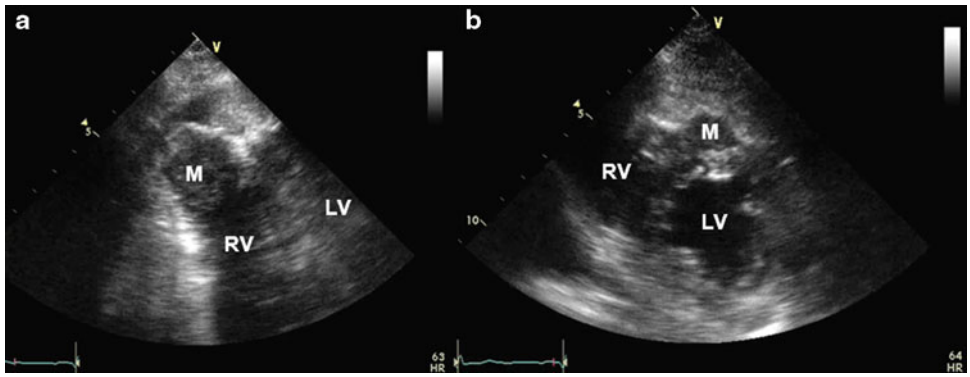

Fig. 8.13 Cardiac localization of metastases originating from a malignant tonsil tumor. Transthoracic echocardiography shows a hypodense, intramyocardial mass (M) localized at the apex of the right ventricle (**a**). In short-axis view (**b**), the mass can be easily differentiated from the surrounding myocardium (courtesy of Pasquale Gianfagna, M.D., Cardiothoracic Department, Azienda Ospedaliero-Universitaria, Udine, Italy). *LV* left ventricle, *RV* right ventricle

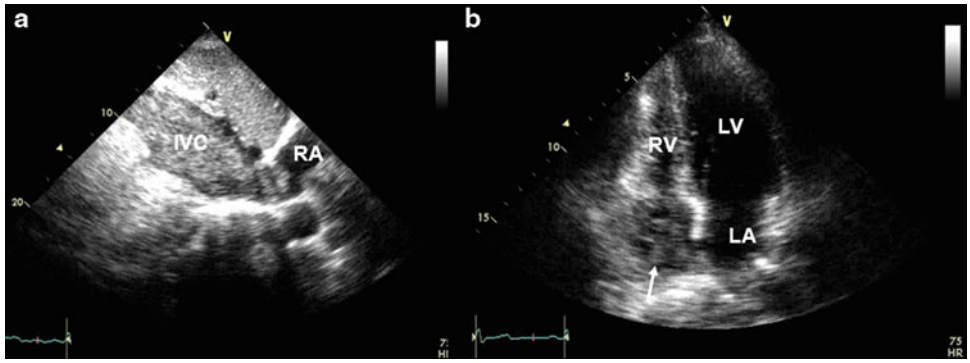

Fig. 8.14 Renal cell carcinoma (hypernephroma). A large hyperdense mass, filling almost completely the lumen of inferior vena cava and protruding into right atrium (*arrow*), can be appreciated at transthoracic echocardiography from both subcostal (**a**) and apical four-chamber view (**b**) (courtesy of Pasquale Gianfagna, M.D., Cardiothoracic Department, Azienda Ospedaliero-Universitaria, Udine, Italy). *IVC* inferior vena cava, *LA* left atrium, *LV* left ventricle, *RA* right atrium, *RV* right ventricle

Box 8.1 Practical Key Points for Echocardiographers

In the **left or right atrium**, the most common benign atrial masses are **myxomas**; *clinical context and contrast infusion provide important clues to distinguish from thrombi.*
In the **right atrium**, the most frequent malignant tumors are **angiosarcomas;** *other type of sarcomas usually originate from the left atrium.*
On **cardiac valves**, most common tumors are **papillary fibroelastomas**; *clinical history and hemocultures are key for differential diagnosis with vegetations.*
In the **ventricles** and in **children**, **rhabdomyomas** and **fibromas** are the most frequent; *rhabdomyomas are usually multiple and decrease in size and number with age.*
Malignant tumors are rapidly progressive and most commonly **secondary;** *pericardium, myocardium or veins with endocardial growth are typically involved, depending on their way of spread.*
Benign tumors may also be hemodynamically "**malignant**" by intramural growth, cavity obstruction or systemic embolization; *pericardial effusion, myocardial or valvular dysfunction may result from local invasion.*

The various echocardiographic techniques (transthoracic and transesophageal, contrast, and 3D ultrasound imaging) allow an accurate anatomic localization and a precise description of these masses, as well as an assessment of their hemodynamic impact. For cases that are not so straightforward, or for cases in which acoustic access is restricted, magnetic resonance imaging and computed tomography scanning are preferred over echocardiography to assess contiguous extracardiac involvement or the presence of metastatic disease. Integration of available clinical data with the knowledge of typical imaging characteristics and natural history of specific cardiac tumors is pivotal for an accurate non-invasive diagnosis.

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