Abstract

Transthoracic echocardiography (TTE) can provide quality, dynamic imaging assessment of intracardiac and extracardiac masses. TTE can be performed bedside and is a well-known widespread diagnostic technique useful for morphological and functional assessment of the heart. However, basic premises need to be stressed: expert and certified ultrasound skill of health-care professional who performs the exam is mandatory; this is not a redundant statement as interobserver variability due to unskillfulness is clearly related to diagnostic pitfalls[1‑3] and a thorough understanding of normal anatomy and normal variants considering embryologic residues is crucial in cardiac imaging which will further avoid potential misdiagnosis. Clearly, echocardiographic findings have to be related to patient’s history and clinical data. Moreover, TTE may be limited in obese patients and those with poor acoustic windows. Complete diagnostic achievement of any cardiac mass obviously derives from multimodality imaging approach and definitive diagnostic histologic examination. Both transthoracic and transesophageal echocardiography (TOE) associated with three-dimensional (3D) echocardiography can be a value-added tool in identifying masses and differential diagnosis.[4]

Keywords: Cardiac masses, echocardiography, neoplasia, thrombus, vegetation

INTRODUCTION

Transthoracic echocardiography (TTE) can provide quality, dynamic imaging assessment of intracardiac and extracardiac masses. TTE can be performed bedside and is a well-known widespread diagnostic technique useful for morphological and functional assessment of the heart. However, basic premises need to be stressed: expert and certified ultrasound skill of health-care professional who performs the exam is mandatory; this is not a redundant statement as interobserver variability due to unskillfulness is clearly related to diagnostic pitfalls[1‑3] and a thorough understanding of normal anatomy and normal variants considering embryologic residues is crucial in cardiac imaging which will further avoid potential misdiagnosis. Clearly, echocardiographic findings have to be related to patient’s history and clinical data. Moreover, TTE may be limited in obese patients and those with poor acoustic windows. Complete diagnostic achievement of any cardiac mass obviously derives from multimodality imaging approach and definitive diagnostic histologic examination. Both transthoracic and transesophageal echocardiography (TOE) associated with three-dimensional (3D) echocardiography can be a value-added tool in identifying masses and differential diagnosis.[4]

Methods

We considered and classified the most important and frequently scanned cardiac masses in echocardiography analyzing their epidemiology and main echocardiographic features. We included some exemplary cases, reviewing the scientific literature via PubMed/MEDLINE database, searching for the most relevant case reports, reviews, and original articles. Echocardiographic pictures presented in this review were extracted from an archive of clinical cases actually diagnosed and managed in the cardiology department of a single-center, community, public health hospital located in Rome – Italy. All the examinations were performed by the European Society of Cardiology/European Association of Cardiovascular Imaging (ESC/EACVI), formerly accredited cardiology consultant in high-volume performance echocardiography laboratory.

Both TTE and TOE pictures presented in this review were acquired using an IE33 Philips ultrasound equipment (Philips

Address for correspondence: Dr. Paolo Diego L’Angiocola, Department of Cardiology, San Giovanni Di Dio Hospital, Via Fatebenefratelli, 34, 34170 Gorizia, Italy. E-mail: paolo.doc@gmail.com

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Medical Systems”, 22100 Bothell-Everett Highway, Bothell, WA 98021-8431, USA). We analyzed and classified main echocardiographic findings related to cardiac masses, providing specific clinical and echocardiographic details, showing exemplary pictures, and correlating specific echocardiographic features with recommendations acquired from echocardiographic position statements extracted from the most relevant international scientific societies of cardiology and cardiovascular imaging field in order to underline and stress which features to search for, in every specific case.

Our aim is to provide a practical tool that can be useful in daily practice for health-care professionals who perform echocardiographic examinations. This review will not analyze anecdotal, extraordinary cases but will focus on more frequently encountered daily practice routine cases providing a useful, pragmatic tool to improve correct analysis of ultrasound images, leading to correct diagnosis.

**Normal variants, mimickers, foreign bodies, and echocardiographic artifacts**

A solid knowledge of morphological anatomy and embryological development of the heart is mandatory for any health-care professional performing echocardiography. Any health-care professional working as a sonographer or imaging consultant needs to know about normal variants and nonpathological, or pathological, but not cardiac mass-related echo findings.\(^5\)\(^-\)\(^7\) Ultrasound artifacts need to be considered as well: they can potentially mislead to incorrect identification of nonexisting intracardiac masses.\(^9\)

The main echocardiographic findings that can mimic cardiac masses are reported in Table 1.

All these structures and anatomical variants have to be considered in the differential diagnosis before labeling echocardiographic findings as pathological cardiac masses.

Figure 1 shows an example of prominent crista terminalis. The crista terminalis is a muscular band that originates between the right sides of superior and inferior vena cava orifices and extends until reaching the opening of right atrial (RA) appendage.\(^9\)

Plain understanding of current clinical conditions and historical clinical record of the patients needs to be acquired by the health-care professional before performing an echocardiogram: the knowledge of remote clinical history will simplify potential misdiagnosis, allowing an easier recognition of foreign iatrogenic bodies such as pacemaker leads in right atrial

![Figure 1: Transthoracic echocardiography apical four-chamber view; white arrow: Crista terminalis. RA = Right atrium](image)

### Table 1: Structures potentially mimicking cardiac masses in echocardiography

| Normal variants or congenital remnants | Pathological variants not related to specific cardiac masses | Iatrogenic foreign bodies or ectopic structures | Artifacts |
|---------------------------------------|-------------------------------------------------------------|------------------------------------------------|---------|
| LV webs, heartstrings, and chords     | Apical form of hypertrophic cardiomyopathy                  | Pacemaker wires                                | Near-field clutter |
| Apical trabeculations                 | Interatrial septal aneurysm                                 | AICD leads                                     | Beam-width artifact |
| LA chords                             | Venous varices (clumps of veins)                            | Occluder interatrial devices                   | Enhancement       |
| Dilated coronary sinus (PLAX view)    | Lambi’s excrescences                                        | Hiatal hernia                                  | Reverberation     |
| Prominent descending aorta (A4Ch view)| Nodules of Arantius                                         | Heterotopic thyroid tissue                     | Refraction        |
| Multiple lobes of the LA appendage    | Fibrous pericardial patch                                   | Central venous lines                           | Mirror image      |
| Pectinate muscles in LA or RA appendages| Dystrophic calcification of the mitral annulus            | Mitral and tricuspid interventional devices (e.g., MitraClip™, Mitralix™, TriClip™) |         |
| Prominent moderator band              | Endomyocardial fibrosis/Loeffler endocarditis               |                                                |         |
| Prominent crista terminalis           | Hematic cyst (childhood)                                   |                                                |         |
| Prominent Eustachian valve            | Pericardial cyst                                            |                                                |         |
| Chiar network                         | Mesothelial.monocytic incidental cardiac excrescences       |                                                |         |
| Redundant mitral chordae apparatus and redundant leaflet tissue of the mitral valve | Bronchogenic cyst                                          |                                                |         |
| Prominent epicardial fat              | Other infective masses (echinococcus cyst, aspergiloma, tuberculoma) |                                                |         |
|                                      | Noncompaction cardiomyopathy                                |                                                |         |
|                                      | Prominent or calcified papillary muscles                    |                                                |         |
|                                      | Dense mitral annular calcification                          |                                                |         |
|                                      | Lipomatous hypertrophy of interatrial septum               |                                                |         |

LV=Left ventricular, LA=Left atrium, RA=Right atrium, PLAX=Parasternal long axis, A4Ch=Apical four chamber, AICD=Automated implantable cardioverter defibrillator
sections, interatrial closure devices, or even already-diagnosed anatomical and normal variants.

**Cardiac masses: Classification, epidemiology, and echocardiographic findings**

Cardiac masses, most often encountered in echocardiography, can be briefly classified into the following three groups: thrombi,[10,11] vegetation,[12,13] and neoplasms.[14]

**Thrombi**

We need to distinguish between left section thrombi and right section thrombi according to different pathophysiology. The former are generally related to atrial fibrillation, prosthetic valves, and ischemic heart disease, whereas the latter are usually related to deep-vein inferior limb thromboembolic disease, foreign iatrogenic body-attached thrombus, and right heart side myocardial infarction-related thrombus.

The size, shape, protrusion, and location of the thrombus can vary depending on the specific etiology, pathophysiology, or underlying cardiac disease.

**Left section thrombi**

Atrial fibrillation has a prevalence of about 2%–3% in the general population and is well known to relate to left atrium (LA) thrombus formation, and the risk of systemic embolic events ranges from 5% to 7% without adequate anticoagulation.[15,16]

LA thrombi can be located in the LA appendage in case of atrial fibrillation and can protrude or not into the LA lumen or be included within the auricula, and they are usually detected using TOE. Although further studies are needed, whenever data are available taking advantage of multimodality radiological imaging approach, anatomy of the left atrial appendage (LAA) has to be considered as well. LAA can be classified according to morphology into four types: “cactus,” “chicken wing,” “Windsock,” and “Cauliflower.” Patients with chicken wing LAA morphology are less likely to have an embolic event.[17]

Two-dimensional and 3D TOE echocardiography can add useful indirect information about LAA morphology. Pulsed wave Doppler (PW) flows in correspondence of LAA possibly need to be measured during TOE examinations as atrial fibrillation patients with nonchicken wing LAA morphologies show a reduced LAA emptying flow velocity (maximum peak of mean emptying velocity at TOE lower than 30–40 cm/s.)[18] and an increased prevalence of spontaneous echo contrast inside the LA when compared with patients with chicken wing morphology.[19] Thus, whenever reduced LAA emptying velocity PW flows and spontaneous echo contrast are detected, a high suspicion of LA thrombus needs to be considered.

Figure 2 in a 19° multiplanar probe TOE picture focusing on LAA shows an example of an LAA remarkably large, isoechoic thrombus partially protruding into the LA lumen in a patient affected by atrial fibrillation: position of the thrombus (interauricular), its isoechoic or hyperechoic brightness, spontaneous echo contrast, and known current atrial fibrillation support the echocardiographic diagnosis of LAA thrombus.

Prosthetic aortic and mitral valves can predispose to the formation of thrombi adherent to prosthetic parts in case of lack of therapeutic anticoagulation, and atrial septal aneurysm can also predispose to atrial thrombus formation. TTE may evidence an incongruous transvalvular flow in case of prosthetic thrombosis both to color Doppler and continuous-wave Doppler analysis, with the former showing turbulence and aliasing effect and the latter showing increased transvalvular flow mean pressure gradients due to reduced effective orifice area. TOE can be more accurate in identifying the position and morphology of intravalvular or periprosthetic thrombus, showing restricted leaflets or disc motion, abnormal regurgitation, loss of physiological regurgitant jets in mechanical valves, or direct visualization of the thrombus or pannus formation adherent to prosthetic structures.[20]

Figure 3 shows a dysfunctional, mechanical, prosthetic mitral valve with an isoechoic intravalvular mass consisting in a thrombus due to lack of therapeutic anticoagulation; here the nondefinite margins of the thrombus and the intravalvular mass that interferes with normal mechanical leaflet motion reducing the intravalvular blood flow can be seen and an hyperechoic effect beyond the level of the mitral valve due to interfering thrombotic body and on color Doppler analysis an abnormal regurgitant flow can also be clearly seen related to the prosthetic incontinence due to the presence of the thrombotic mass.

The incidence of left ventricular (LV) thrombi is approximately 7/10,000 patients. Eighty percent of patients who develop intraventricular thrombi are affected by ischemic heart disease, while the rest is due to dilated cardiomyopathy and stress-induced cardiomyopathy.[21]

In case of systolic dysfunction and in particular of apical akinesia, with or without evidence of LV apical aneurysm, it is sometimes possible that a thrombus is generated close to LV apex.[15] LV thrombi are usually identified as discrete echo-dense (isoechoic
or hyperechoic) intraluminal masses with defined margins that are distinct from the endocardium and seen throughout systole and diastole, have mural attachment, are sessile, and are usually located in the apex; one of the most useful discriminating features is the coexistence of the underlying abnormalities of regional or global LV wall motion. TTE has a sensitivity of 95% and a specificity of 86% in the detection of LV thrombus. Echocardiographic contrast agent can be used to allow for a more accurate assessment of LV volumes and eventually thrombus detection in case of doubt. TTE has a sensitivity of 95% and a specificity of 86% in the detection of LV thrombus. Echocardiographic contrast agent can be used to allow for a more accurate assessment of LV volumes and eventually thrombus detection in case of doubt. TTE has a sensitivity of 95% and a specificity of 86% in the detection of LV thrombus. Echocardiographic contrast agent can be used to allow for a more accurate assessment of LV volumes and eventually thrombus detection in case of doubt. TTE has a sensitivity of 95% and a specificity of 86% in the detection of LV thrombus. Echocardiographic contrast agent can be used to allow for a more accurate assessment of LV volumes and eventually thrombus detection in case of doubt.

Figure 4 shows an apical thrombus: It shows the thrombotic nature of the mass as it is isoechoic, has a mural attachment, with defined contours distinguished from endocardial edge, and is clearly related to apical akinesia.

Figure 5 shows a thrombotic mass in a zoomed, live 3D TTE apical 4-chamber scan showing the mobility and the size and the shape of the pedunculated mass attached to LV akinetic apex.

3D TTE and TEE can provide remarkable added value in echocardiographic assessment of cardiac masses, and its use has to be considered especially if surgical planning is necessary. 3D evaluation allows unlimited slicing and cropping, favors anatomic detail recognition, and allows visualization of 3D structures in motion, evaluation of the size of the cardiac mass, visualization of the true apex and accurate calculation of LV volumes and ejection fraction in case of good acoustic windows and favorable anatomic alignment of heart structures.

The echocardiographic features and main clinical correlations of left sections thrombi are summarized in Table 2.

**Right section thrombi**

In patients with confirmed diagnosis of pulmonary

| Table 2: Clinical and echocardiographic features of left section thrombotic masses |
| --- |
| **Left section mass** | Clinical/echocardiographic findings |
| **Left atrial thrombus** | Atrial fibrillation/flutter |
| | Isoechoic/hyperechoic intra-atrial, sessile, or mobile mass |
| | LAA echo-dense mass location |
| **Prosthetic valve thrombus** | Isoechoic/hyperechoic peri-/intravalvular sessile or mobile mass |
| | Lack of proper anticoagulation |
| | Prosthetic dysfunction (increased transvalvular mean CW Doppler gradient, restricted leaflet/disc motion, color Doppler aliasing effect, etc.) |
| **LV thrombus** | Isoechoic/hyperechoic mass with defined margins |
| | distinct from endocardial edge and mural attachment |
| | Apical location |
| | Wall motion-related abnormalities (hypokinesia and akinesia) |
| | Ischemic heart disease |

LAA=Left atrial appendage, CW=Continuous wave, LV=Left ventricular
embolism (PE), right heart located or migrating thrombi are visualized by echocardiography in only ~4% of cases.[31,32] Therapeutic management needs to be tailored on every specific patient in these cases. Clearly, echocardiographic detection of a right-sided migrating thrombus in a patient with suspected PE actually confirms the diagnosis; however, all the diagnostic and therapeutic steps to validate the diagnosis and coherently treat the patient are mandatory.[25]

Figure 6 shows a case of migrating thrombus in a patient with a diagnosis of PE: here, a bilobed hyperechoic/isoechoic mass with definite edges wandering into the right atrium and protruding into the LV as well is shown.

Any foreign iatrogenic body inserted into the heart can provide support to the formation of thrombotic masses; we then have to consider specific conditions such as the presence of central vein catheters or pacemaker leads as possible concurrent substrates for thrombotic formation and raise a high suspicion of thrombus whenever a hyperechoic/isoechoic in plus image attached to this device is encountered in TTE.[26,27] Differential diagnosis obviously includes the possibility of vegetation presence versus thrombus: clinical data associated with ultrasound findings will lead to correct diagnostic conclusive considerations.

Right ventricular thrombi can be associated with right myocardial infarction as well as its directly related complication;[28] in this case, already suggested recommendations for LV thrombotic mass identification in ischemic heart disease are valid.

The echocardiographic features and main correlations of right section thrombi are summarized in Table 3.

**Vegetation**

Endocarditis is defined as “an inflammation of the endocardium” that can be related to different etiologies, though large part is caused by infectious agents. The incidence of infective endocarditis is between 2 and 10 cases/100,000 person/year.[29,30] IE is more commonly associated with invasive medical procedures, injection drug use, and older age.[31,32] About 75% of patients who develop IE have underlying structural heart disease.[33] In the past, rheumatic heart disease with mitral stenosis was the most common valvular defect in patients with IE. Recently, the most common predisposing lesions are mitral regurgitation, aortic valve disease, and congenital heart disease.[34–35] Mitral valve prolapse associated with moderate or severe regurgitation is another risk factor for IE.[36] The presence of a prosthetic cardiac valve is a remarkable risk factor for IE.[37] European data report a IE prevalence ranging from 0.8% to 3% among intensive care unit patients.[38,39] Vegetation consists in a mass of platelets, fibrin, microorganisms, and inflammatory cells related to infectious active process originating on a preexisting structural substrate; those lesions can be identified by echocardiography and represent the active bacterial focus of infection.

TTE and TOE must be performed as soon as a concrete suspicion of endocarditis occurs, according to clinical

| Right ventricular thrombus | Clinical/echocardiographic features |
|----------------------------|------------------------------------|
| Right atrial thrombus      | Suspicion of already-validated diagnosis of PE |
|                           | Isoechoic/hyperechoic intra-atrial, mobile mass with definite edges and variable size or shape |
| Right ventricular thrombus | Migrating thrombus into RV in suspected or already-validated diagnosis of PE |
|                           | Myocardial infarction of the right ventricle (wall motion-related abnormalities, isoechoic/hyperechoic mass with defined margins distinct from endocardial edge and mural attachment) |

PE=Pulmonary embolism, RV=Right ventricle

| Table 4: Echocardiographic findings in infective endocarditis |
|---------------------------------------------------------------|
| **Infectious finding** | **Echocardiographic findings** |
|------------------------|-------------------------------|
| Vegetation             | Oscillating or nonoscillating intracardiac mass on valve or other endocardial structures, or on implanted intracardiac material |
| Abscess                | Thickened, nonhomogeneous perivalvular area with echodense or echolucent appearance |
| Pseudoaneurysm         | Pulsatile perivalvular echo-free space, with color Doppler flow detected |
| Perforation            | Interruption of endocardial tissue continuity traversed by color Doppler flow |
| Fistula                | Color Doppler communication between two neighboring cavities through a perforation |
| Valve aneurysm         | Saccular bulging of valvular tissue |
| Dehiscence of a prosthetic valve | Paravalvular regurgitation identified by TTE/TOE, with or without rocking motion of the prosthesis |

TTE=Transthoracic echocardiography, TOE=Transesophageal echocardiography
complete evaluation and considering modified Duke diagnostic criteria,\(^{[40]}\) in order to achieve earlier and proper therapeutic approach.

The echocardiographic findings related to IE are reported in Table 4 as reported in an ESC/EACVI consensus paper.\(^{[41,42]}\)

Figure 7 shows a multiplanar probe 124° oriented, long-axis TOE image at the level of a native aortic valve that spots an isoechoic, indented, intravalvular aortic mass which oscillates throughout complete cardiac cycle mainly protruding on the LV outflow tract and partially jutting through the aortic orifice into the aorta during systole. This mass clearly represents a vegetation.

Figure 8 shows a multiplanar probe 41° oriented TOE image identifying a round-shaped mass attached to an implantable cardioverter defibrillator lead oscillating into the right ventricle. In this case, the pedunculated, round, isoechoic mass is not clearly distinguishable from a thrombus if based only on echocardiographic findings, and differential diagnosis becomes hard without related clinical data.

In general, controversies origin when trying to discriminate vegetation from thrombus, but concurrent clinical findings, laboratory tests, and complete clinical evaluation of the patient will lead to correct diagnosis.

**Neoplasms**

The prevalence of primary cardiac tumors is lower than 0.1% in large autopic studies.\(^{[43]}\) The incidence of cardiac metastatic masses involving cardiac tissues ranges from 2.3% to 18.3% of patients with extracardiac malignant neoplasms.\(^{[44]}\) Among the benign cardiac tumors, which represent approximately 90% of all diagnosed cardiac neoplasms, the majority are myxomas, followed by papillary fibroelastomas.\(^{[13]}\) The most common primary malignant cardiac tumors are sarcoma, angiosarcoma, and leiomyosarcoma. In younger patients (<18 years old), fibroma and rhabdomyoma are the most frequent lesions. Primary malignant tumors in children are mostly represented by rhabdomyosarcoma and variants of malignant teratoma.\(^{[13,45]}\)

Cardiac neoplasms are statistically associated with specific localization in the heart: usually, myxomas and lipomas are mainly related to atrial localization, whereas other kinds of neoplasms such as rhabdomyomas and lymphomas are more often localized in ventricles. Fibroelastomas are typically attached to valvular tissues.\(^{[46]}\)

Echocardiographic contrast agents can be useful to confirm the presence of an intracardiac mass. Contrast hyperenhancement of scanned masses can raise the suspicion of malignant and highly vascularized tumors as higher contrast enhancement is related to higher vascularization and help in differential diagnosis as thrombi are not affected by contrast agents’ use; myxomas generally tend to be only partially enhanced by contrast agents.\(^{[47,48]}\)

To evaluate a cardiac mass in echocardiography, we then need to consider some of the following key factors if we already have excluded the diagnostic suspicion of thrombus or vegetation: age of the patient, localization of the mass,
clinical general context related to the patient, and ultrasound features of the mass.

Figure 9 in apical 5-chamber view shows an isoechoic round mass jutting into the LA attached by a small pedunculated trait to the basal wall of the LA. Figure 10 in a subcostal view of the same case shows that the isoechoic mass seems partially attached to the basal interatrial septum as well, with the latter showing a type 1R aneurysm according to Olivares–Reyes classification of interatrial septal aneurisms.\cite{49}

Figures 11 and 12 show interesting 3D TEE and TOE pictures of a fibroelastoma attached to the aortic left coronary aortic cusp; here, the isoechoic dense nature of the rounded pedunculated mass can be clearly identified, attached to the left coronary aortic cusp, and can be measured and accurately evaluated in its shape using 3D TTE and TOE scans.

Figure 13 shows a dramatic picture of a pericardial, remarkably large, isoechoic/hyperechoic, heterogeneous mass adherent and partially infiltrating LV wall, compatible with a secondary, metastatic lesion of a primary melanoma; here, a small amount of pericardial effusion located posteriorly to the right atrium can also be seen.

The main clinical and echocardiographic features of neoplasms are summarized in Table 5.

**Extracardiac masses**

A brief mention has to be spent about extracardiac masses encountered in echocardiography. Although not frequent, in these cases, the masses are not related to myocardial tissue and are visible during echocardiographic examination in patients affected by diseases that are not cardiac in etiology.

Figure 14 depicts an apical four-chamber view with color Doppler double image showing an isoechoic mass compressing the LA that is an already well-known diagnosed pulmonary neoplasia in a young patient; careful attention has to be paid...
in these cases and complete clinical context of the patients can lead to correct interpretation of the images.

Figure 15 shows an off-axis subcostal view pointing to the ectopic mass of an infiltrating renal neoplasia invading the inferior vena cava. Here, an isoechoic mass protruding into the lumen of the inferior vena cava that clearly shows its dense nature on color Doppler analysis as well can be seen; color Doppler box clearly shows blood turbulence around the solid mass that on the contrary does not show color enhancement at all.

Figure 16 shows a parasternal long-axis view of a patient affected by a large hiatal hernia: this condition can simulate a left atrial intracardiac/extracardiac mass showing an isoechoic-hyperechoic, dense, mass-mimicking-area located posteriorly to the LA. Sonographers must be aware of this rare ultrasound finding in order to achieve correct differential diagnosis: the history and physical examination of the patient and properly performed slightly “off-axis” parasternal long-axis and apical views, together with possible, respiratory fluctuation of the hernia and intraluminal swirling of gastroesophageal reflux matter in subcostal views, help making the correct diagnosis.

**Table 5: Structural and echocardiographic features of most common neoplasia**

| Neoplasms   | Localization                                      | Enhancement with contrast agents | Age of the patient | Echo features                                      |
|-------------|---------------------------------------------------|----------------------------------|--------------------|---------------------------------------------------|
| Mixoma      | LA (majority of cases) RA                         | Mild enhancement, depending on   | Any age            | Sessile, pedunculated, isoechoic, definite margins |
| Fibroelastoma| Valve structures                                  | on vascularization               | Any age            | Small size, endocardial attachment                 |
| Lipoma      | Subendocardium, or pericardium or on cardiac valve structures | No enhancement                 | Any age            | Broad based, immobile, no pedicle, well circumscribed |
| Rhabdomyoma | Ventricular walls, atrioventricular valves        | Remarkable enhancement           | <1 year old        | Small, well-circumscribed isolated, or multiple nodules or a pedunculated mass |
| Sarcomas    | LA                                               | Variable, not always significant enhancement | Any age            | Broad-based heterogeneous echogenicity; hypoechogenic areas may indicate tumor necrosis |
| Angiosarcomas| RA                                               |                                  |                    |                                                   |
| Lymphoma    | Especially in the RA                              | Variable                         | Any age            | Homogeneous, infiltrating masses leading to “wall thickening” or nodular masses |

LA=Left atrium, RA=Right atrium

**Useful additional tips in ultrasound/morphological evaluation of cardiac masses**

When scanning an identified thrombus, we need to remember some key echographic features: the mural portion of thrombus is acoustically brighter than the distal portion as the latter mostly consists of red blood cells held together by a delicate fibrin mesh; clots that show less echo-brightness are more likely to embolize as they are softer and fresher in their structure; mobile, protruding, pedunculated, and more recently organized thrombi are more likely to origin emboli; and sessile and pedunculated large thrombi may show an isoechoic/anechoic central core related to colliquation. Thrombi do not acquire enhancement after administration of ultrasound contrast agents.

**Conclusions**

Echocardiography is a useful technique to diagnose intracardiac and extracardiac masses. Shape, size, location, and ultrasound features of the scanned mass associated with clinical and other instrumental data can lead to correct diagnosis of the lesions. Main cardiac masses consist of thrombi, vegetation,
and neoplasms. Expert echocardiographic evaluation of the masses can help in the differential diagnosis, leading to specific diagnostic suspicion and proper treatment. 3D TEE and TOE together with multimodality imaging approach usually optimally define the nature of the mass.

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Conflicts of interest
There are no conflicts of interest.

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