

**Cardiac masses on echo can result from:**

- **Tumours**
  - Primary cardiac tumours
    - Benign
    - Malignant
  - Secondary cardiac tumours
- **Thrombus**
- **Vegetations**
- **Normal variants and other conditions, e.g.:**
  - Moderator band
  - Lambl's excrescences
  - Eustachian valve
  - Chiari network
  - Lipomatous hypertrophy of the interatrial septum
  - Dilated vessels
  - Cysts
  - Implanted devices

## CARDIAC TUMOURS

**Secondary cardiac tumours** (direct spread from adjacent malignancies or metastatic disease) are the most common tumours found in the heart.

- Metastatic tumours usually involve the pericardium and rarely involve the endocardium.
- The most commonly associated echo feature is a pericardial effusion.
- Melanomas have the highest rate of pericardial metastases (up to 65% of melanomas can metastasise to the heart).
- Both renal and uterine cancers can extend up the IVC as one complete mass to the RA. This is important to note as curative resection is possible in this situation. Therefore, the presence of an RA mass should prompt IVC interrogation.
- Carcinoid tumours do not readily metastasise to right-sided heart valves –they secrete biologically active metabolites that fibrose and stiffen the valves.

**Primary cardiac tumours** are those that arise from the heart itself. They are rare (1 in 2000 autopsies) and account for a small percentage of the total number of cardiac tumours. 75% are benign

Primary cardiac tumours can present with systemic features such as fever and weight loss, or more specifically with:

- Embolism – either of part the tumour itself or adherent thrombus
- Obstruction – usually of a valve orifice or outflow tract
- Arrhythmias – either tachyarrhythmias, such as ventricular tachycardia, or atrioventricular block.

**Myxoma** is the commonest primary cardiac tumour, accounting for 50% of cases, and is commoner in women. 75–80% are found in the LA, 15–20% in the RA, and rarely in the ventricles. Occurrence on valves is very rare but described. Significant variation in size is seen.

Around 10% of myxomas are familial (autosomal dominant), and these are more commonly multiple and found in the ventricles. Familial myxomas tend to present at a younger age. There can be associated abnormalities such as facial freckling and endocrine tumours, and such syndromes are grouped together as a ‘Carney complex’. Other myxoma syndromes include NAME syndrome and LAMB syndrome. Screening of first-degree relatives is appropriate in suspected familial cases.

Myxomas are attached to the heart by a pedunculated stalk. Atrial myxomas classically attach via a stalk to the interatrial **septum** at the fossa ovalis and can sometimes be seen to prolapse through the MV orifice. Myxomas rarely invade into local tissues, but **readily embolize**, a common form of presentation. They can recur after resection due to the multicentric nature of the disease rather than inadequate resection.

**Papillary fibroelastoma** is a small (< 1.5 cm) benign valvular tumour, attached to the **d**ownstream side (i.e. side of the **d**istal chamber) of the aortic or mitral valve (unlike vegetations which attach to upstream side). They account for 10% of primary cardiac tumours. They are usually found incidentally during echo, cardiac surgery or post mortem, and their similarity to vegetations can lead to a mistaken diagnosis of infective endocarditis. Although **not frequently**, the tumours can embolize and surgical resection should therefore be considered.

**Lipomas** are usually seen beneath the epicardium. Cardiac MRI is a useful technique to confirm the diagnosis. Lipomas are distinct from lipomatous hypertrophy of the interatrial septum. *Lipomatous hypertrophy of interatrial septum (RA/LA) is a Lipomatous thickening of the interatrial septum that creates a dumbbell-like appearance of the superior and inferior atrial septum, sparing the fossa ovalis. It is limited to the interatrial septum and does not protrude into the atrial cavity. It may mimic an infiltrative process.*

**Primary malignant** tumours make up 25% of primary cardiac tumours and the vast majority are **sarcomas**.

- There are various types of cardiac sarcoma, including angiosarcoma, rhabdomyosarcoma, malignant fibrous histiocytoma and osteosarcoma. Angiosarcomas are the commonest primary malignant tumour (9%) with rhabdomyosarcomas accounting for 5% and fibrosarcomas for 3%.
- Sarcomas are sometimes described as a ‘cauliflower’ mass due to their irregular borders.
- Sarcomas can arise from the inter-atrial **septum** and extend into the atrial appendage.
- Sarcomas can invade myocardium and pericardium, leading to a pericardial effusion.
- Sarcomas have a predilection for the RA but do occur in the LA.
- Angiosarcomas almost always affect the RA and they occur more commonly in men.

- CT/MRI is often required for tissue characterization
- **Remember:** Secondary malignant tumours are the commonest tumours found in the heart.

**Hints:**

- Transpulmonary contrast may help differentiate tumour from thrombus if there is a rich blood supply to the cardiac tumour
- The most common benign primary cardiac tumour is a myxoma (27%). Lipomas and papillary fibroelastomas account for 10% each, mesothelioma of the AV node accounts for 1% of benign tumours.
- Extracardiac masses can be visible without evidence of pericardial collection, e.g. coronary aneurysm, hiatus hernia

## CARDIAC THROMBUS

Cardiac thrombus is more likely to form when:

1. There is stasis (or slow flow) of blood
2. There is abnormal endocardium (allowing thrombus to attach)
3. The blood is hypercoagulable (making it more likely to clot).

**LA (and LAA) thrombus** formation is more likely in AF, when there is a loss of normal atrial contraction. Compared with a **myxoma**, a thrombus usually has a more irregular shape. Thrombus usually attaches to the endocardium via a broad base rather than a pedicle, and is consequently less mobile. It is important to try to distinguish between thrombus and the **pectinate muscles**, the normal muscle ridges found on the walls of both atria and the appendage. Pectinate muscles are immobile and run in bands; thrombus is usually more rounded and mobile. Rheumatic MS carries a high risk of thrombus formation even when in sinus rhythm.

**LV thrombus** formation would be very unusual in the presence of a structurally normal LV with good function. Thrombus formation is more likely in LV regions of akinesia or significant hypokinesia following myocardial infarction, when reduced contractility predisposes to thrombus formation (particularly if there is aneurysm formation). Pseudo-aneurysms are also often lined with thrombus.

**Right heart thrombus** is less commonly found, and may represent a thromboembolism that has arisen in the peripheral veins and is 'in transit' to becoming a pulmonary embolism. Another cause of right heart thrombi is the presence of devices such as pacing/defibrillator leads or intravascular catheters, which can act as a focus for thrombus formation.

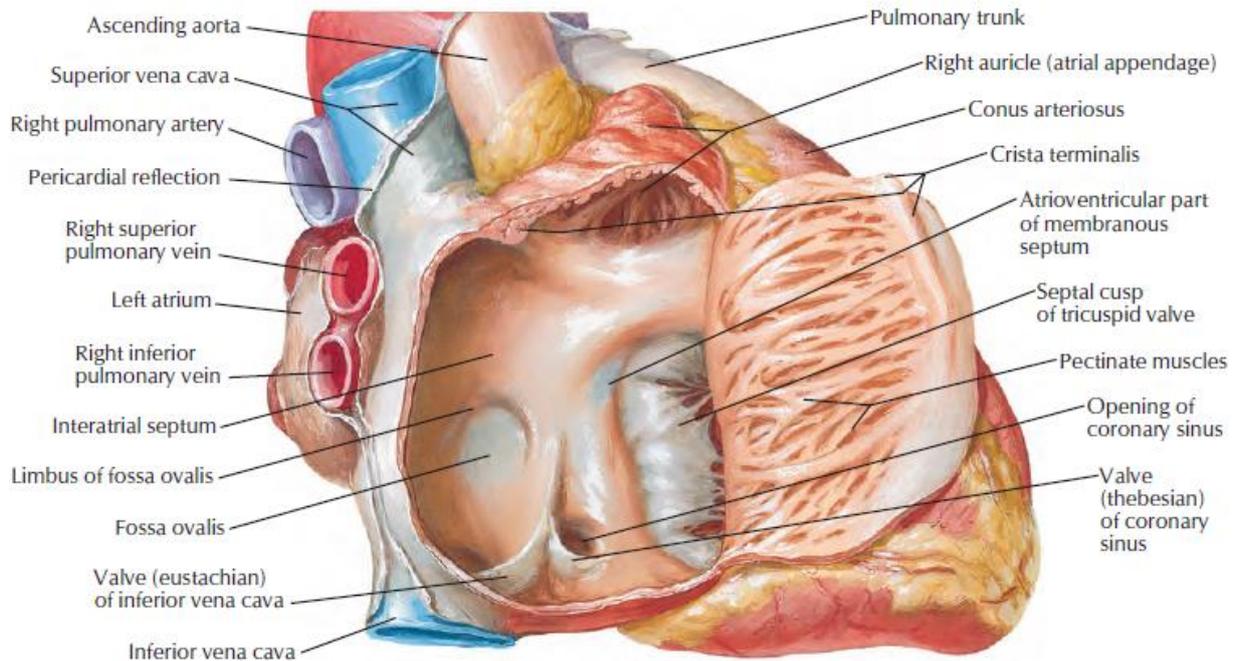
**Spontaneous echo contrast**- stasis of blood within the heart (and sometimes even the aorta) can be evident as 'spontaneous echo contrast'. This has the appearance of a swirling 'cloud' of tiny particles, hence it is sometimes referred to as 'smoke'. Spontaneous contrast is caused by echo reflections from aggregations of red blood cells moving at low velocity, and it is most often observed in the LA (TOE is more sensitive) in patients in AF, particularly if they also have mitral stenosis. Spontaneous echo contrast indicates an increased risk of thrombus formation. TTE is better than TOE for the detection of ventricular thrombus, as the ventricle is closer to the probe on TTE imaging.

**Hypereosinophilia** due to eosinophilic leukaemia, tropical hypereosinophilia, or idiopathic eosinophilia results in characteristic abnormalities detected with echocardiography. The most classic abnormality is obliteration of the left or right ventricular apex by laminar thrombus. Pathologically, the thrombus is composed of inflammatory tissue, thrombus, and eosinophilic infiltrates. It results in a reduction of ventricular chamber size and increasing stiffness, resulting in a restrictive cardiomyopathic picture. Additionally, hypereosinophilic syndrome has a propensity to involve the posterior left ventricular wall and posterior mitral valve leaflet and result in MR

## CARDIAC VEGETATIONS

The characteristic echo appearance of a vegetation is of an echogenic mass, irregular in shape, attached to the 'upstream' side of a valve leaflet (i.e. side of the **proximal** chamber). Vegetations can be attached to any part of the valve, but most commonly at the coaptation line. Vegetations move with the leaflet but in a more chaotic ('oscillating') manner. It is common for a vegetation to prolapse through the valve as it opens.

## ANATOMIC VARIANTS MIMICKING PATHOLOGY ON ECHOCARDIOGRAPHY



Opened right atrium: right lateral view

### RELATED TO THE RIGHT ATRIUM

- **Eustachian Valve** is a residual **embryonic** attachment seen sometimes at the point of entry of the IVC into the RA. When this valve has a more extensive fenestration, it is termed the Chiari network. Both are considered normal variants, but can be mistaken for a mass, thrombus or vegetation.
- **Chiari Network** is a residual **embryonic** attachment seen as a multiple filamentous structures attached to the RA wall near the RA-IVC junction and extending into the RA cavity. It is thought to be a variant of Eustachian valve with more extensive fenestration. It is highly mobile with a random movement, not necessarily related to valvular movement. It is present in around 2% of the population as a normal variant and should be differentiated from free RA thrombus. The presence of a Chiari network is associated with an increased risk of ASD/PFO.
- **Lipomatous hypertrophy of interatrial septum (RA/LA)** is a Lipomatous thickening of the interatrial septum that creates a dumbbell-like appearance of the superior and inferior atrial septum, sparing the fossa ovalis. It is limited to the interatrial septum and does not protrude into the atrial cavity. It may mimic an infiltrative process.
- **Crista Terminalis** is a well-defined **fibromuscular** ridge separating a smooth sinus venarum and trabeculated RA. Externally, it corresponds to the sulcus terminalis, and internally, it extends from the SVC to IVC along the **lateral** RA wall. Prominent crista terminalis may be confused for RA tumour on TTE, but crista terminalis is differentiated by (1) its appearance as a nodular mass of similar echogenicity with adjacent myocardium, (2) its location at the posterolateral wall of the RA near the SVC, which corresponds to the course of crista terminalis connecting the SVC and IVC, and (3) the phasic change in its size becoming thicker or larger during atrial systole
- **Pectinate Muscles (RA/LA)** A series of parallel **ridges** known as pectinate muscles course across the anterior endocardial surfaces of the left and right atria, including both appendages
- Catheters/pacemaker leads
- Fatty material (surrounding the tricuspid annulus)

### RELATED TO THE LEFT ATRIUM

- **Lipomatous hypertrophy of interatrial septum (RA/LA)**
- **Pectinate muscles (RA/LA)**
- Suture line following transplant
- Fossa ovalis
- Calcified mitral annulus
- Coronary sinus
- Ridge between LUPV and LAA
- Transverse sinus

### RELATED TO THE RIGHT VENTRICLE

- **Moderator Band:** a prominent **muscular ridge** that stretches between the RV free wall and is particularly well seen from the apical window
- **Lushka's muscle** is an accessory **papillary muscle** of the septal leaflet of the TV sometimes seen in the RVOT
- Catheters and pacemaker leads
- Muscle bundles/trabeculations

### RELATED TO THE LEFT VENTRICLE

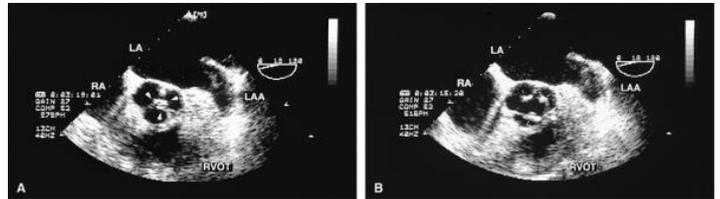
- False chords
- Papillary muscles
- Left ventricle trabeculations

### RELATED TO THE AORTA

- Brachiocephalic vein
- Innominate vein
- Pleural effusion

### RELATED TO THE AORTIC VALVE

**Nodulus Arantii** are small **fibrous** nodules, which can be seen at the centre of the free edge of each cusp of the aortic valve. They are normal variants that may be due to repeated cusp coaptation and are more prominent in older patients.



**Lambl's Excrescences** thin, delicate filamentous strands that arise from the ventricular edge of aortic cusps. Considered normal variants, these structures are seen increasingly with advancing age and improved image quality. As such, they may represent a form of degenerative change of the valve that occurs over time. They can occasionally be multiple. An important goal in the evaluation of such structures is to distinguish them from pathologic entities, especially vegetations. This can be difficult and generally requires some consideration of the clinical setting

