Compression of the left atrium by extra-cardiac structures is a rare cause of dyspnoea or reduced exercise tolerance and can easily be visualized by transthoracic echocardiography (TTE). An impression of the left atrium visualized by TTE could be the first indication of the presence of a pathological structure dorsal to the left atrium; such a structure can, in time, compress the left atrium. The existence of this phenomenon and its clinical implications will be reviewed. The impressing structures are divided into four anatomic groups: (i) gastrointestinal structures, which are the most common, (ii) mediastinal structures, (iii) aorta and intrapericardial structures, and (iv) pulmonary structures. Explanatory examples of left atrial impression with different causes and various levels of severity are presented.

**KEYWORDS**
Left atrial compression; Extra-cardiac diagnosis; Sarcoidosis

**Introduction**
Echocardiography is the primary non-invasive imaging modality for the assessment of cardiac anatomy and function. Two well-known indications for transthoracic echocardiography (TTE) are suspected left ventricular (LV) dysfunction and valvular disease. When cardiac function is normal and a direct explanation for dyspnoea, reduced exercise tolerance, or fatigue is unclear, special attention must be paid to the region dorsal to the left atrium. In some cases, non-cardiac pathology can be found in that area which can account for these symptoms.

It is more than 10 years ago when this subject was last reviewed. More recently, different case reports were presented. This article discusses the subject matter and reviews the available case reports.

**Anatomy**
The left atrium is an infero-posteriorly located cardiac chamber with a low intraluminal pressure. It has a relatively thin wall, making, in particular the left atrium vulnerable to impression from the assorted structures mentioned in Table 1. Especially, the oesophagus and the descending aorta have parts located very near the left atrium (Figure 1). The four pulmonary veins approach the left atrium through the postero-lateral side; this position makes these veins also susceptible to impression from the same structures.

**Classification and diagnosis**
D'Cruz et al. proposed the subdivision of left atrial impression based on the severity of anatomical deformation and its haemodynamic consequences into three different classes: (i) proximity (a contiguous or adjacent structure without chamber deformation), (ii) encroachment (distortion of normal cardiovascular architecture without haemodynamic effect), and (iii) compression (where impression leads to severe inflow obstruction causing haemodynamic instability and symptoms). Per definition proximity and encroachment do not lead to symptoms and are, therefore, mostly accidental findings.

Compression of the left atrium reduces the volume of the left atrium and causes low cardiac output, giving dyspnoea, reduced exercise tolerance, or even haemodynamic instability. In addition, left atrial pressure rises with the subsequently elevated pulmonary venous pressure, which may eventually lead to pulmonary oedema. A combination of these symptoms is often suggestive of heart failure or can mimic a cardiac tamponade.

Even a slight impression of the left atrium can be visualized using standard echo views. The round shape of the atrial wall becomes distorted. These characteristics make the use of transoesophageal echocardiography (TEE) in diagnosing left atrial impression in most situations unnecessary.

The analysis with TTE is limited in cases with a poor sonographic window, as seen with extreme obesity, mechanical ventilation, or post-thoracic surgery setting. The analysis with TEE is indicated under these circumstances.

Colour flow Doppler echocardiography can visualize the turbulent blood flow into the left atrium, which is an indication of significant compression of the pulmonary veins.
A contrast echo can be used to differentiate between a compressive vascular (e.g. a thoracic aneurysm) or a non-vascular (e.g. the oesophagus) structure. An additional CT or MRI scan can give a more comprehensive view of the structure and more insight into its origin. The use of intravenous contrast outlines the possible participation of major blood vessels in the impressing mass.

Pressure measured by right heart catheterization in the wedge position can be used to estimate the left atrial pressure. A relative low cardiac output can be measured in the case of a compression of the left atrium, despite a normal LV function. Such a measurement has, to the best of our knowledge, not yet been described in the literature.

The impressing structures

Left atrial compression or encroachment diagnosed with TTE has been reported previously. We give an overview of the reported structures, which we have divided into four categories based on its origin. An example is included with each category.

<table>
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<th>Category</th>
<th>Examples</th>
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| A: gastrointestinal structures | Impression of the left atrium due to gastrointestinal structures is either caused by distension of structures in their normal position or by displacement of structures (sometimes combined with distension). The most frequently mentioned example of a displaced structure is migration of the stomach through a diaphragmatic hernia. 
Raza et al. presented three patients with an intrathoracic located stomach causing severe left atrial compression leading to haemodynamic instability. Aspiration of stomach contents resulted in immediate improvement. A swallow syncope is usually caused by a rapid increase in the vagal tone, resulting in bradycardia or atrioventricular block. However, after swallowing, syncope can also be the result of a transient compression of the left atrium because of a rapid distension of an intrathoracic lying stomach or an oesophageal hernia sac, resulting in tachycardia.
An intrathoracic lying gastric volvulus compressing the left atrium is a typical example of a displaced structure with also abnormal distention.
Achalasia, a disease in which an impaired relaxation of the lower oesophageal sphincter causes abnormal distension of the distal oesophagus, can result in the compression of the left atrium and is an example of abnormal distension without displacement.
Chronic gastric volvulus by a para-oesophageal hernia and a diaphragmatic hernia.
Pseudoaneurysm with subepicardial dissection onto the left atrial wall.
Haematoma from rupture of type B aortic dissection.
Pericardial cyst.
Pericardial haematoma.
D: pulmonary structures
Lung tumour.
Bronchogenic cyst.

Category B: mediastinal structures

Dubrava et al. described a paracardiac lymphoma compressing the left atrium that caused a recurrent syncope. Transthoracic echocardiography was the first imaging technique that indicated a mediastinal tumour. Initial presentation of lymphoma with cardiac symptoms is rare.
Two other reported causes of mediastinal compression of the left atrium are a thymoma and a schwannoma.

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A literature overview of extrinsic left atrial impression illustrated by four examples

Figure 3 Transthoracic echocardiography (A) shows an impression of the left atrium (arrow) due to lymphadenopathy in sarcoidosis, in a haemodynamic stable patient with progressive dyspnoea and reduced exercise tolerance. LA, left atrium; RA, right atrium; LV, left ventricle. Colour flow Doppler echocardiography (not included) demonstrated turbulent flow from the pulmonary veins into the left atrium, indicating compression of the pulmonary veins. The additional CT scan (B) revealed a mediastinal mass posterior to the left atrium (arrows).

Figure 4 Transthoracic echocardiography (A) and computed tomography scan (B) of a 76-year-old patient with the symptoms of an obstructive shock. Analysis first with transthoracic echocardiography later with computed tomography scanning depicts a descending aneurysm with a large intramural hematoma (arrows on computed tomography scan) compressing the left atrium, having a maximum diameter of 13 cm. Inflow of the left atrium was severely compromised (arrow on TTE). LA, left atrium; LV, left ventricle; Ao, aorta.

Figure 5 Analysis with transthoracic echocardiography (A) revealed an echolucent mass impressing the left atrium (arrow) in an asymptomatic patient. LA, left atrium; RA, right atrium; LV, left ventricle; c, echolucent mass. Later performed chest X-ray (B) shows a retrocardiac mass (arrow). Biopsy identified the structure as a bronchogenic cyst.

Figure 3 depicts the impression of the left atrium by lymphadenopathy in sarcoidosis in a patient with progressive dyspnoea. Sarcoidosis has, to the best of our knowledge, never been described before to cause compression of the left atrium.

Category C: aorta and intrapericardial structures

Dissected and non-dissected aneurysm of the aortic root and of the descending aorta can cause left atrium compression.19,20 The described aneurysms of the descending aorta have a maximum diameter of at least 7 cm.21,22 Pericardial haematomas caused by cardiac surgery, percutaneous coronary intervention, or a rupture of a type B dissection23 can cause left atrial compression. Pericardial adhesions restrict the area of the haematoma, resulting in a local area impressing the cardiac wall. This directs their spreading along the path of least resistance. The characteristic echographical view of a pericardial haematoma is a heterogeneous mass with smooth edges broadly attached to posterior and/or lateral walls.

Figure 4 is an example of a compression of the left atrium by a large aneurysm of the descending aorta with a prominent thrombus.

Category D: pulmonary structures

A lung tumour and a cyst arising from the lung parenchyma have been reported to cause left atrial impression.2,24,25 Bronchogenic cysts are lesions of congenital origin and are positioned usually in the lung parenchyma or mediastinum. Most bronchogenic cysts will eventually result in symptoms caused by the compression of local structures, rupture of the cyst, or infections.26 Mawatari et al.24 reported compression of the left atrium due to a large bronchial cyst positioned near the carina with adhesions to the left atrium wall. Complete extirpation of bronchogenic cysts is often possible, gives an excellent prognosis, and is nowadays generally recommended. Especially, in the cases of structures near the cardiac wall, extirpation must be considered to prevent adhesion in future.25,26 Figure 5 shows left atrial compression caused by a bronchogenic cyst.

Discussion and recommendations

Structures of various origin can impress the left atrium. These structures generally grow slowly, which offers a relatively long period, in which these structures can be discovered using TTE, before they generate symptoms of compression. Owing to the more widespread use of TTE in order to investigate all kinds of cardiac symptoms, even in patients without symptoms of left atrial impression, pathological structures dorsal to the left atrium will be seen more frequently. In these cases, TTE will lead to a diagnosis of extra-cardiac pathology.

Left atrium compression could lead to symptoms mimicking congestive heart failure. Unlike left atrial compression, congestive heart failure is associated with an enlarged left atrium. Particularly in patients who do not respond to medical therapy of heart failure, a compression of the left atrium must be kept in mind and can be further evaluated using TTE with special attention to the size of the left atrial, distortion of left atrial walls, and the area dorsal to the left atrium.

Analysis with TEE can be used to obtain more information about the impressing structure or can be used when TTE has limitations.

When a structure behind the left atrium is diagnosed using TTE, an additional CT scan can give a more comprehensive view of this structure and more insight into its origin.

Once a pathological structure behind the left atrium has been diagnosed, careful monitoring to determine the...
growth of the structure and the effects on the cardiac wall is necessary. In some cases, especially when compression is present or expected in near future or when the structure is growing fast, surgical removal has to be considered.

In conclusion, structures dorsal to the left atrium can be visualized using TTE and this can lead to a diagnosis of extracardiac pathology. These structures can increase in size, which can ultimately lead, in a number of cases, to compression of the left atrium. This causes symptoms of inflow disturbance. Therefore, left atrial compression must be kept in mind as an infrequent cause of dyspnoea and is essential to be recognized in time.

Conflict of interest: none declared.

References


