European Journal of Echocardiography (2008) **9**, 661–664
doi:10.1093/ejechocard/jen031

# Left atrial impression: a sign of extra-cardiac pathology

**Johan M. van Rooijen and Lambert F.M. van den Merkhof***

*Department of Cardiology, Scheper Ziekenhuis Emmen, PO Box 30002, 7800 RA Emmen, The Netherlands*

Received 24 August 2007; accepted after revision 9 January 2008; online publish-ahead-of-print 26 April 2008

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

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.

## 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.[1] 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.

* Corresponding author. Tel: +31 591 691275; fax: +31 591 691278.
*E-mail address*: l.vdmerkhof@sze.nl

## 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.[1]

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.[2] 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.

**Table 1** Reported causes of extrinsic encroachment or compression of the left atrium

| | |
|---|---|
| A: gastrointestinal (GI) tract | C: aorta/intrapericardial structures |
| Diaphragmatic and oesophageal hernia[4–9] | Ascending thoracic aortic aneurysm[19,20,27] |
| Oesophageal leiomyosarcoma[15] | Descending thoracic aortic aneurysm[21,22,28] |
| Achalasia[3,12,13] | Aortic root dilatation and scoliosis[29] |
| Chronic gastric volvulus by a para-oesophageal hernia[11] and a diaphragmatic hernia[10] | Pseudoaneurysm with subepicardial dissection onto the left atrial wall[30] |
| Oesophageal haematoma[14] | Haematoma from rupture of type B aortic dissection[23,31] |
| B: mediastinum | Pericardial cyst[32] |
| Mediastinal lymphoma[16,33] | Pericardial haematoma[34,35] |
| Mediastinal schwannoma[18] | D: pulmonary structures |
| Sarcoidosis (this article) | Lung tumour[2] |
| Thymoma[17] | Bronchogenic cyst[24,25] |

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.[3]

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.

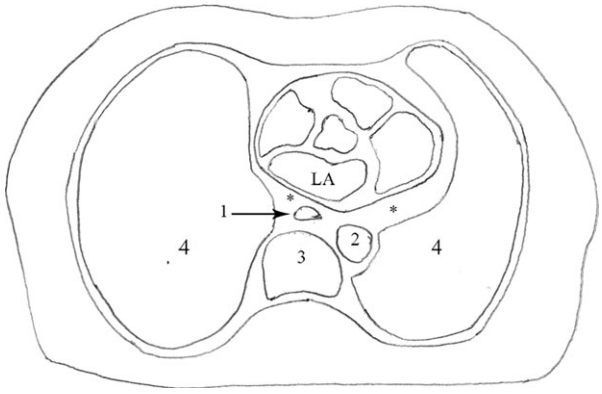


**Figure 1** Transversal schematic at the level of the left atrium. LA, left atrium; 1, oesophagus; 2, aorta descendens; 3, corpus vertebra; 4, lungs; *mediastinum.

### Category 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.[4–8]

Raza *et al.*[7] 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.[6,9]

An intrathoracic lying gastric volvulus compressing the left atrium is a typical example of a displaced structure with also abnormal distention.[10,11]

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.[3,12,13] Another example of abnormal distension without displacement is an oesophageal haematoma or a leiomyosarcoma of the oesophagus.[14,15]

Left atrial compression mediated through gastrointestinal structures is characterized by upper gastrointestinal complaints, such as pyrosis and nausea, and by a postprandial relation with symptoms of left atrial compression.

As an example of this category, *Figure 2* depicts the result of a TTE and a chest X-ray of a patient with an intrathoracic lying stomach, showing left atrial wall impression and a retrocardiac mass with air and a fluid level. This is an example of compression because of displacement of a structure.

### Category B: mediastinal structures

Dubrava *et al.*[16] 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.[17,18]

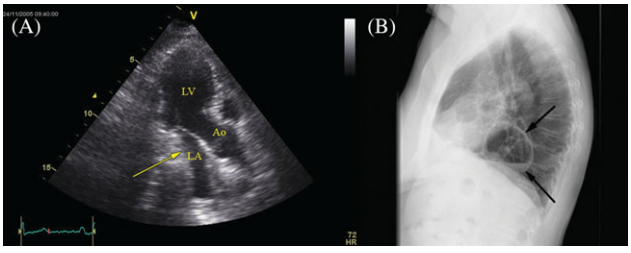


**Figure 2** Transthoracic echocardiography analysis (*A*) in a patient with postprandial dyspnoea complaints revealed an impression of the left atrium (arrow). LA, left atrium; LV, left ventricle, Ao, aorta. Chest X-ray (*B*) shows an intrathoracic lying stomach appearing as a retrocardiac mass (arrows) with air and a fluid level.

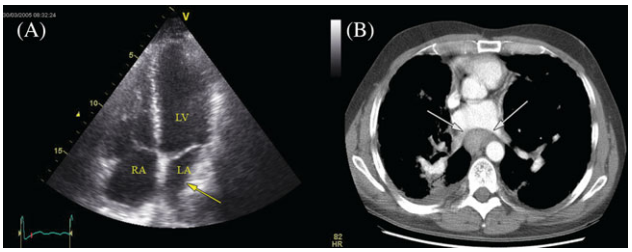


**Figure 3** Transthoracic echocardiography (*A*) shows an impression of the left atrium (arrow) due to lymphadenopathy in sarcoidosis, in a haemodynamic stable patient with progressive dyspnoea and reduced exercise tolerance. LA, left atrium; RA, right atrium; LV, left ventricle. Colour flow Doppler 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).

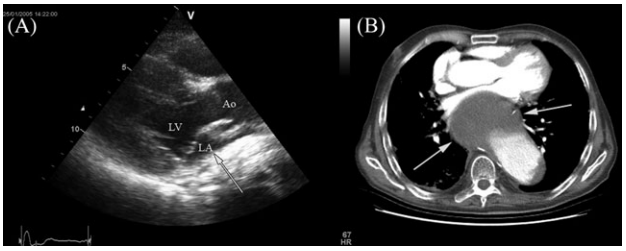


**Figure 4** Transthoracic echocardiography (*A*) and computed tomography scan (*B*) of a 76-year-old patient with the symptoms of an obstructive shock. Analysis first with transthoracic echocardiography later with computed tomography scanning depicts a descending aneurysm with a large intramural hematoma (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.

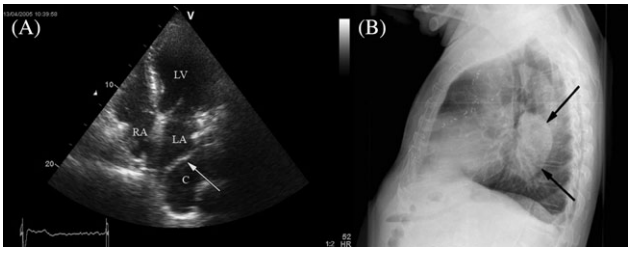


**Figure 5** Analysis with transthoracic echocardiography (*A*) revealed an echolucent mass impressing the left atrium (arrow) in an asymptomatic patient. LA, left atrium; RA, right atrium; LV, left ventricle; c, echolucent mass Later performed chest X-ray (*B*) shows a retrocardiac mass (arrow). Biopsy identified the structure as a bronchial 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 dissection[23] 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


1. D'Cruz IA, Feghali N, Gross CM. Echocardiographic manifestations of mediastinal masses compressing or encroaching on the heart. *Echocardiography* 1994;**11**:523–33.
2. DeLuca A, Daniels S, Pathak N. Pulmonary edema due to extreme left atrial compression. *N J Med* 1991;**88**:37–8.
3. Stoupakis G, Fuhrman MA, Dabu L, Knezevic D, Saric M. The use of contrast echocardiography in the diagnosis of an unusual cause of congestive heart failure: achalasia. *Echocardiography* 2004;**21**:149–52.
4. Hunt GS, Gilchrist DM, Hirji MK. Cardiac compression and decompensation due to hiatus hernia. *Can J Cardiol* 1996;**12**:295–6.
5. Ito H, Kitami M, Ohgi S, Ohe H, Ozoe A, Sasaki H *et al*. Large hiatus hernia compressing the heart and impairing the respiratory function: a case report. *J Cardiol* 2003;**41**:29–34.
6. Maekawa T, Suematsu M, Shimada T, Go M, Shimada T. Unusual swallow syncope caused by huge hiatal hernia. *Intern Med* 2002;**41**:199–201.
7. Raza ST, Mukherjee SK, Danias PG, Abraham J, Johnson KM, Sands MJ Jr *et al*. Hemodynamically significant extrinsic left atrial compression by gastric structures in the mediastinum. *Ann Intern Med* 1995;**123**:114–6.
8. Siu CW, Jim MH, Ho HH, Chu F, Chan HW, Lau CP *et al*. Recurrent acute heart failure caused by sliding hiatus hernia. *Postgrad Med J* 2005;**81**:268–9.
9. Oishi Y, Ishimoto T, Nagase N, Mori K, Fujimoto S, Hayashi S *et al*. Syncope upon swallowing caused by an esophageal hiatal hernia compressing the left atrium: a case report. *Echocardiography* 2004;**21**:61–4.
10. Kalra PR, Frymann R, Allen DR. Strangulated gastric volvulus: an unusual cause of cardiac compression resulting in electromechanical dissociation. *Heart* 2000;**83**:550.
11. Shriki JE, Nguyen K, Rozo JC, Reul GJ, Mortazavi A. Rare chronic gastric volvulus associated with left atrial and mediastinal compression. *Tex Heart Inst J* 2002;**29**:324–8.
12. Mates M, Veselka J, Belohlavek J. Esophageal achalasia compressing the heart diagnosed by echocardiography. *Int J Cardiol* 1998;**66**:225–7.
13. Yilmaz MB, Arat N, Biyikoglu SF, Korkmaz S, Sabah I. Extrinsic left atrial compression in a patient with achalasia. *Int J Cardiol* 2002;**85**:301–3.
14. Nault I, Bertrand OF. Severe haemodynamic compromise due to left atrial compression by oesophageal haematoma. *Heart* 2007;**93**:1190.
15. Nishi K, Yamada M, Morishita D, Nakamura Y, Murata Y, Fujioka M *et al*. Leiomyosarcoma of the esophagus associated with pulmonary edema by the compression of the left atrium. *Nihon Kyobu Shikkan Gakkai Zasshi* 1991;**29**:1042–6.
16. Dubrava J, Drgona L, Kadlecik R. An unusual cause of recurrent syncope: mediastinal lymphoma diagnosed with transesophageal echocardiography. *Eur J Intern Med* 2005;**16**:204–6.
17. Canedo MI, Otken L, Stefadouros MA. Echocardiographic features of cardiac compression by a thymoma simulating cardiac tamponade and obstruction of the superior vena cava. *Br Heart J* 1977;**39**:1038–42.
18. Mondillo S, Agricola E, Ammaturo T, Guerrini F. A mediastinal schwannoma causing left atrial compression. *J Cardiovasc Surg(Torino)* 1999;**40**:319–20.
19. Anton E, Echeverria M. Images in cardiovascular medicine. An uncommon complication of nondissected ascending aortic aneurysm. *Circulation* 2005;**112**:e116–7.
20. Walpot J, Amsel B, Pasteuning WH, Olree M. Left atrial compression by dissecting aneurysm of the ascending aorta. *J Am Soc Echocardiogr* 2007;**20**:1220–6.
21. Breall JA, Goldberger AL, Warren SE, Diver DJ, Sellke FW. Posterior mediastinal masses: rare causes of cardiac compression. *Am Heart J* 1992;**124**:523–6.
22. Celenk MK, Ozeke O, Selcuk MT, Selcuk H, Cagli K. Left atrial compression by thoracic aneurysm mimicking congestive heart failure. *Echocardiography* 2005;**22**:677–8.
23. Pyatt JR, Osula S, Mushahwar SS, Somauroo JD, Charles RG. Extrinsic compression of the left atrium: an unusual complication of a type B aortic dissection. *Int J Cardiol* 2001;**79**:89–90.
24. Mawatari T, Itoh T, Hachiro Y, Harada H, Kobayashi T, Saitoh T *et al*. Large bronchial cyst causing compression of the left atrium. *Ann Thorac Cardiovasc Surg* 2003;**9**:261–3.
25. Volpi A, Cavalli A, Maggioni AP, Pieri-Nerli F. Left atrial compression by a mediastinal bronchogenic cyst presenting with paroxysmal atrial fibrillation. *Thorax* 1988;**43**:216–7.
26. Sarper A, Ayten A, Golbasi I, Demircan A, Isin E. Bronchogenic cyst. *Tex Heart Inst J* 2003;**30**:105–8.
27. Minematsu N, Furumi K, Ohara T, Goto R, Tanaka M, Watanabe T *et al*. Left atrial pressure gradient and right heart failure secondary to compression of the left atrium by a huge ascending aortic aneurysm: a case report. *J Cardiol* 2000;**35**:129–33.
28. Gandhi NM, Greaves M, Brooks NH. Rare case of heart failure caused by compression of the left atrium by a thoracic aortic aneurysm. *Heart* 2004;**90**:e9.
29. Satou GM, McGowan FX, Colan SD. Left atrial compression from severe aortic root dilation and scoliosis. *Heart Dis* 2000;**2**:340–1.
30. Nathaniel C, Lane S, Palma R, Scheinerman SJ, Missri JC. Pseudoaneurysm causing partial obliteration of the left atrium: case report and review. *Catheter Cardiovasc Diagn* 1996;**38**:83–6.
31. Vicente T, Pascual D, Pinar E, Garcia A, Lopez J, Valdes M. Extrinsic compression of the left atrium as an infrequent and fatal form of type B aortic dissection: value of ECG. *Rev Esp Cardiol* 1997;**50**:590–2.
32. Urayama K, Sato K, Ohtomo E, Hashiguchi R, Haneda T, Kamei F *et al*. Surgical treatment of pericardial cyst causing cardiac compression, report of a case. *Rinsho Kyobu Geka* 1988;**8**:283–5.
33. Iwase M, Nagura E, Miyahara T, Goto J, Kajita M, Yamada H. Malignant lymphoma compressing the heart and causing acute left-sided heart failure. *Am Heart J* 1990;**119**:968–70.
34. Gologorsky E, Gologorsky A, Galbut DL, Wolfenson A. Left atrial compression by a pericardial hematoma presenting as an obstructing intracavitary mass: a difficult differential diagnosis. *Anesth Analg* 2002;**95**:567–9.
35. Kadner A, Chen RH, Collard CD, Adams DH. Isolated left atrial tamponade following circumflex artery angioplasty. *Heart* 2000;**84**:514.