Lipomatous Hypertrophy of the Interatrial Septum: A Case Report and Review of the Literature

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INTRODUCTION

Lipomatous hypertrophy of the interatrial septum (LASH) is a benign lesion characterized by massive accumulation of fat in the interatrial septum that exceeds 2 cm in thickness and is part of the differential diagnosis for malignant and benign atrial tumors. We report a case of an extreme form of LASH, discuss the main features of this lesion and the significant diagnostic role of noninvasive imaging modalities, and briefly review the existing literature.

CASE PRESENTATION

A 63-year-old man with suspicion for a malignant cardiac mass was referred from a local hospital for further evaluation. The patient reported mild shortness of breath and palpitations that started 6 months previously. He was obese (body mass index 35 kg/m^2) and reported a history of hypertension and diabetes, under pharmaceutical therapy (angiotensin-converting enzyme inhibitor and metformin, respectively). The clinical examination revealed a mild to moderate murmur of mitral regurgitation, posteroanterior chest radiography showed a normal cardiac silhouette, and electrocardiography revealed that the patient was in sinus tachycardia with frequent premature atrial contractions. To evaluate the possible cardiac cause of the patient's symptoms, we performed transthoracic echocardiography (TTE), which revealed a massive intracardiac atrial septal lesion partially exceeding 3 cm in width (indicating either an extreme form of a lipomatous septum or a mass) and mild to moderate mitral regurgitation (Figures 1A, 2, and 3, Video 1). Twenty-four-hour Holter monitoring revealed short but frequent episodes of atrial fibrillation. The next step in the diagnostic algorithm would normally be transesophageal echocardiography (TEE), but the patient was reluctant to undergo the examination. Thus, we performed cardiac magnetic resonance imaging (CMR), which showed homogeneous bilobar interatrial septal thickening, with sparing of the fossa ovalis. On T1-weighted sequences, the aforementioned thickening had increased signal intensity, similar to subcutaneous and pericardial fat, whereas on T1-weighted and T2-weighted sequences with fat suppression, low-intensity signal was seen. In first-pass perfusion images, there were no signs of increased vascularity, and in late gadolinium enhancement images, there was slightly inhomogeneous enhancement. These findings were pathognomonic of an extreme form of LASH (Figures 1B, 4, and 5, Video 2).

After completing the investigation, we initiated a β-blocker and an anticoagulant (rivaroxaban). The patient was reassured as to the benign nature of the lipomatous lesion and discharged with a recommendation for regular follow-up.

DISCUSSION

LASH was first reported by Prior in 1964.[1] Its prevalence ranges from 2.2% to 8%,[2,3] depending on the diagnostic modality used for its detection (multislice computed tomography vs TEE, respectively). It is a benign lesion of the interatrial septum characterized by massive accumulation of fat >2 cm thick.[2] Although the majority of patients with LASH remain asymptomatic, it is infrequently accompanied by atrial arrhythmias and even more rarely by malignant arrhythmias and sudden cardiac death.[2]

The exact mechanism of malignant arrhythmias in patients with LASH remains unknown, and a number of hypotheses have been proposed. Malignant cardiac arrhythmias may occur (1) as a result of extensive bleeding into the lesion; (2) because of coronary artery disease, which often coexists in the frequently obese and elderly patients with LASH; or (3) as a result of the involvement of the interatrial septum and the wall of the right atrium, which interfere with the architecture of atrial myocytes and subsequently could affect the conducting pathways.[4] The total volume of fat tissue and the characteristic "dome and dip" configuration of the P waves in leads II, III, and aVF of the electrocardiogram have been reported as predictive (risk) factors for the development of arrhythmias.[4,5] Furthermore, the extent of fat toward the superior vena cava may cause its obstruction and symptoms of congestive heart failure.[6] Notably, LASH is associated with obesity and advanced age,[2,3] which are also risk factors for atrial fibrillation. However, the independent relationship between LASH and supraventricular arrhythmias is yet to be established.[7] The optimal therapeutic management of patients with LASH consists of timely diagnosis, patient reassurance, and close follow-up. Nevertheless, surgical resection and septal reconstruction are possible therapeutic interventions in very rare cases of lesions that cause circulatory obstruction or malignant arrhythmias.[8]

Data regarding the etiology of LASH remain scarce.[5] Histologically, LASH is characterized by myocardial fibers, infiltrated with mature

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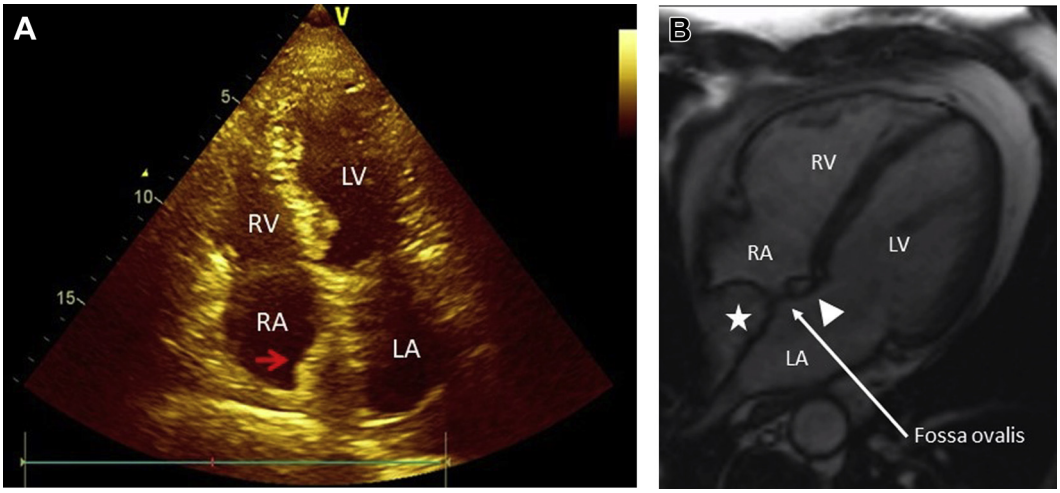

Figure 1 **(A)** TTE, apical four-chamber view. The *red arrow* indicates the thickened interatrial septum. **(B)** CMR of the LASH (*star*) in four-chamber view: end-diastolic frame of a cine image. Note that LASH spares the fossa ovalis. The *arrowhead* points to LASH anteriorly to the fossa ovalis. *LA*, Left atrium; *LV*, left ventricle; *RA*, right atrium; *RV*, right ventricle.

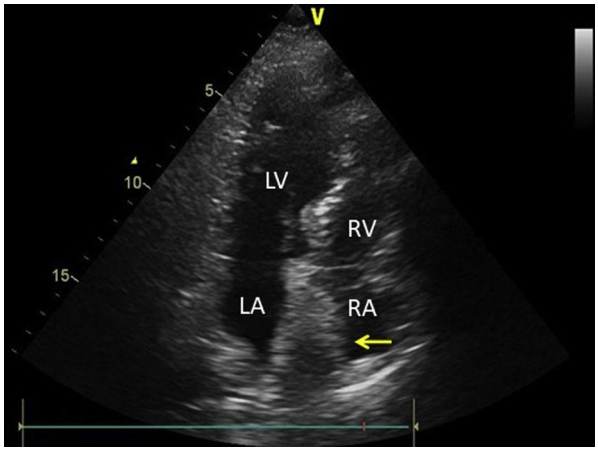

Figure 2 TTE, atypical apical four-chamber view. The *yellow arrow* indicates LASH. *LA*, Left atrium; *LV*, left ventricle; *RA*, right atrium; *RV*, right ventricle.

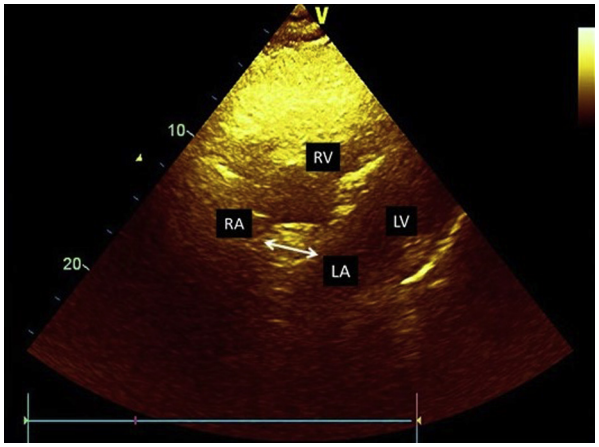

Figure 3 TTE, subcostal view. The *white arrow* represents the hypertrophied interatrial septal thickness. *LA*, Left atrium; *LV*, left ventricle; *RA*, right atrium; *RV*, right ventricle.

adipose cells, which are interspersed with fetal fat cells. The fat accumulation is cephalad and caudal to the fossa ovalis, accompanied by sparing of the fossa ovalis itself, which gives LASH its characteristic "dumbbell" shape.[9] Hypertrophy is usually more extensive in the cephalad portion of the interatrial septum compared with the caudal portion, and both parts project into the left and right atrial cavities. The differential diagnosis of LASH includes benign and malignant cardiac tumors involving the interatrial septum, such as metastases, myxomas, rhabdomyomas, fibromas, fibroelastomas, and mesotheliomas (Table 1).

A number of imaging modalities, including echocardiography, computed tomography, and CMR have been used for the diagnosis of LASH.[3] Two-dimensional TTE and TEE are the diagnostic modalities of choice[5] because these modalities are widely available, the cost per examination is low, and side effects are infrequent. In clinical practice, an echocardiographer examining a patient with a "cardiac mass" should take into consideration the patient's age and medical history, as well as the localization and echocardiographic characteristics of the lesion.[10] In our case, the patient was elderly and obese, and TTE revealed hypertrophy of the proximal and distal portions of the atrial septum with sparing of the fossa ovalis (dumbbell shape). The aforementioned characteristic appearance and location of LASH aids in echocardiographic differentiation from cardiac tumors and makes its diagnosis probable. Notably, among the most likely alternative diagnoses are myxomas and lipomas. However, myxomas originate from the interatrial septum near the fossa ovalis and usually have a stalk, whereas lipomas are encapsulated.[5] Echocardiographic contrast agents may assist in detecting an intracardiac mass and characterizing it further on the basis of the extent of contrast enhancement, which is a marker of vascularity. For example, malignant and highly vascular tumors manifest hyperenhancement with contrast, thrombi exhibit no enhancement at all, and myxomas show partial enhancement.[10] The role of three-dimensional TTE and TEE for the diagnosis of LASH is promising.[10] Computed tomography can be helpful for the differential diagnosis of LASH from malignancies, because of their different relative

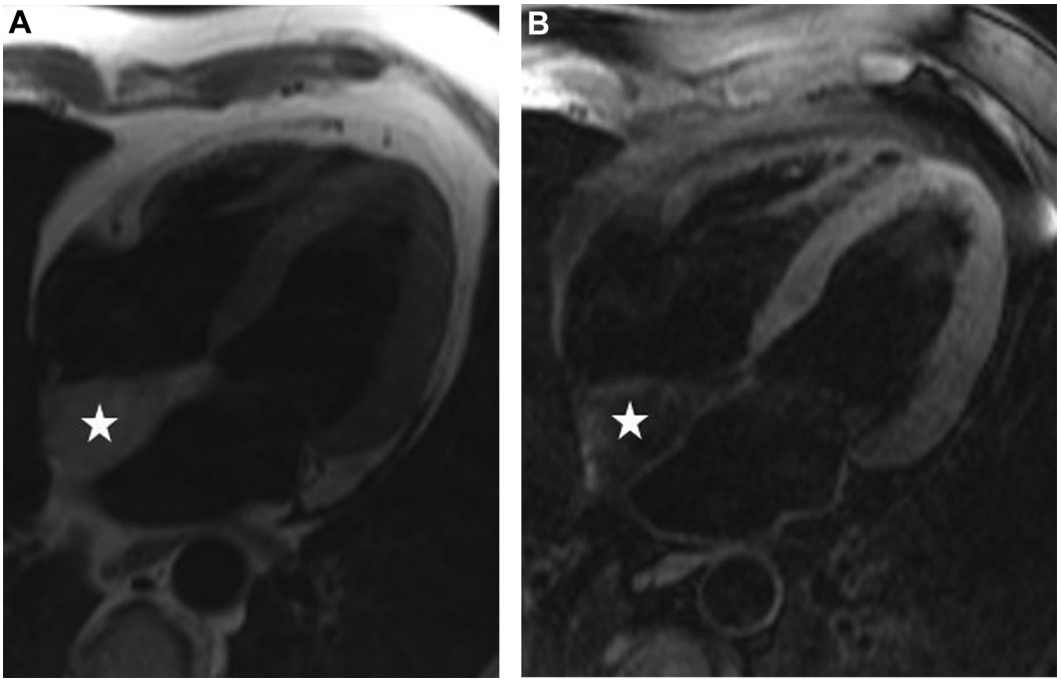

Figure 4 **(A)** CMR of LASH (*star*) in the four-chamber view. In T1-weighted images, LASH appears bright. **(B)** CMR of LASH (*star*) in the four-chamber view. In T1-weighted images with fat suppression, LASH appears dark. The combination of T1-weighted and T1-weighted images with fat suppression **(A,B)** is diagnostic for fat.

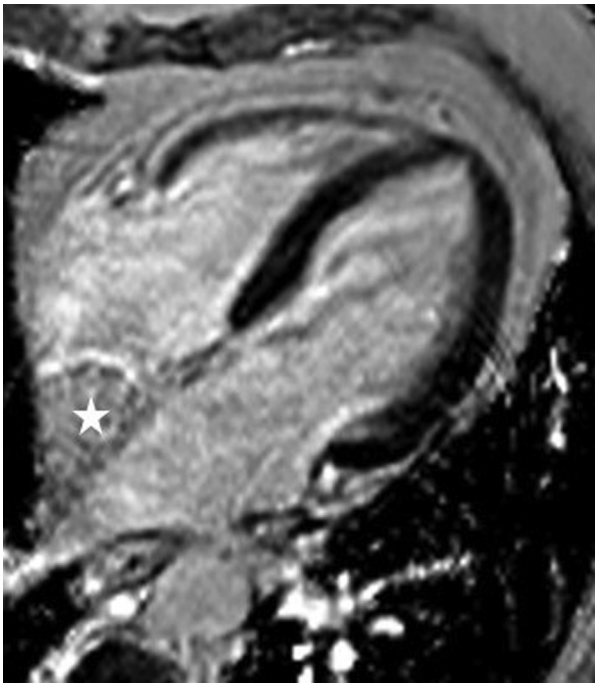

Figure 5 CMR of LASH (*star*) in the four-chamber view. In late gadolinium enhancement images, LASH shows mildly increased signal intensity compared with ventricular myocardium.

densities. In particular, LASH has the pathognomonic attenuation coefficient of adipose tissue, which is absent in neoplasms.[11] The role of CMR is crucial in determining the borders of LASH and the extension into the interventricular septum and the ventricular free wall. Furthermore, it can provide valuable information regarding lesion composition (fat, solid, cystic or fibrous tissue).[12] Regarding localization, morphology, and signal intensity, the CMR features suggesting a malignant nature of a mass are invasion of extracardiac structures, involvement of more than one cardiac chamber, involvement of the right side of the heart, tissue inhomogeneity, poor definition of borders, lesion diameter $>$ 5 cm, and the presence of pericardial or pleural effusion. The performance of a perfusion study during contrast agent injection assists in the confirmation of the diagnosis of malignancy and improved characterization of its nature.[13] LASH can sometimes be confused with lipomas because of similar signal characteristics on CMR. Differential diagnosis is based on fat extension (>2 cm) in transverse diameter, the involvement of the limbus of the fossa ovalis, and sparing of the fossa ovalis membrane, which are unique morphologic features of LASH.[12]

Our case shows the importance of a multimodality approach in patients with LASH. Bedside TTE revealed a lesion in the interatrial septum extending to both the left and right atria, making the diagnosis of LASH probable. CMR revealed the presence of fatty tissue in the interatrial septum with the characteristic "dumbbell" shape and confirmed the diagnosis. Electrocardiography depicted frequent premature atrial contractions, which were the reason for 24-hour Holter monitoring and the report of the episodes of atrial fibrillation. Although there are situations in which each imaging modality (TTE, TEE, computed tomography, and CMR) can individually establish the diagnosis of LASH, not infrequently the diagnosis is based on a combination of echocardiography and computed tomography or CMR,[14,15] as in our case.

Bearing in mind the increasing life expectancy of the general population, evolution of noninvasive imaging techniques, and the rising prevalence of obesity, the diagnosis of LASH is becoming more probable.

Table 1 Imaging characteristics and differential diagnosis of cardiac masses on the basis of two-dimensional echocardiography and CMR

Cardiac mass	Two-dimensional echocardiography	Echocardiographic contrast imaging	Cine CMR	T1-weighted imaging*	T1-weighted imaging, fat suppression	T2-weighted imaging*	T2-weighted imaging, fat suppression	LGE CMR (after contrast enhancement)
Pseudotumor								
Pericardial cyst	Echolucent mass adjoining the cardiac border, frequently septated	No enhancement	Encapsulated fluid-filled structure that generally is directly attached to the pericardium but rarely can be attached by a peduncle; usually located in the right pericardiophrenic angle	Low	Low	High	High	No uptake
Thrombus	Varies from a small, immobile mural mass to a large protruding mobile mass; may be homogeneously echogenic or may have heterogeneous texture with lucent areas	No enhancement	Isointense/ hypointense mass (if recent thrombus), typically located in the LA and less often in the LV; most often localized near a wall motion abnormality or in the left atrial appendage	Low (if recent, high)	Low (if recent, high)	Low (if recent, high)	Low (if recent, high)	No uptake
Benign mass								
Myxoma	Heterogeneous mobile mass pedunculated on a fibrovascular stalk (polypoid, papillary), in the region of the fossa ovalis	Partially enhanced	Hypointense, highly mobile, occasionally prolapsing through the mitral valve	Isointense	Isointense	High	High	Heterogeneous

(*Continued*)

Table 1 (*Continued*)

Cardiac mass	Two-dimensional echocardiography	Echocardiographic contrast imaging	Cine CMR	T1-weighted imaging*	T1-weighted imaging, fat suppression	T2-weighted imaging*	T2-weighted imaging, fat suppression	LGE CMR (after contrast enhancement)
Fibroma	Distinct, well-demarcated, noncontractile and solid, highly echogenic mass mainly in the LV	No enhancement	Isointense/ hypointense, solitary, well-defined, noncontractile mass that often narrows the ventricular cavity	Isointense	Isointense	Low	Low	Hyperenhancement
Lipoma	Homogeneous, broad-based, immobile, without a pedicle and encapsulated; most often small in size	No enhancement	Arise from the epicardium or endocardium; when originates from the endocardium, it manifests decreased mobility and a broad base of attachment	High	Low	High	Low	No uptake
LASH	Fatty infiltration of the proximal and distal portions of the atrial septum, generally with sparing of the fossa ovalis, without a stalk and most commonly seen in the elderly and obese	No enhancement	Nonencapsulated, immobile, hyperintense mass, without stalk; septal thickening >2 cm, sparing the fossa ovalis membrane (dumbbell shape)	High	Low	High	Low	No uptake

Rhabdomyoma	Small, well-circumscribed (multiple) nodules or a pedunculated mass in LV or RV, especially in infants and children	No enhancement	Arise intramurally in the ventricular myocardium and unlike fibromas, they are multiple in 90% of cases; they are well circumscribed and vary from a few millimeters to a few centimeters in size	Isointense	Isointense	Isointense/high	Isointense/high	No/minimal uptake
Malignant mass								
Angiosarcoma	Lobulated masses, distinctly heterogeneous with an area of necrosis or hemorrhage; they have no stalk, differentiating them from myxomas or papillary fibroelastomas; typically in the RA and RV	Hyperenhancement	Isointense (heterogeneous), large right atrial mass with or without pericardial involvement	Heterogeneous	Heterogeneous	Heterogeneous	Heterogeneous	Heterogeneous
Rhabdomyosarcoma	Arise from any cardiac structure, initially invade the pericardium	Hyperenhancement	Isointense mass, involves multiple sites within the heart, including the valves	Isointense	Isointense	Hyperintense	Hyperintense	Homogeneous

(*Continued*)

Table 1 (*Continued*)

Cardiac mass	Two-dimensional echocardiography	Echocardiographic contrast imaging	Cine CMR	T1-weighted imaging*	T1-weighted imaging, fat suppression	T2-weighted imaging*	T2-weighted imaging, fat suppression	LGE CMR (after contrast enhancement)
Sarcoma (undifferentiated)	Broad-based mass, typically in the LA (differential diagnosis is a myxoma) with heterogeneous echogenicity	Hyperenhancement	Isointense (heterogeneous) mass, most often in the LA	Isointense	Isointense	Hyperintense	Hyperintense	Heterogeneous
Lymphoma	Homogeneous, infiltrating masses leading to wall thickening or as nodular masses intruding into the heart chambers, especially the RA	Hyperenhancement	Isointense mass, most often in the RA accompanied by pericardial effusion	Isointense	Isointense	Isointense	Isointense	No/minimal uptake
Metastatic mass†	The pericardium is more frequently involved with metastases and typically presents with a pericardial effusion	Hyperenhancement	The most common site of involvement is the pericardium	Low	Low	High	High	Heterogeneous

LA, Left atrium; *LGE*, late gadolinium enhancement; *LV*, left ventricle; *RA*, right atrium; *RV*, right ventricle.
*T1- and T2-weighted imaging signal intensity is relative to myocardium.
†Metastatic melanoma has a high T1-weighted and a low T2-weighted signal intensity.

CONCLUSION

LASH is a benign lesion of the interatrial septum, often asymptomatic. The role of multimodality imaging techniques in the diagnosis of LASH is pivotal. Making a correct and timely diagnosis prevents the patient from undergoing unnecessary examinations with probable financial, social, and psychological consequences, because in most cases of LASH, the only therapeutic strategy consists of patient reassurance and regular follow-up.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.case.2017.06.005.

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