

## A Case of Left Atrial Free-Floating Thrombus

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A 74-year-old woman who had paroxysmal atrial fibrillation without mitral stenosis was hospitalized for syncope and right-sided weakness. Echocardiography revealed a large free-floating thrombus in the left atrium, sometimes prolapsing partially into the left ventricle in diastole. Because of her poor neurological status, she was managed with anticoagulation. On the 12th day, the thrombus had disappeared on the follow-up echocardiography, and aortoiliac embolization was later detected on computed tomography. Unfortunately, she developed various complications of stroke and limb infarction, and died after 4 months of hospital care. In addition to this case report, we reviewed a total 70 cases of left atrial free-floating thrombus. Atrial fibrillation and mitral pathology were two major causative factors. All the cases, except 1, were confirmed on echocardiography. The most common presentation that led to echocardiography was systemic embolization, followed by heart failure. Others were acute hemodynamic decompensation from mitral obstruction, chest pain, palpitation, and bacteremia. Cardiac thrombectomy was the preferred treatment modality with favorable outcomes.

**Key Words:** Echocardiography, Free floating, Left atrium, Thrombus

### Introduction

Left atrial free-floating thrombus (LAFFT) is rare type of left atrial thrombus that causes stroke, limb infarction, dyspnea, syncope, or sudden death. The thrombus is thought to begin as a small mural thrombus attached to the atrial wall or left atrial appendage [1]. The thrombus gradually grows to form a projecting mass that is connected by a pedicle

to the atrial wall. As the bulbous end of the thrombus enlarges, the pedicle becomes longer and thinner and finally vanishes. After the thrombus becomes free, it moves around in the left atrium, is polished by the atrial structure, and acquires a smooth, ball-like shape.

Wood in 1814 first used the term *ball thrombus* in a description of the autopsy findings of a 15-year-old girl who had rheumatic mitral stenosis and syncope [2]. In the pre-echographic era, the diagnosis depended on the presence of a ball-shaped thrombus during autopsy. In the echographic era, researchers described not only various echographic findings, especially free-floating movement of the thrombus, but also treatment modalities and outcomes.

Wrisley *et al.* [2] reviewed 11 reported cases of the echographic era (from 1976 to 1990) and literature reported in the pre-echographic era. Since echocardiography became widely available, numerous cases have been reported. In this study, we report our experience of a case of LAFFT and review other cases reported in the literature.

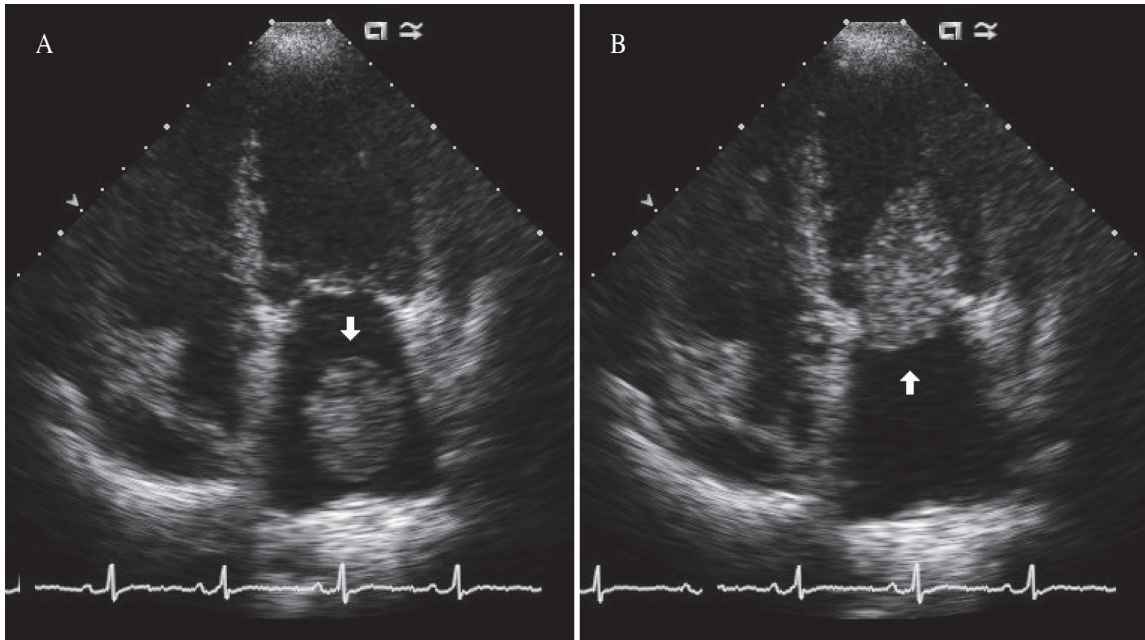
## Case Report

A 74-year-old woman presented to our hospital with syncope and weakness of the right limbs. Her medical history revealed type 2 diabetes and hypertension. She showed confused mentality and neurologic examination confirmed right-sided weakness. Her blood pressure was 110/80 mmHg, heart rate was regular at 80 beats/min, and respiratory rate was 20 breaths/min. Chest radiography revealed cardiomegaly, but no pulmonary congestion. Her laboratory finding was non-specific. Initial electrocardiography revealed sinus rhythm, but paroxysmal atrial fibrillation was detected during the admission period. Non-contrast brain computed tomography (CT) did not reveal any

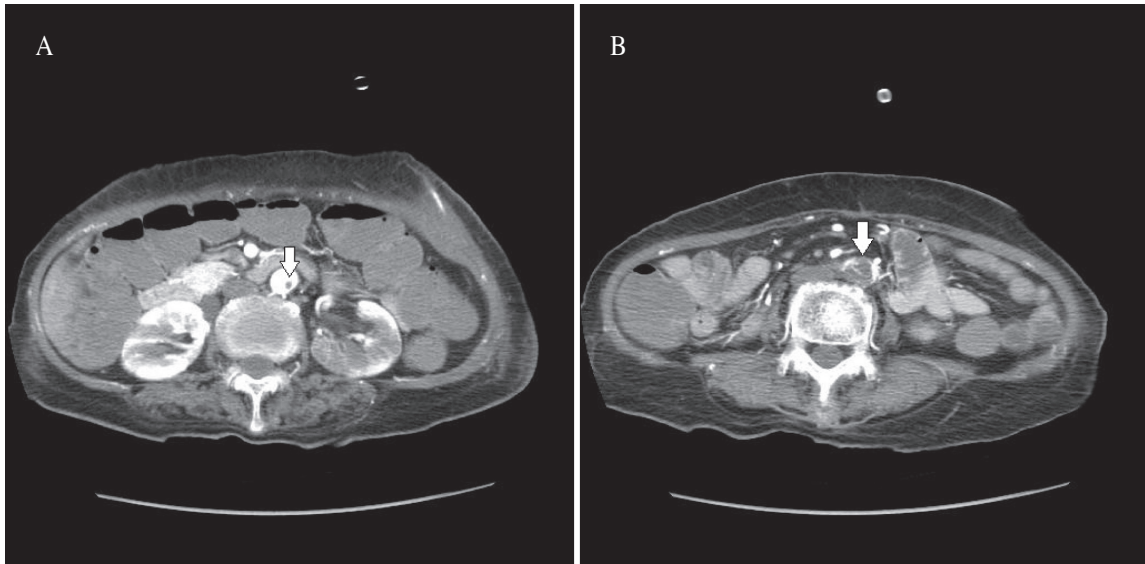
brain hemorrhage. Magnetic resonance imaging of the brain revealed multiple foci with T2-weighted hyperintensity in the left basal ganglion and both the occipital and parietal lobes, which were consistent with thromboembolic stroke. Transthoracic echocardiography revealed a 5.7×3.1-cm ovoid floating mass in the enlarged left atrium (Fig. 1A). The mass rotated on its own axis and sometimes prolapsed partially into the left ventricle in diastole (Fig. 1B). The left ventricle showed apical ballooning. Mild mitral regurgitation without mitral stenosis was observed. Cardiac surgery was not performed because of her progressive neurological deterioration, and anticoagulation with heparin and warfarin was started. On the follow-up echocardiography performed on the 12th admission day, the mass in the left atrium was observed to have disappeared completely. On the 26th admission day, gangrene developed in the right toes, and CT angiography revealed a saddle embolus occluding the aortoiliac arteries and infarction of both the kidneys (Fig. 2A&B). Her later course was complicated by infective sequelae and she finally died after 4 months of hospital care.

## Discussion

We reviewed 70 cases of LAFFT, including 69 cases from 65 papers written in English since 1990 and the present case. As of April 2015, a search of PubMed by using the keyword "left atrial free floating thrombus" returned 122 articles. Of these articles, 17 were discarded because they were published before 1990. Of the remaining 105 articles, 4 were unavailable in full text, 1 reported a case that was already reported, and 1 was a duplicate. Nine articles dealt with either right-sided thrombus or thrombus with a patent foramen ovale, 1 article dealt with aortic free-floating thrombus,



**Fig. 1.** (A) Transthoracic echocardiogram shows a large free-floating thrombus (arrow) in the left atrium. (B) Transthoracic echocardiogram shows a thrombus (arrow) transiently impacted on the mitral orifice.



**Fig. 2.** (A) Abdominal computed tomographic image shows the upper tip of a large embolus (arrow) in the abdominal aorta and infarctions of both the kidneys. (B) Abdominal computed tomographic image shows a large embolus (arrow) in the aortoiliac bifurcation.

and 1 reported on a cardiac angiosarcoma, not a thrombus. Two articles described mural thrombi, which were not identified in spite of preoperative

evaluation and became free-floating thrombi during open-heart procedure. Twenty-one cases were written in languages other than English. Finally, after

the process of elimination, we collected 65 full-text articles that reported cases of left atrial free-floating thrombus.

In the opinion of Hewitt, the diagnosis of free-floating ball thrombus should be based on two criteria, namely the thrombus must be larger than the mitral orifice and it should have a smooth surface without attachment to the atrial wall [3]. However, strict discrimination between a true free-floating ball thrombus and other large spherical thrombi with a pedicle in the left atrium is just for academic purpose and may be dangerous if applied in clinical practice [1]. In the 7 cases we reviewed, the thrombus had a pedicle that was demonstrated on echocardiography or in cardiac surgery. But, it was highly mobile and large enough to be confined in LA, so we included these cases in the analysis. Table 1 summarizes the demographic characteristics, rhythm and mitral pathology (stenosis or prosthesis), clinical presentation, treatment modality, and outcomes of the 69 cases published since 1990.

#### *Rhythm and Mitral Pathology*

According to Virchow's triad, thrombosis is caused by blood stasis, hypercoagulability, and endothelial injury. Mitral stenosis and atrial fibrillation are the two most well-known factors that trigger blood stasis and induce LAFFT. Large LA diameter and absence of significant mitral regurgitation were associated with blood stasis and thrombus formation in Beppu's study [4]. The presence of mitral prosthesis with a large LA diameter was also associated with blood stasis [5]. In 1982, Schechter [6] reported that in their autopsy cases of LA ball thrombus, only 11.3% (19/168) were without mitral valve disease. In our review, 38.5% cases (27/70) of LAFFT developed without mitral pathology (Table 2). The difference in the frequency of mitral pathology between the previous report and our review may be a consequence of the

increased prevalence of atrial fibrillation and/or other structural cardiac conditions. Other possible explanations were early detection of LAFFT before fatality or selection bias. A large consecutive study by Agmon *et al.* [7] about echocardiographic characteristics of patients with LA thrombus and sinus rhythm reported that 6.1% (23/380) of thrombus cases presented with sinus rhythm, which was not much different from the 8.8% that we derived from our own review (6/68, 2 unknown cases of rhythms excluded). Our review showed that 4 of 6 patients with LAFFT and sinus rhythm had no mitral pathology. For the 4 cases of sinus rhythm without mitral pathology, the suggested possible etiologies of thrombus formation were malignancy, restrictive cardiomyopathy, use of cyclosporine after heart transplantation, and hypercoagulable state after off-pump coronary artery bypass surgery [8-11]. Other conditions associated with thrombus formation in the reviewed cases were dilated cardiomyopathy, hypertrophic cardiomyopathy, low cardiac output, pregnancy, infertility treatment, and lobectomy of the lung due to squamous cell carcinoma [12-16].

#### *Clinical Presentation*

All the cases, except 1, were confirmed by using transthoracic echocardiography (TTE) and/or transesophageal echocardiography (TEE). Thus, we identified which presentations led patients to undergo echocardiography. The leading cause was evaluation for systemic embolization (Table 3). The second most common cause was evaluation for heart failure. Other causes were evaluation for acute hemodynamic decompensation, chest pain (including 3 cases of myocardial infarction), palpitation, and bacteremia. Some cases were detected incidentally during preoperative evaluation, routine follow-up after mitral valve surgery, and evaluation for an unidentified

**Table 1.** Summary of 69 reported cases with left atrial free-floating thrombus

First Author	Age	Sex	Rhythm	Mitral pathology	Presentation lead to echography	Treatment modality	Prognosis
Lau	80	F	AF	None	HF, embolization	Cardiac thrombectomy	Recovery
Alushi	81	F	AF	None	AHD, embolization	Cardiac thrombectomy	Recovery
Hisatomi	79	F	AF	Prosthesis	Embolization	Cardiac thrombectomy	Recovery
Tahara	77	M	AF	None	Embolization	Anticoagulation	Death
Hong	82	F	AF	None	Embolization	Others	Recovery
Demir	67	F	AF	Stenosis (1.34cm <sup>2</sup> )	AHD	Cardiac thrombectomy	Unknown
Erdil	48	M	SR	None	Palpitation	Cardiac thrombectomy	Recovery
Chidambaram	36	F	AF	None	Embolization	Cardiac thrombectomy	Death
Rider	75	F	AF	Stenosis (Severe)	AHD, embolization	Cardiac surgery planned	Death
Carrigan	84	F	AF	Prosthesis	AHD	Others	Unknown
Ozkan	46	M	AF	Prosthesis	Incidental	Cardiac thrombectomy	Recovery
Martinez	24	F	SR	Stenosis (0.8cm <sup>2</sup> )	HF	Anticoagulation	Recovery
Pocar	78	F	AF	None	Embolization	Cardiac thrombectomy	Unknown
Fujiwara	75	F	AF	None	Chest pain	Cardiac thrombectomy	Recovery
Kakkavas	80	F	AF	None	Embolization	Anticoagulation	Death
Papadopoulos	72	N/A	AF	Prosthesis	Incidental	Others	Unknown
Yagmur	80	F	AF	None	Embolization	Cardiac thrombectomy	Unknown
Teskin	61	M	AF	None	HF	Cardiac thrombectomy	Recovery
Tanoue	48	M	AF	None	HF, chest pain	Anticoagulation	Recovery
Ucak	73	F	SR	None	HF	Cardiac thrombectomy	Recovery
Shetty	69	M	N/A	Prosthesis	Embolization	Anticoagulation	Death
Popescu	53	F	AF	Prosthesis	Incidental	Cardiac thrombectomy	Recovery
Cemin	95	F	AF	None	AHD	Anticoagulation	Death
Das	53	F	SR	Stenosis (0.69cm <sup>2</sup> )	HF	Anticoagulation	Death
Ozdemir	43	F	AF	None	HF, palpitation	Anticoagulation	Recovery
Lee	56	F	AF	None	AHD, embolization	Cardiac thrombectomy	Recovery
Başar	67	F	AF	Prosthesis	Incidental	Anticoagulation	Death
Alyan	67	M	AF	Stenosis (1.4cm <sup>2</sup> )	HF, embolization, palpitation	Cardiac thrombectomy	Unknown
Awamleh	53	M	AF	Stenosis (Moderate)	Embolization	Cardiac thrombectomy	Recovery
Gurcun	34	F	AF	None	AHD, HF, embolization, palpitation	Cardiac thrombectomy	Death
Turhan	11	N/A	SR	None	Embolization	Cardiac thrombectomy	Unknown
Bauer	74	F	AF	None	HF	Cardiac thrombectomy	Recovery
Chen	51	F	PAF	Prosthesis	Bacteremia	Anticoagulation	Unknown
Ohkado	73	F	AF	None	Chest pain	Cardiac thrombectomy	Recovery
Tornóczy	68	F	AF	Stenosis (0.8cm <sup>2</sup> )	AHD, chest pain	Cardiac surgery planned	Death
Vaid	78	M	AF	Stenosis (0.7cm <sup>2</sup> )	HF	Others	Unknown
Ha	52	F	PAF	Prosthesis	Embolization	Cardiac surgery planned	Recovery
Yoshida	77	F	AF	None	Embolization	Cardiac thrombectomy	Recovery
Daniel	82	F	AF	None	AHD	Cardiac thrombectomy	Recovery
Kaneda	59	F	AF	Stenosis (1.5cm <sup>2</sup> )	HF	Cardiac thrombectomy	Recovery
Kaneda	79	F	AF	Prosthesis	Incidental	Cardiac thrombectomy	Death
Cakir	47	F	AF	Stenosis (Unspecified)	AHD, HF, palpitation	Cardiac thrombectomy	Unknown
Selcuk	46	F	N/A	Stenosis (Severe)	HF	Cardiac thrombectomy	Recovery
Matsuyama	67	M	AF	Stenosis (0.7cm <sup>2</sup> )	Embolization	Cardiac thrombectomy	Recovery
Lee	42	F	AF	Stenosis (1.8cm <sup>2</sup> )	AHD, HF, embolization, palpitation	Anticoagulation	Death
Nagaraja	30	M	AF	Stenosis (0.8cm <sup>2</sup> )	HF	Anticoagulation	Recovery
Tsioufis	65	F	AF	Stenosis (Unspecified)	AHD, HF	Cardiac thrombectomy	Recovery
Nagumo	68	M	AF	None	Embolization	Cardiac thrombectomy	Recovery
Saito	59	F	AF	None	Embolization	Cardiac thrombectomy	Recovery
Saito	68	F	AF	None	Embolization	Cardiac thrombectomy	Recovery
Abaci	34	F	AF	Stenosis (0.7cm <sup>2</sup> )	HF, embolization, palpitation	Cardiac thrombectomy	Recovery
Manga	47	M	AF	Stenosis (0.8cm <sup>2</sup> )	Embolization	Cardiac thrombectomy	Unknown
Astengo	80	F	AF	Stenosis (1.35cm <sup>2</sup> )	Embolization	Anticoagulation	Recovery
Carp	72	F	AF	Stenosis (1.7cm <sup>2</sup> )	Chest pain	Cardiac thrombectomy	Unknown
Vitale	69	F	AF	Stenosis (0.8cm <sup>2</sup> )	HF	Cardiac thrombectomy	Recovery
Harpaz	64	M	AF	Prosthesis	HF	Anticoagulation	Recovery
Miyamoto	62	F	AF	Stenosis (1.52cm <sup>2</sup> )	Embolization	Cardiac thrombectomy	Unknown
Miyamoto	65	F	AF	Stenosis (1.54cm <sup>2</sup> )	Embolization	Cardiac thrombectomy	Unknown
Alkan	45	F	AF	Stenosis (1.7cm <sup>2</sup> )	HF	Cardiac thrombectomy	Unknown
Alkan	59	F	AF	Stenosis (1.6cm <sup>2</sup> )	HF, embolization	Cardiac thrombectomy	Unknown
Gonzalez	51	F	AF	Prosthesis	Chest pain	Cardiac thrombectomy	Recovery
Chow	60	F	AF	Stenosis (0.9cm <sup>2</sup> )	HF	Cardiac thrombectomy	Recovery
Fernandez	56	M	SR	None	AHD, HF, embolization, chest pain	Cardiac surgery planned	Death
Black	49	M	AF	Stenosis (0.7cm <sup>2</sup> )	Embolization	Others	Recovery
Rey	59	F	AF	Stenosis (1.5cm <sup>2</sup> )	HF, embolization	Cardiac thrombectomy	Unknown
Chow	59	F	AF	Stenosis (1.0cm <sup>2</sup> )	HF, embolization	Cardiac thrombectomy	Recovery
Yeoh	39	F	AF	Stenosis (0.8cm <sup>2</sup> )	AHD	Cardiac thrombectomy	Unknown
Chow	46	F	AF	Prosthesis	Incidental	Cardiac surgery planned	Recovery
Mohan	27	F	AF	Post valvotomy	HF	Cardiac thrombectomy	Unknown

AF: atrial fibrillation, HF: heart failure, N/A: not available, PAF: paroxysmal atrial fibrillation, SR: sinus rhythm, AHD: acute hemodynamic decompensation.



**Table 2.** Rhythm and mitral pathology

	SR (n = 6)	AF (n = 62)	Unknown (n = 2)
Absence of mitral pathology (n = 27)	4	23	0
Presence of mitral pathology (n = 43)	2	39	2

SR: sinus rhythm, AF: atrial fibrillation.

**Table 3.** Clinical presentations that led to echocardiography

Presentation*	n
Embolization <sup>†</sup>	34
Heart failure	27
Acute hemodynamic decompensation <sup>‡</sup>	15
Chest pain <sup>§</sup>	7
Palpitation	7
Bacteremia	1
Incidental	6

\*Several presentations, except for incidental, can occur in the same patient; <sup>†</sup>In the brain and/or limbs in most cases but in the mesentery in one case; <sup>‡</sup>Such as paroxysmal dyspnea, syncope, and cardiogenic shock; <sup>§</sup>Including three cases of myocardial infarction.

intracardiac mass on chest CT imaging. Our reviewed articles did not provide evidence that chest pain or myocardial infarction was caused by embolisms. Acute hemodynamic decompensation

due to frequent or prolonged impaction of thrombus to the mitral orifice causes paroxysmal dyspnea, syncope, and cardiogenic shock, which is an interesting feature (so-called hole in one) of LAFFT [17].

#### *Echocardiographic findings*

In our review, the typical shape of a free-floating thrombus was spherical exteriorly and a laminated onion skin-like appearance interiorly [18]. A few of the thrombi showed an ovoid shape with partial irregularity and, occasionally, heterogeneous content with a cystic portion [19]. Thrombus moved around randomly and ricocheted off the atrial wall. More than half of the cases were described as having transient blockade of the mitral orifice by a free-floating thrombus. In some of these cases, during the diastolic phase, the thrombus occasionally affected the mitral orifice; and during the systolic phase, it was ejected away. Miyamoto *et al.* [20] described

**Table 4.** Treatment modality and outcome

Treatment modality	Recovery	Death	Unknown
Cardiac surgery (performed, n = 45)	27	3	15
Cardiac surgery (not performed but planned, n = 5)	2	3	0
Anticoagulation (poor condition to cardiac surgery, n = 9)	2	6	1
Anticoagulation (no consent to cardiac surgery, n = 6)	4	2	0
Others* (n = 5)	2	0	3

\*Unknown treatment modality or embolization of the entire thrombus before initiation of treatment strategy.

alteration of the moving pattern of LAFFT according to body position change in 2 cases with atrial fibrillation. They revealed that the left decubitus and sitting positions diminished the contact rate between the thrombus and the mitral leaflet. However, the right decubitus and spine positions increased contact rate and sometimes caused thrombus impaction. This means that taking a specific position may lower serious complications of thrombus, such as embolization or significant mitral obstruction. One case of embolization occurred during the TEE procedure, and the authors who reported the case argued that TEE should be performed when TTE is non-diagnostic. And argued if TEE is necessary, it is important to maintain hemodynamic stability during the procedure [21]. However, in 32 other cases we reviewed, TEE was performed without noticeable complications.

#### *Treatment Modality and Its Outcome*

In about two-thirds (50/70) of our reviewed cases, cardiac thrombectomy was planned, but cardiac surgery was not performed in 5 of these cases because the patient died while awaiting surgery in 3 cases and the entire thrombus was ejected to systemic circulation before surgery in 2 cases (Table 4). Among the 3 patients who died while awaiting surgery, 1 died from septic shock; 1 died from the thrombus being lodged permanently in the mitral orifice, which was confirmed based on autopsy results; and 1 died from a newly developed large aortoiliac embolization and cardiogenic shock. Fifteen patients received anticoagulation treatment, including 1 patient who received thrombolysis with urokinase. The reported recovery rate was much higher in the surgical group (29/50) than in the anticoagulation group (6/15), and the mortality was much lower in the surgical group (6/50) than in the anticoagulation group (8/15). Five cases could not be categorized as either cardiac surgery or

anticoagulation because of lack of information or an intricate clinical situation.

#### *Limitations*

The articles we reviewed were written from different perspectives. Some articles focused on etiology, some on treatment and clinical outcome, and few on echocardiographic features. Thus, each paper contained limited information and variables. Some clinical presentations such as mild dyspnea and palpitation may have been ignored or masked by other serious conditions. By contrast, we assume that shock, syncope, or embolic events are well recognized by authors.

## **Summary**

We experienced a case of LAFFT that initially presented as syncope and stroke. The patient had no mitral stenosis but showed paroxysmal atrial fibrillation. Because of her poor neurologic condition, she was treated with anticoagulation but eventually died from complications of stroke and limb infarction. We reviewed 70 cases of LAFFT. Atrial fibrillation and mitral pathology were the two major etiologies of free-floating thrombus. All the cases, except 1, were confirmed by using echocardiography. The most common presentation that led to echocardiography was symptoms related to systemic embolization, followed by heart failure. Other presentations included acute hemodynamic decompensation, chest pain, palpitation, and bacteremia. Some of the cases were incidental. Cardiac surgery was the preferred treatment modality with favorable outcome.

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