

CASE REPORT

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# Iatrogenic Intramural Hematoma Identified by Intravascular Ultrasound Following Selective Angiography of the Left Internal Mammary Artery



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## ABSTRACT

This case reports on iatrogenic intramural hematoma of the left internal mammary artery (LIMA) identified on intravascular ultrasound. This case illustrates the importance of intravascular imaging to identify the presence and extent of an intraluminal hematoma that is not visualized on angiography and that was the cause of ischemic symptoms following LIMA injection. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2019;1:127-30) © 2019 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

The left internal mammary artery (LIMA) bypass grafts to the left anterior descending artery (LAD) are superior to saphenous venous grafts because of better long-term patency and higher rate of patient survival (1,2). LIMA is now

the preferred bypass graft for LAD and consequently this led to an increase in LIMA angiography in patients returning to the cardiac catheterization laboratory for recurrence of ischemic symptoms (3). Iatrogenic LIMA dissections have been rarely reported, and the incidence is likely to be underestimated. To our knowledge, intramural hematomas have not been described within the LIMA from iatrogenic injury. We present a case of LIMA intramural hematoma that was elusive on an angiogram but was well defined with intravascular ultrasound (IVUS) and treated successfully with a drug-eluting stent.

## LEARNING OBJECTIVES

- Angiography underestimates the presence of dissections and intramural hematoma.
- A low threshold to evaluate the LIMA with IVUS is recommended when ischemia is seen post-LIMA angiography with no clear angiographic findings of obstructive disease.
- The LIMA is at risk of dissection if the catheter is not coaxial to the vessel and irrespective of whether a normal arterial waveform is present. Nonselective injection of the LIMA is likely to be a safer alternative if adequate dye opacification can be achieved.

## HISTORY OF PRESENTATION

A 76-year-old man presented with dyspnea, hypoxia, and abnormal troponin I level. He was placed on bilevel positive airways pressure and was initiated on intravenous furosemide because of pulmonary congestion. His symptoms significantly improved. His lungs had baseline crackles but cleared rapidly after

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**ABBREVIATIONS  
AND ACRONYMS****IVUS** = intravascular  
ultrasound**LAD** = left anterior descending  
artery**LIMA** = left Internal mammary  
artery**SVG** = saphenous vein graft

diuresis. His heart had a regular rhythm; normal S<sub>1</sub> and S<sub>2</sub>; and no rubs, murmurs, or gallops. There was no lower extremity edema.

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**PAST MEDICAL HISTORY**

His past medical history was significant for coronary artery disease post-bypass surgery 17 years ago with the following grafts: a LIMA to the LAD; saphenous vein graft (SVG) to the obtuse marginal artery; SVG to the posterior descending artery; and SVG to the diagonal. He had a history of hyperlipidemia and hypertension. He did not overuse alcohol and was an ex-smoker.

**DIFFERENTIAL DIAGNOSIS**

The differential diagnosis included acute coronary syndrome, pulmonary embolus, lung infection, acute systolic and/or diastolic heart failure, and arrhythmia.

**INVESTIGATIONS**

Computed tomography angiography of the chest revealed no evidence of pulmonary embolus or infection. Echocardiography revealed an ejection fraction of 45%, which was a significant drop from his normal ejection fraction of 60% in 2017. His electrocardiogram did not show acute ST-segment changes, and he was in normal sinus rhythm.

**MANAGEMENT**

The patient was referred for angiography given his history of coronary artery disease, heart failure presentation, drop in ejection fraction, and abnormal troponin level. This revealed an ejection fraction of 45%, and his SVG to the diagonal and obtuse marginal arteries were occluded. On injection of the LIMA, he developed ischemic symptoms of chest pain and borderline drop in his systolic blood pressure at 90 mm Hg. No apparent obstructive disease was seen in the LIMA on the anteroposterior projection (Figure 1A). Chest discomfort in mid-chest persisted. An oblique view to the LIMA was then obtained and revealed a partial narrowing of about 50% in the LIMA at its origin but no dissection (Figure 1B, arrow). A 300- $\mu$ g dose of intra-IMA nitroglycerin was administered with no resolution of this narrowing. A 6-F LIMA guide was then placed at the origin of the LIMA and the vessel was wired with a Whisper ES wire

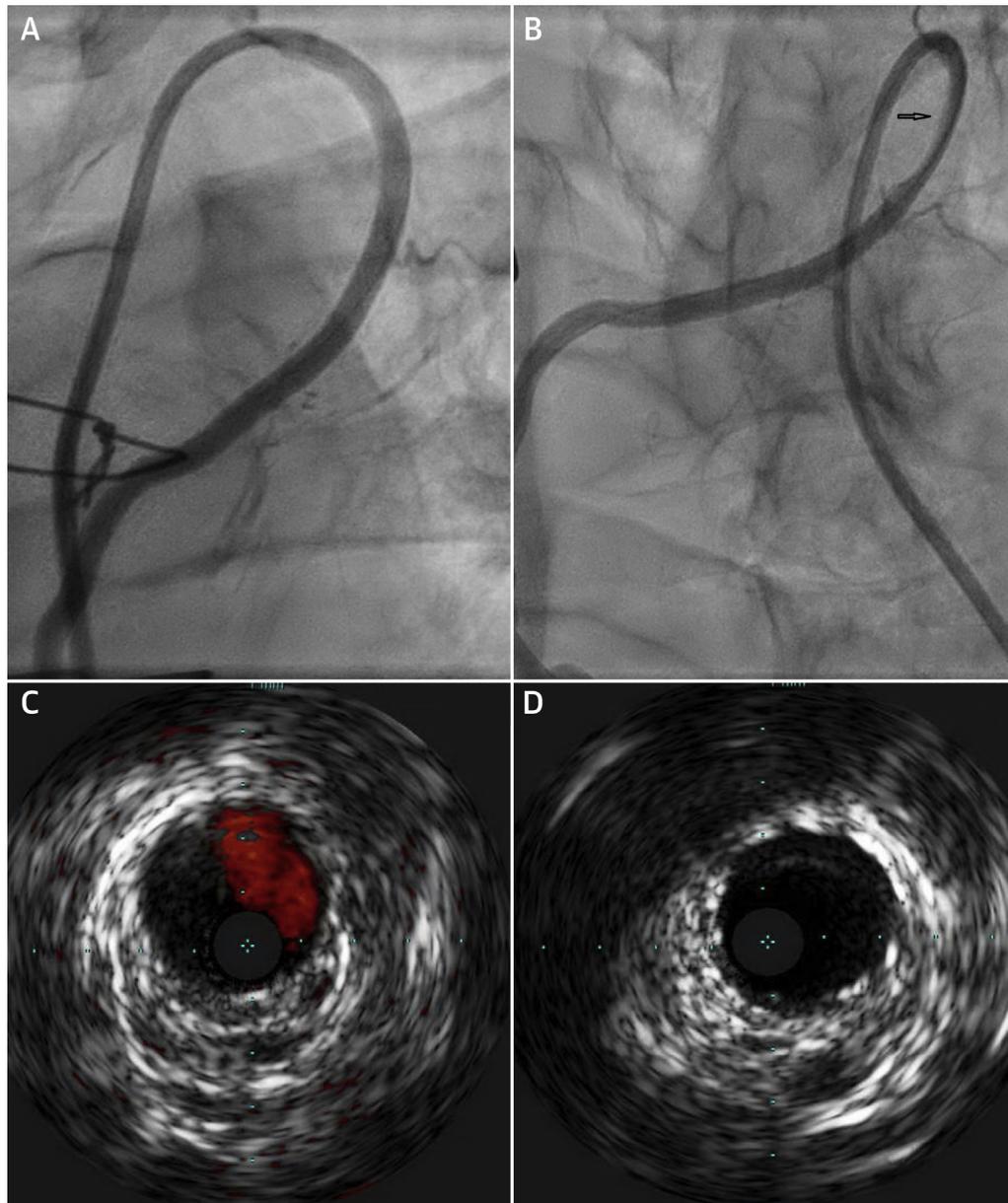
(Abbott Vascular, Santa Clara, California). Using the Eagle Eye Platinum ST catheter (Phillips, Cambridge, Massachusetts), IVUS was then performed to the origin of the LIMA. This revealed an intramural hematoma with a significant flap obstructing the proximal segment of the LIMA (Figure 1C, Video 1). The exact entry point of the hematoma could not be seen, but its proximal and distal edges were well defined by IVUS. The hematoma was localized between the intima and media with a floppy dissection flap. There was no flow seen within the hematoma. Color flow using Chromaflo (Chromaflo Technologies, Ashtabula, Ohio) identified the true lumen as seen in Figure 1C. Stenting of the area of dissection was carried on using a 3.5  $\times$  38-mm Xience drug-eluting stent (Abbott) dilated to 16 atm of pressure. Stent apposition and full expansion were seen post-stenting with IVUS (Figure 1D) with full coverage of the hematoma. Patient's symptoms resolved and did well post-procedure.

**DISCUSSION**

LIMA dissection during catheterization is a dreadful iatrogenic complication. There are only 7 reported cases of catheter-induced LIMA dissection in the published data (Table 1) (4-8). It is likely that these dissections are under-reported. We are reporting an iatrogenic complication of LIMA dissection that is set apart from the other cases by the dissection not being visualized on angiography. The lesion could not be seen on an anteroposterior view and only a partially narrowed LIMA graft was noted on an angulated view (Figure 1B, arrow). This appeared to be like a spasm but did not resolve with intravascular nitroglycerin. The presence of the intramural hematoma became clear on IVUS, which allowed us to identify its length and degree of lumen compromise. Based on the IVUS findings, stenting of the area of the lumen compromise was carried on successfully with no further adverse consequences. The patient did well and was discharged home on dual antiplatelet therapy with clopidogrel and aspirin.

IVUS is a valuable tool to identify intramural hematoma and dissections that are often undetected by an angiogram (9). There are no guidelines on the use of IVUS in evaluating the LIMA. A low threshold to use IVUS is recommended in patients with ischemia following LIMA injection when angiography does not reveal significant pathology. Studies have shown that angiography underestimates dissections, degree of narrowing, stent underexpansion, presence of thrombus, or degree of

**FIGURE 1** Intramural Hematoma Following IMA Angiography



**(A)** Internal mammary artery (IMA) angiography on anteroposterior view showing no evidence of dissection. **(B)** Internal mammary artery angiography on oblique view showing partial narrowing of the vessel at its origin and proximal segment (**arrow**). **(C)** Intramural hematoma on intravascular ultrasound with ChromaFlo. See [Video 1](#). **(D)** Post-stenting of the internal mammary artery. Resolution of the hematoma and good stent expansion and apposition are noted.

calcification. Following stenting of the LIMA, the IVUS was helpful in determining that the hematoma has not expanded beyond the stented segment and allowed accurate sizing of the stent and evaluation of its expansion and apposition post-deployment.

Stenting of LIMA dissection should cover the entire length of the dissection. In 1 case report, partial stenting has shown recurrence of acute closure of the LIMA. Also an antegrade crossing of the LIMA may not be possible with large flaps created by the dye injection against the wall of the

**TABLE 1** Reported Cases of Iatrogenic LIMA Dissections

Case #	Sex/Age (yrs)	Catheter Type	Graft Site	First Author (Year) (Ref. #)
1	M/76	IMA	LAD	Current case
2	M/60	JR	LAD	Jien and Wei (2017) (4)
3	M/58	JR 3.5	LAD	Vatrano et al. (2014) (5)
4	F/67	JR 3.5	LAD	Vatrano et al. (2014) (5)
5	M/58	4-F IMA	RI	Khan et al. (2014) (6)
6	M/62	7-F JR 4	LAD	Freeman et al. (2004) (7)
7	F/43	5-F IMA	LAD	Freeman et al. (2004) (7)
8	M/58	8-F IMA	LAD	Moon and Nanavati (1999) (8)

IMA = internal mammary artery; JR = Judkins right; LAD = left anterior descending artery; LIMA = left internal mammary artery; RI = ramus intermedius.

vessel. A retrograde wiring from the native LAD if possible will then be needed to achieve recanalization. In our case, and even with an excellent arterial waveform, the dye injection led to the intramural hematoma. This is related to the angle of the LIMA catheter against the wall of the vessel. Therefore, we advise having a coaxial injection or a nonselective injection of the LIMA to avoid dissection even in the presence of excellent waveform. Quite often, large LIMA requires a large-volume, high-flow injection of dye to fill adequately that could contribute to dis-

sections if the tip of the catheter is directed toward the wall of the vessel.

### FOLLOW-UP

The patient did well post-procedure and repair of the LIMA dissection. His pain subsided. He was discharged home. Long-term follow-up is not available.

### CONCLUSIONS

IVUS is an important modality to identify LIMA intramural hematoma and dissections that are underappreciated on an angiogram. A low threshold to evaluate the LIMA with IVUS is recommended when ischemia is seen post-LIMA angiography even when the angiogram does not reveal a definitive area of obstruction or dissection. Finally, it is important that injection of the LIMA occurs with the catheter coaxial to the vessel irrespective of whether there is an excellent arterial waveform.

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**KEY WORDS** iatrogenic, intramural hematoma, intravascular ultrasound, left internal mammary artery, stent

**APPENDIX** For a supplemental video, please see the online version of this paper.