

A nasty surprise: cardiogenic shock induced by extensive dissection of the left internal mammary artery graft occurring 3 months after coronary angiography—a case report

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Background

Acute dissection of the left internal mammary artery (LIMA) graft in patients with previous cardiac bypass surgery is a rare but potentially life-threatening condition.

Case summary

A 58-year-old man with history of coronary artery disease and bypass surgery 15 years ago presented with acute coronary syndrome (non-ST-elevation myocardial infarction, NSTEMI). Angiography showed severe three-vessel disease with occlusion of a saphenous vein graft (SVG) to the first diagonal branch but patent grafts to left artery descendens (LIMA) and SVG to the right coronary artery. No coronary intervention was performed and the patient was treated medically (aspirin and ticagrelor) and discharged home after 6 days. Three months later, the patient again was admitted to the hospital with acute coronary syndrome (NSTEMI) and developing cardiogenic shock. Angiography now showed an extensive flow limiting dissection of his LIMA graft with the dissection starting at the ostium of the LIMA. After implantation of an Impella 2.5, percutaneous coronary intervention (PCI) of the graft was performed under guidance by optical coherence tomography (OCT) leading to implantation of a drug-eluting stent into the ostium of the LIMA and repeated balloon dilatations of the medial and distal parts of the graft. Antegrade flow was established and the patient's condition improved so that the Impella was removed in the cath lab. After an uneventful course, the patient was discharged home after 6 days. Elective repeat angiography after 8 weeks showed an excellent functional result without persisting signs of LIMA dissection or stenosis.

Discussion

Acute dissection of a LIMA graft is a rare event that may lead to a life-threatening condition. According to the literature, LIMA dissection happens during coronary interventions in approximately half of the cases but it also may evolve spontaneously. However, as seen from our case, there might be a substantial delay between LIMA angiography and the clinical onset of dissection. In the vast majority of cases, dissection of LIMA can be treated by PCI. The use of Impella as reported for the first time in this case may improve the safety of the procedure. In accordance to PCI of the native coronary arteries, it seems possible to leave non-flow limiting dissections in cases of extensive disease in order to avoid the late complications of complete stenting of the graft.

Keywords

LIMA • Dissection • Cardiogenic shock • PCI • Impella • Case report

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Learning points

- Dissection of the left internal mammary artery (LIMA) can occur either spontaneously or induced by coronary angiography/intervention and lead to haemodynamic compromise up to cardiogenic shock.
- There might be a substantial delay (3 months in this case) between the initial damaging event of the LIMA (e.g. angiography) and clinical manifestation of the dissection.
- Percutaneous coronary intervention (PCI) is a safe treatment strategy in the majority of cases, and left ventricular assist devices (e.g. Impella) can be used during PCI in the case of haemodynamic compromise.

Introduction

The left internal mammary artery (LIMA) has become the conduit of choice for bypass of the left anterior descending coronary artery because of its superior patency rates especially in comparison to saphenous vein grafts (SVGs).¹ Acute dissection of the LIMA graft is a rare but potentially life-threatening condition that requires immediate and consequent diagnosis and treatment.

Timeline

2003	Coronary artery bypass grafting with left internal mammary artery–left artery descendens (LIMA-LAD), saphenous vein graft–right coronary artery (SVG-RCA), SVG-diagonal branch of the LAD (RD)
14 May 2018	Non-ST-elevation myocardial infarction (NSTEMI), coronary angiography via left radial artery shows occlusion of SVG-RD but patent grafts LIMA-LAD and SVG-RCA, conservative management
18 August 2018	NSTEMI with developing cardiogenic shock, coronary angiography via right femoral artery reveals acute extensive dissection of LIMA graft; temporary implantation of Impella 2.5 via left femoral artery; percutaneous coronary intervention of proximal LIMA with drug-eluting stent implantation leaving a persistent dissection of distal LIMA graft
22 October 2018	Elective repeat angiography shows patent LIMA

Case presentation

A 58-year-old man with known history of coronary artery disease was admitted to the emergency department on 14 May 2018 due to acute coronary syndrome. He had previous bypass surgery in 2003 with grafting of the left anterior descending artery (LAD)

using the LIMA and two SVGs to right coronary artery (RCA) and the first diagonal branch (RD), respectively. On 12 lead electrocardiogram, there were no relevant pathologies, but serial laboratory testing found a significant rise of cardiac troponin I indicating non-ST-elevation myocardial infarction (high-sensitive Troponin I (hsTnT I): 263 pg/mL; normal range: <26 pg/mL). Medical treatment was initiated with fondaparinux 2.5 mg o.d. subcutaneously and the patient continued to take aspirin. Additionally, ticagrelor was started on 15 May 2018 (180 mg loading dose). Coronary angiography was performed via left radial artery on 15 May 2018 (5-Fr diagnostic catheters; JR4, JL4, AL1 for SVC, BC for LIMA) and revealed a chronic occlusion of the mid LAD as well as of the proximal RCA with no significant lesion of the left circumflex artery. The LIMA graft as well as the SVG to RCA were found to be patent, whereas the SVG to RD was found occluded (*Figure 1*). According to risk-benefit evaluation and as the patient reported that his chest pain had resolved for several hours, no coronary intervention was performed. Transthoracic echocardiography showed mildly reduced left ventricular (LV)-ejection fraction (EF) (52%) with hypokinesia of the anterior and septal walls. The patient was treated at the chest pain unit for 48 h and finally discharged home on 22 May 2018 after an uneventful hospital stay.

On 18 August 2018, the patient was again admitted to the emergency department due to reoccurrence of unstable angina and progressive dyspnoea (blood pressure 129/79 mmHg, heart rate 88/min). Electrocardiogram was found normal, but there was a significant elevated troponin I on admission (hsTnT I: 82 pg/mL; normal range: <26 pg/mL) so that the patient was sent to the cath lab on the same day. Coronary angiography performed via the right femoral artery now showed an extensive dissection of the LIMA leading to impaired blood flow (TIMI I) (for video files see *Supplement*). During angiography, a slowly but progressive decline of blood pressure could be observed (RR 98/66, heart rate 94/min), while the patient reported worsening of his dyspnoea. Left ventricular angiography showed akinesia of the anterior and septal walls with a significantly impaired LV-EF (calculated to be 45%) (*Figure 2*). An Impella 2.5 (Abiomed Europe GmbH, Germany) was inserted via the left femoral artery and percutaneous coronary intervention (PCI) of the LIMA was done using a 6-Fr IMA guiding catheter (Medtronic Launcher, Medtronic, USA) and an Asahi Sion blue wire (Asahi Intecc Co., Japan). After several balloon inflations with 2.0 and 3.0 mm balloons (Pantera Pro, Biotronik, Germany), an Orsiro-DES 3.5 × 30 mm (Biotronik, Germany) was implanted into the ostium of the graft (10 atm/20 s). At this stage, blood flow through the LIMA was restored, but there was still a visible stenosis of the medial and distal part of the vessel. OCT analysis (Abbott, USA), showed a proper stent placement with good restoration of the lumen of the proximal LIMA, while dissection could still be seen from the distal end of the implanted stent over a length of approximately 50 mm (*Figure 3*). Due to some malapposition of the implanted drug-eluting stent (DES) in the proximal part, post-dilatation was performed here with a 4.0 × 15 mm NC balloon (Pantera Leo, Biotronik, Germany). As blood flow in the LIMA graft had persistently normalized (TIMI III) and both haemodynamics and the patients well-being were stabilized, no further stents were implanted. After stepwise weaning,

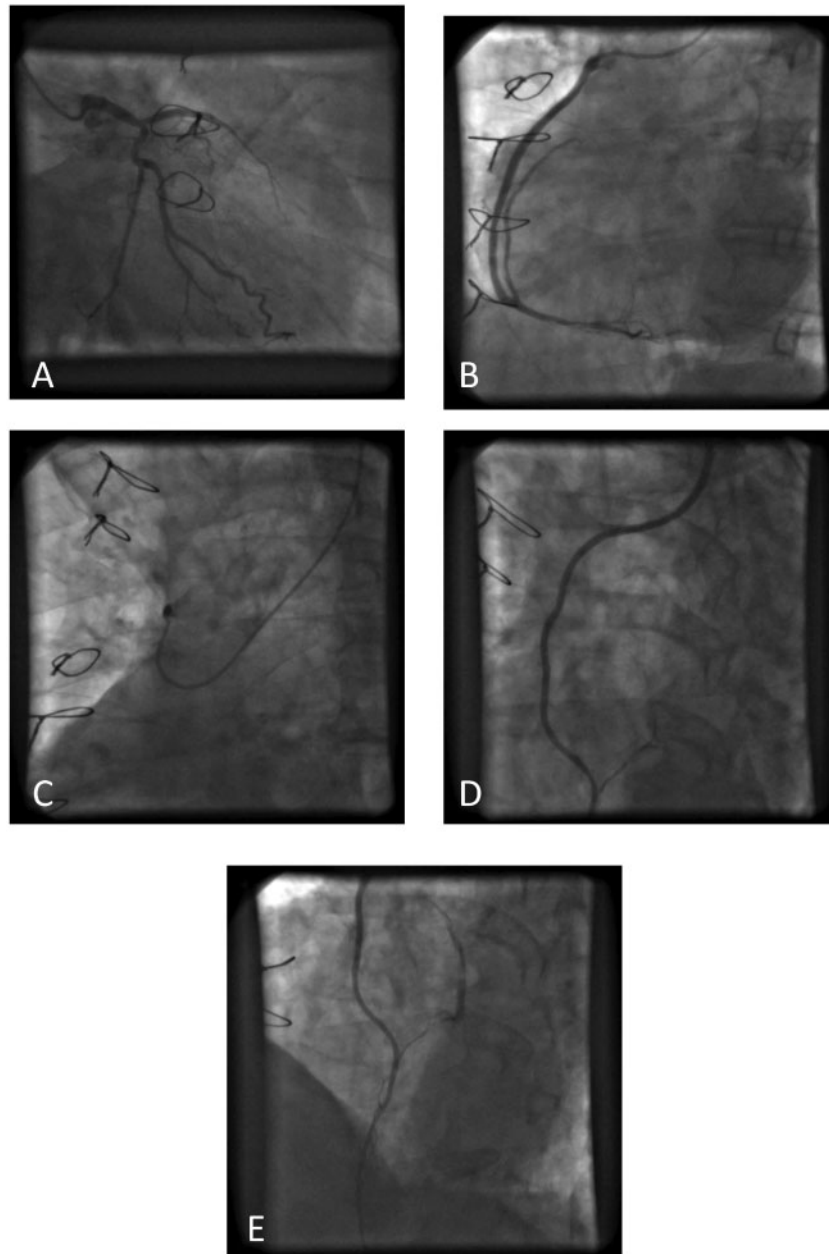


Figure 1 Coronary angiography from 15 May 2018 showing left coronary artery (A), saphenous vein graft to right coronary artery (B), proximally occluded saphenous vein graft to diagonal branch (C), and patent left internal mammary artery (D and E). Retrograde filling of the saphenous vein graft to diagonal branch is seen on E.

the Impella 2.5 was removed in the cath lab. The patient was transferred to intensive care unit for monitoring of vital signs until the next day when he was sent to a normal ward. Transthoracic echocardiogram before discharge showed a normalization of LV function (EF 59%) without regional wall motion abnormalities, and the patient was discharged home on 24 August 2018. Elective angiographic follow-up was performed on 22 October 2018 which showed a patent LIMA graft without signs of stenosis or persistent dissection (Figure 4).

Discussion

Dissection of the LIMA is a rare event that can be iatrogenic in the setting of coronary angiography or can occur spontaneously (overview of cases given in Khan *et al.*²). For spontaneous dissection, a mechanism involving extensive physical movement of the arms in conjunction with the adhesion of the LIMA to the chest wall has been proposed.³ The case reported here seems noteworthy for several reasons. First, the dissection of the LIMA became clinically overt with

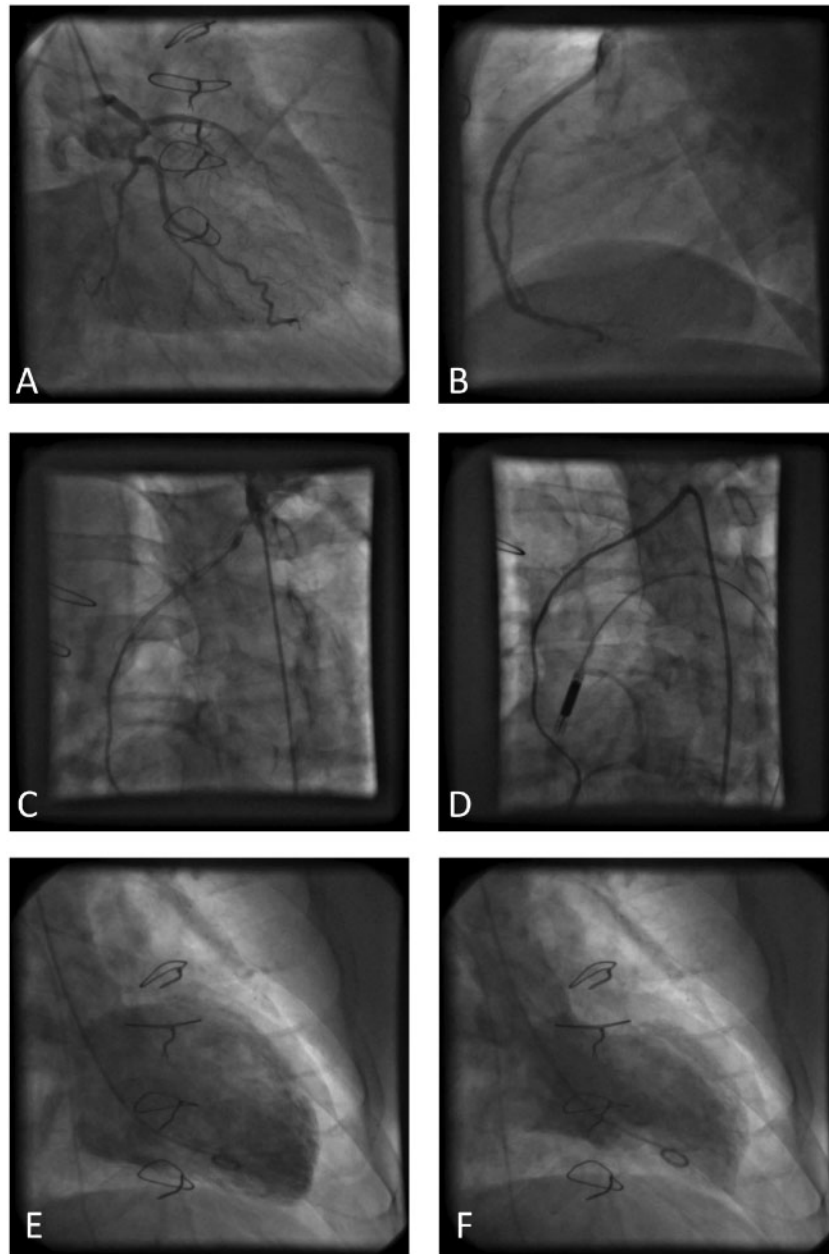


Figure 2 Coronary angiography from 18 August 2018 showing left coronary artery (A), saphenous vein graft to right coronary artery (B), left internal mammary artery with extensive dissection (C), and the result after percutaneous coronary intervention with drug-eluting stent implantation in proximal left internal mammary artery graft and Impella 2.5 in place (D). Left ventricular angiography at end of diastole (E) and end of systole (F) as seen before percutaneous coronary intervention.

a latency of 3 months after selective angiography, which is highly suggestive for a catheter-induced initial damaging event that was initially asymptomatic. Second, PCI of the LIMA graft was performed under haemodynamic support with an Impella pump, which to our knowledge has not been reported before. The left ventricular unloading induced by the Impella device prevented the progression of haemodynamic deterioration and potentially limited infarct size as known

from experimental studies.^{4,5} Third, due to the length of the dissection, a DES was only implanted into the ostium of the graft while a long segment of the dissected LIMA was only treated by balloon angioplasty, which turned out to be favourable strategy in the follow-up angiography after 8 weeks. Additionally, the use of OCT to guide PCI was of special value in the presented case. On the one hand, it allowed the diagnosis of partial malapposition of the implanted stent

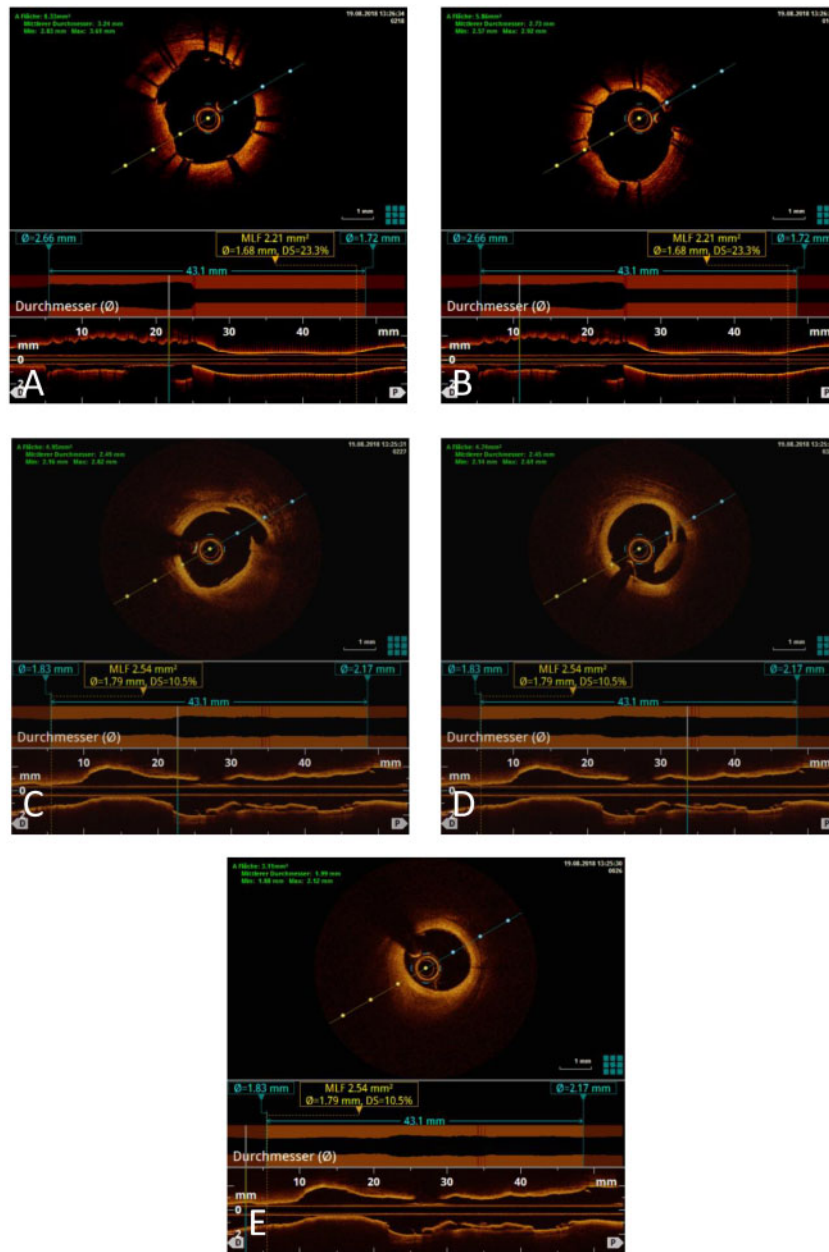


Figure 3 Optical coherence tomography performed on 18 August 2018 of the left internal mammary artery graft after percutaneous coronary intervention and drug-eluting stent implantation (two runs), images orientated from proximal (A) to distal (E). (A and B) Implanted drug-eluting stent with no signs of persisting dissection but partial malapposition of the stent (A). (C and D) Persisting but not flow-limiting dissection of the left internal mammary artery graft. (E) Left internal mammary artery graft distal to the dissection (normal appearance).

that could be immediately treated with proper post-dilatation. This seems important as a suboptimal result of DES implantation diagnosed by OCT has been linked to unfavourable clinical outcomes.⁶ On the other hand, OCT confirmed the diagnosis of the persisting dissection in the medial segment of the graft that was not covered by the stent but also showed the 'benign' aspect of the dissection without signs of flow limitation or obstruction of the true lumen which prompted the abdication of additional stent implantations that

otherwise would have potentially increased risk of later stent thrombosis or in-stent restenosis.

Conclusion

Acute dissection of a LIMA graft is a rare event that may lead to a life-threatening condition. As seen from our case, there might be a

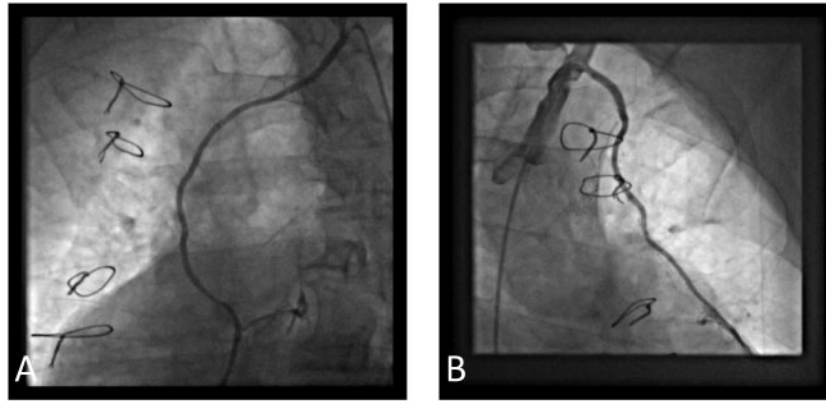


Figure 4 Angiography of the left internal mammary artery graft from 22 October 2018 showing no signs of persisting dissection or stenosis (angiographic views: left anterior oblique 55/0 (A); right anterior oblique 30/0 (B)).

substantial delay between the damaging event (e.g. selective LIMA angiography) and the clinical onset of dissection. In the vast majority of cases, dissection of LIMA can be treated by PCI and the use of Impella may improve the safety of the procedure. In extensive lesions, it seems possible to leave non-flow limiting dissections in order to avoid the late complications of complete stenting of the graft.

Lead author biography



Dr. Ebelt studied medicine at Martin-Luther-University in Halle, Germany, where he graduated in 1999. After three years as a postdoc at the Institute of Physiological Chemistry, he completed his training in internal

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Supplementary material

Supplementary material is available at *European Heart Journal - Case Reports* online.

Slide sets: A fully edited slide set detailing this case and suitable for local presentation is available online as [Supplementary data](#).

Consent: The author/s confirm that written consent for submission and publication of this case report including image(s) and associated text has been obtained from the patient in line with COPE guidance.

Conflict of interest: H.E. has received honoraria for lectures from Boston Scientific, Abiomed, and Biotronik. M.H. has received a travel grant from Biotronik.

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