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Case Reports

Acute Occlusion of the Left Main Coronary Artery Following Intracoronary Ultrasound Examination

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Intracoronary ultrasound (ICUS) is generally considered as safe procedure, with a low complication rate. We describe a nearly fatal complication of a diagnostic ICUS study that was treated successfully with stent implantation in the left main coronary artery and discuss the indications and remaining risks of this procedure. *Cathet. Cardiovasc. Intervent.* 47:181–184, 1999. © 1999 Wiley-Liss, Inc.

Key words: intracoronary ultrasound; acute coronary artery closure

CASE REPORT

A 69-year-old man underwent a diagnostic catheterisation for post-infarction angina. He had recently suffered an inferior infarction that was treated with streptokinase, and complained about chest pain at low effort, with ischemic repolarisation abnormalities on stress testing. Left ventricular function was mildly decreased with inferior akinesia. Coronary angiography revealed diffuse coronary sclerosis with mainly severe stenoses of the proximal right coronary artery, the proximal circumflex artery, and an anterolateral branch. There were only minor irregularities in the left anterior descending artery and the diagonal branches. The left main coronary artery showed diffuse atherosclerosis, but it was unclear how important this stenosis was (Fig. 1).

Therefore, the patient was referred for an intracoronary ultrasound (ICUS) study to demonstrate better or exclude left main coronary artery disease. A femoral approach was used with a 7 F FL4 soft-tipped guiding catheter. The patient was pre-treated with a bolus of 200 µg intracoronary nitroglycerin. After a bolus of 10,000 IU heparin, a 0.014-in high-torque floppy guidewire was introduced in the left anterior descending artery (LAD). A 3.2 F, 30 MHz mechanically rotated coronary imaging catheter (Ultracross, Boston Scientific, Sunnyvale, CA) was carefully introduced into the LAD over the guide wire. There was no wedging of the catheter in the left main coronary artery and the patient had no symptoms. Continuous ultrasound imaging was recorded while the catheter was withdrawn at a speed of 0.5 mm/sec using an automatic

catheter pullback device (ClearView Ultra system, Boston Scientific, San Jose, CA). The LAD showed minor sclerosis without significant stenosis, but the left main coronary artery showed a severe cross-sectional area loss of 83% in its distal portion (Fig. 2A). A few millimeters more proximal, an ulcerative lesion was seen with a small, moving intimal flap protruding in the lumen, possibly a dissection (Fig. 2B). During the whole study the patient was asymptomatic.

The procedure was terminated uneventfully, and the patient was put in bed. Ten minutes later, he suddenly developed angina with severe hypotension, followed by electromechanical dissociation. Cardiopulmonary resuscitation was started. The left main stem appeared to be subtotally occluded with very slow run-off into the circumflex artery (Fig. 3). A guidewire could be introduced through the left main coronary artery into the LAD, and an angioplasty of the occluded segment was performed, with implantation of a 4 × 24 mm AVE GFX stent (Applied Vascular Engineering, Richmond, Canada) in the left main stem. Circulation could be restored with inotropic support, and an intra-aortic balloon pump was placed. The patient was directly referred from the cathlab

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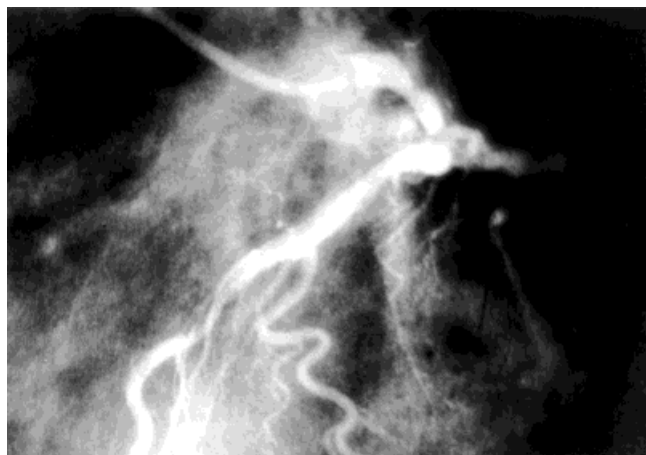


Fig. 1. Angiogram of the left coronary artery in the left anterior oblique projection (50°). There is a stenosis of questionable severity in the distal portion of the left main stem.

to the operating theatre, where an emergency coronary bypass procedure was performed with five distal anastomoses. There was a minor myocardial infarction with moderate increase of myocardial enzymes (peak CK 556 IU/l, CKMB 48 IU/l). The postoperative period was uneventful, apart from a transient ischemic attack.

DISCUSSION

ICUS has gained widespread acceptance as a tool to assess coronary artery disease. It is generally considered a safe procedure, with a low complication rate [1–4]. In a study with ICUS after heart transplantation, there was no clinical morbidity, but vessel spasm occurred in 8.3% of 240 examinations with 5 F or 4.3 F catheters [3]. In a multicenter survey study of 1,837 examinations, spasm was reported in 2.8% and dissection in 0.38% [4]. Major complications such as myocardial infarction or urgent bypass surgery occurred in seven patients (0.38%). No deaths occurred. Acute coronary closure with ICUS seems to be very rare. We found only three cases reported in the literature [5,6]. To our knowledge, this is the first report of acute closure of the left main coronary artery induced by an ICUS catheter in a diagnostic study. Alfonso et al. [5] reported one major complication in a series of 158 consecutive ICUS studies: in a control study after a successful directional atherectomy, introduction of a 4.8 F ultrasound catheter in the LAD resulted in an abrupt coronary closure at the site of the lesion. Although the angiogram performed before the ICUS study had shown a smooth contour without signs of dissection, the ultrasound image now showed a large medial dissection and an image highly suggestive of a small thrombus just proximal to this site. This complication was treated with

prolonged balloon insufflations and implantation of a coronary stent.

Ge et al. [6] described two cases of acute coronary closure with ICUS in a series of 550 patients. In one patient subsequent coronary angiography showed intimal dissection at the site of the studied lesion with distal occlusion and subsequent distal embolisation. This patient was not only treated with balloon angioplasty, but intracoronary and intravenous urokinase were also administered. Both occlusions occurred when the ICUS catheter (one 2.9 F, and the other 4.8 F) was introduced through a high-degree stenosis for which balloon angioplasty was planned. Therefore one can wonder whether the additional ICUS study would really have given useful additional information and if this complication couldn't have been avoided.

Acute thrombosis with intracoronary ultrasound has been described [5], and thus anticoagulation agents must be given before starting the procedure [2]. We give an intravenous bolus of 10,000 IU heparin, and the patients are usually on aspirin. Most authors also recommend an intracoronary bolus of nitroglycerine to prevent spasm, which is also our policy. Catheter manipulation must be gentle and delicate over a small guidewire to minimize the risk of endothelial damage. Wedging of the catheter in a severely narrowed segment must be avoided. The distal vessels with a luminal diameters <2 mm are considered unfit for ICUS examination [1,2]. With the development of smaller catheters (3.2 F and smaller), the risk of ICUS has seemingly been further reduced with recently reported minor complication rates of 1.1% [7].

It seems that most complications are related to interventional procedures [4,7]. Nevertheless, an intimal tear in a ruptured atherosclerotic plaque can pass unremarked at angiography. The contact with the catheter can lead to a further dissection. It is unclear whether the dissection in the left main artery observed with the pull-back was caused by crossing the stenosis with the guidewire and ultrasound catheter or resulted from a spontaneous dissection of an atherosclerotic plaque unrelated to the ICUS imaging procedure. We believe that the small dissection must have dissected further when the catheter was removed, leading to an acute occlusion. This complication is particularly dangerous in the left main stem as nearly the whole left ventricle is jeopardised and severe hypotension can develop, further threatening myocardial perfusion and leading to a cascade of refractory shock, decreased perfusion, and death. Some authors propose thrombus formation as the possible mechanism of acute coronary closure with ICUS and have given intracoronary streptokinase in this setting [6]. Thrombus formation may occur despite pretreatment with aspirin and adequate heparinisation bolus. Most cases of acute closure are

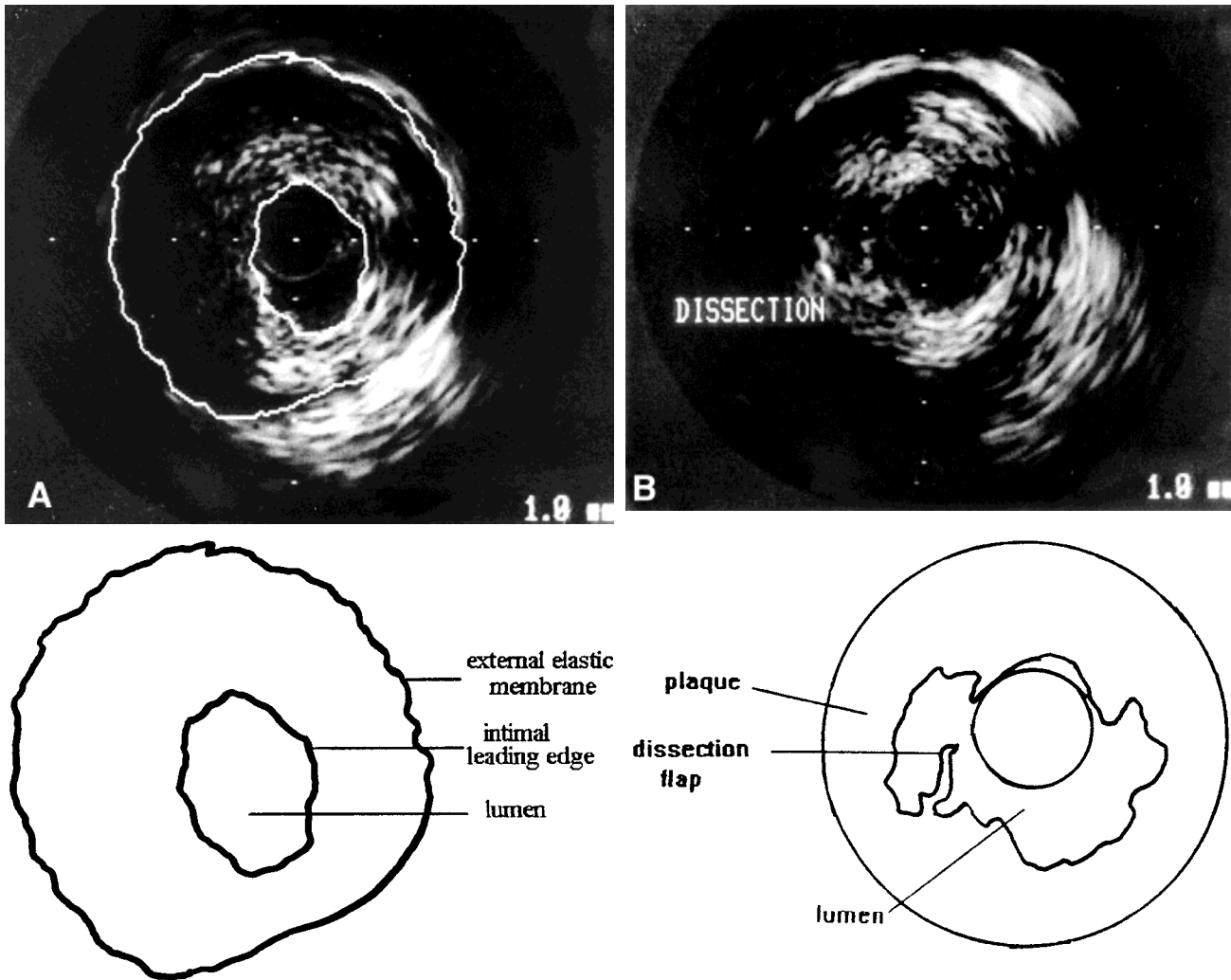


Fig. 2. Intracoronary ultrasound images in the same patient. **A:** Distal left main stem at the narrowest point: large concentric plaque with a cross-sectional reduction of the lumen of 83% and a lumen area of 3.7 mm². **B:** A few millimeters more proximally: a large concentric plaque with echodense fibrocalcific deposits is seen. The ultrasound catheter is nearly intubated in the plaque between 10 and 3 o'clock. In the remaining lumen a dissection flap can be seen between 7 and 8 o'clock. **C, D:** Schematic legend for A and B.

probably due to a combination of the presence of an intraluminal dissection flap and associated thrombus.

ICUS has proved its usefulness in assessing coronary disease. Even minor degrees of atherosclerosis can be studied with this technique [1,3,8]. ICUS studies have especially contributed greatly in understanding and guiding interventional procedures [9]. Diagnostic ICUS is particularly useful to exclude significant stenoses in patients with ambiguous angiograms, such as in eccentric lesions, at ostial locations, or in severe vessel tortuosity or overlap [2,10]. It has proven its value in assessing left main stem disease [11]. ICUS is also useful to study the clinical significance of "intermediate" lesions. A 70% cross-sectional area stenosis is considered to constitute a

hemodynamically significant obstruction. More physiologic measurements such as blood flow measurement with intracoronary Doppler or measurement of the translesional pressure gradient and fractional flow reserve or even noninvasive functional studies might be a better first-line approach in this setting [2].

However, appropriate normals for distal left main coronary arteries are difficult to obtain, and, therefore these measurements may not apply in our patient. Thus, one can wonder how strict the indication for an ICUS study was in our patient. At the start of the study a contrast injection was made in the left coronary artery. The stenosis in the left main artery seemed more severe than on the previous coronary angiogram. This was only

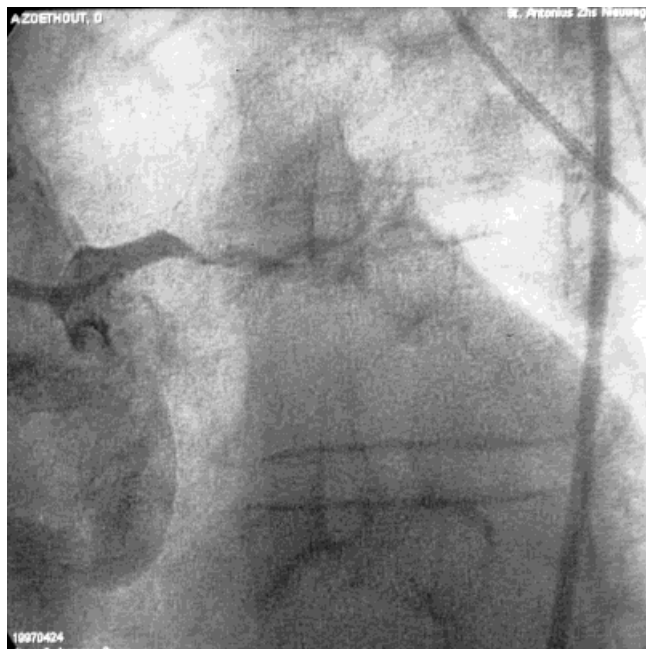


Fig. 3. Subtotal occlusion of the left main coronary artery after a diagnostic intracoronary ultrasound study with very slow run-off into the circumflex artery and anterolateral branch. The left descending artery is not filling.

confirmed by the ICUS study, where an 83% area stenosis was found. Before referring a patient for an ICUS study for an ambiguous angiogram, the first question to ask is whether a second coronary angiogram with supplemental views may clarify the problem, thus avoiding the risk of a more invasive procedure. Great caution should be taken with ICUS when the vessel is extremely small or severely stenosed or with angiographically unstable lesions [6].

CONCLUSIONS

We report on a case of acute coronary closure of the left main coronary artery after a diagnostic ICUS study. While cardiopulmonary resuscitation was performed, the occlusion was successfully opened with balloon angio-

plasty and a stent was implanted in the left main stem. This nearly fatal complication reminds us that even with the smaller catheters actually used, this procedure still has a small but definite risk. ICUS should not be done without a clear indication and weighing the potential risks against the intended benefit. Its use should be limited to experienced interventional cardiologists able to treat possible complications.

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