

## Case Report

## Percutaneous Coronary Intervention Facilitated by Extracorporeal Membrane Oxygenation Support in a Patient with Cardiogenic Shock

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## Key words:

**Cardiogenic shock, ECMO, myocardial infarction**

A 60-year-old man was admitted to our department with non ST-segment elevation myocardial infarction complicated by cardiogenic shock. Total revascularization, using percutaneous coronary intervention facilitated by extracorporeal membrane oxygenation support, was performed, with a favorable outcome.

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**E**xtracorporeal membrane oxygenation (ECMO) uses conventional cardiopulmonary bypass technology to support the circulation with continuous, non-pulsative cardiac output and extracorporeal oxygenation. ECMO exists in two variations: a venovenous variation for respiratory support and an arteriovenous form for total cardiopulmonary support. It consists of a venous reservoir, a centrifugal pump, a membrane oxygenator, pre- and post-oxygenator monitors, and a re-warming circuit. ECMO can be applied percutaneously by cannulation of the femoral artery and femoral vein using the Seldinger technique.

Here we present a case of non ST-elevation myocardial infarction (NSTEMI) complicated by cardiogenic shock and treated with urgent percutaneous coronary intervention (PCI) facilitated by ECMO.

### Case presentation

A 60-year-old man, with a history of systemic hypertension and metformin-treated type 2 diabetes mellitus, was referred to our hospital for urgent catheterization due

to NSTEMI complicated by cardiogenic shock. Two days previously he had been admitted to a nearby hospital due to shortness of breath. The electrocardiogram showed QS in leads V<sub>1</sub>-V<sub>3</sub> with additional slow R wave progression in leads V<sub>4</sub>-V<sub>6</sub> and a Q wave in the inferior leads, and he had a progressive troponin T leakage. Transthoracic ultrasound showed a dilated left ventricle with hypokinetic anterior and inferior walls, with an estimated ejection fraction of 25%, but no signs of mechanical complication.

On arrival at our hospital, the patient had symptoms of pulmonary congestion, as well as peripheral hypoperfusion (low urine volume production and mental disorientation), associated with low blood pressure (85/45 mmHg). An urgent catheterization was performed through the right femoral artery and revealed significant three-vessel disease, including a chronic total occlusion of the posterolateral branch. After consultation between the interventional cardiologist and the cardiac surgeon, revascularization with PCI facilitated by ECMO support was decided upon.

The patient was sedated with intra-

venous diazepam. The left femoral artery was cannulated with an 18F cannula (Femflex®, Edwards Life Science, Irvine CA, USA) and the right atrium of the heart was cannulated through the right femoral vein with a 21F cannula (BioMedicus®, Medtronic, Anaheim CA, USA), under local anesthesia with lidocaine. The cannulae were connected to a centrifugal pump (Jostra Rotaflow®, Maquet Cardiopulmonary AG, Hirrlingen, Germany) equipped with a oxygenator (Jostra Qaudrox®, Maquet Cardiopulmonary AG, Hirrlingen, Germany). The time from decision making to complete cardiopulmonary support was less than 15 minutes. Circulatory support at 4.8 L/min maintained an acceptable hemodynamic condition and venous saturation. Bivalirudin (1.75 mg/kg as a bolus intravenous dose and 0.75 mg/kg/h as an intravenous infusion) was administered as an anticoagulation regimen.

PCI was performed with standard techniques and bare metal stents (Liberte®, Boston Scientific Corp.) were deployed in the proximal left anterior descending artery (3.0 × 28 mm and 2.75 × 32 mm, Figure 1, A & B), the first obtuse marginal branch (2.75 × 16 mm, Figure 1, C & D) and the right coronary artery (3.5 × 28 mm, 4.0 × 20 mm and 4.0 × 28 mm, Figure 1, E & F). An attempt to open the chronically totally occluded posterolateral branch was unsuccessful, due to difficulties in passing the guidewire through the lesion. The procedure was completed with angiographic success and a closure device (Angioseal®, St Jude Medical Inc., Minnetonka MN, USA) was placed in the right femoral artery. Radiation exposure time was 15 minutes and consumed contrast volume was 290 ml.

The patient was transferred to the intensive care unit and was weaned from ECMO after 24 hours without complications. External compression was applied to the right femoral vein after sheath removal (Femostop®, Radi Medical, Uppsala, Sweden), while a suture closure device (Prostar XL®, Perclose Inc., Menlo Park CA, USA) was applied to the left femoral artery.

Antiplatelet treatment was administered with aspirin (320 mg loading dose and 75 mg daily thereafter) and clopidogrel (600 mg loading dose and 75 mg daily thereafter). No complications associated with ECMO (access site bleedings, infections, anemia or thrombocytopenia, thrombotic complications) were observed.<sup>1</sup> The post-infarction period was complicated by transient renal failure, with serum creatinine rising from 1.1 mg/dl to 2.7 mg/dl four days after the catheterization, but normalizing again during hospitalization.

The patient was discharged home ten days after catheterization, with ejection fraction 30%, blood pressure 110/70 mmHg and on treatment with enalapril, metoprolol, simvastatin, aspirin, clopidogrel and insulin.

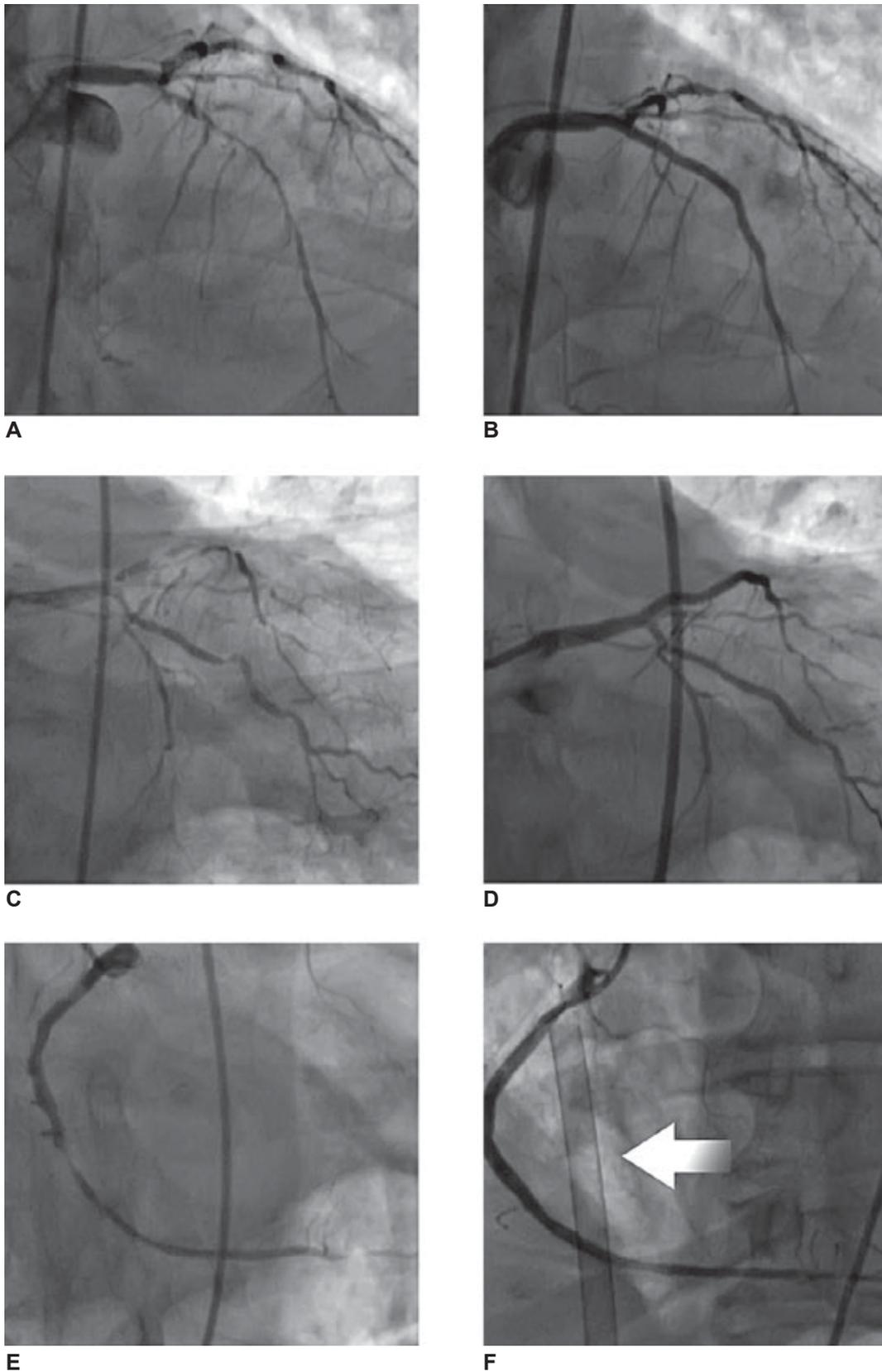
## Discussion

The treatment of patients with cardiogenic shock is based mostly on extrapolated data from other patients with acute coronary syndromes and on expert consensus opinion, given the lack of randomized trials answering specific questions in these patients. The European Society of Cardiology guidelines for ST-elevation myocardial infarction complicated by cardiogenic shock recommend the use of intra-aortic balloon therapy (Class I, Level of evidence C) or “other” left ventricular assist devices (Class IIa, Level of evidence C).<sup>2</sup> However, the benefits from the use of the intra-aortic balloon pump have been strongly questioned lately.<sup>3</sup>

ECMO has also been used in the past for support during high risk PCI procedures,<sup>4-7</sup> but it is not the only assist device used for this purpose. Tandem-Heart (Cardiac Assist Inc., Pittsburg PA, USA) has also been used, but the necessity for transeptal puncture complicates the placement of this device.<sup>8,9</sup> The Impella Recover (Abiomed, Danvers MA, USA) is another circulatory assist device used,<sup>10,11</sup> but the arrhythmogenic effect of the rotary blood pump, due to left ventricle stimulation, is a serious concern in patients with acute myocardial infarction.

An important issue in this case is anticoagulation treatment during ECMO treatment, which was given in the form of intravenous bivalirudin infusion continued after PCI. Bivalirudin has been tested mainly in the setting of PCI, with favorable outcomes compared to unfractionated heparin as regards safety aspects.<sup>12</sup> It is also simple to use, since an adjustment of dosing based on measurements of activated clotting time is not needed. Nevertheless, bivalirudin is much more expensive than unfractionated heparin, especially in such patients who require prolonged infusion. Bivalirudin in patients with ECMO has been previously tested in the setting of heparin-induced thrombocytopenia syndrome,<sup>13</sup> where the standard treatment with heparin is contraindicated.

In conclusion, urgent PCI facilitated by ECMO support is feasible in patients with cardiogenic shock. The safety and efficacy of this treatment needs to be evaluated in future trials.



**Figure 1.** Left anterior descending coronary artery before (A) and after (B) treatment. Left circumflex coronary artery before (C) and after (D) treatment. Right coronary artery before (E) and after (F) treatment. The white arrow indicates the venous cannula inserted from the right femoral vein up to the right atrium.

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