Extra-corporeal membrane oxygenation (ECMO) implantation is limited to specialized centres with cardiac surgery facilities. ECMO implantations in centres without on-site cardiovascular surgery facilities have been reported with ECMO system and surgeon dispatched from the referring hospital. We report the circumstances, feasibility, in-hospital complications and outcomes of ECMO implantation by an interventional cardiologist team in a local hospital with a high-volume catheterization laboratory but without on-site cardiovascular surgery facilities.

Methods

Study hospital
The Hospital Centre of Amiens hosts a catheterization laboratory available 24 hours a day, 7 days a week (24/7), with a team of 12 interventional cardiology nurses and four interventional cardiologists. The hospital catheterization area covers a population of 900 000 people. One thousand to 1000 percutaneous coronary interventions (PCIs) are performed annually. This local hospital does not have a cardiac surgery department. The nearest cardiac surgical hospital is located 100 km away.

Patients requiring ECMO implantation should ideally be transported to the cardiac surgical hospital before they become haemodynamically critically unstable. However, when the patient deteriorates extremely rapidly, it was considered better for the local cardiac catheterization team to implant the ECMO. The patient should be transferred to the cardiac surgical hospital after implantation.

Patient population
Inclusion criteria for ECMO implantation in situ are:
1. Witnessed refractory cardiac arrest, occurring either outside or inside the hospital. The expected no-flow time had to be ≤ 5 minutes and the expected low-flow time ≤ 100 minutes
2. Severe cardiogenic shock.

Procedure

Hardware: Biomedicus portable bypass system (Medtronic, Minneapolis, MN, USA). ECMO comprises an extracorporeal circuit containing a centrifugal pump and a membrane oxygenator (Optiox Maquet, Orleans, France). Percutaneous cannulae (Medtronic).

In most cases, ECMO implantation was performed on the site of collapse in patients who developed in-hospital refractory cardiac arrest, and in the catheterization laboratory in patients who developed out-of-hospital refractory arrest or in the case of severe cardiogenic shock. The interventional cardiologist implanted the cannulae while the two nurses assembled and primed the circuit with normal heparinized saline. The femoral artery was cannulated according to the Seldinger technique with a 14–17 Fr cannula (depending on the size of the patient) and the femoral vein with a 21 Fr cannula.

Puncture was echo-assisted when required, especially in the case of refractory cardiac arrest due to the absence of a femoral arterial pulse. In some cases, distal femoral arterial perfusion was obtained using a 5 Fr sheath, with an echo-guided intergrade puncture to avoid ischaemia of the distal limb when required (Figure 1).

The patient population was divided into two groups according to the patient’s condition at the time of implantation: patients implanted in refractory cardiac arrest (during cardiac massage) and patients implanted in severe cardiogenic shock.

Results

Between September 2006 and September 2010, 51 consecutive patients underwent ECMO implantation by the local team. The annual rate of implantations increased during the course of the study (Figure 2). Twenty-four patients had refractory cardiac arrest and 27 were in refractory cardiogenic shock (Figure 3). Figure 2: Patients implanted.

As shown in Figure 4, 13/24 patients with refractory cardiac arrest and 6/17 with out-of-hospital refractory cardiac arrest fulfilled the predefined inclusion time criteria of no flow ≤ 5 minutes and low flow ≤ 100 minutes.

Figure 3: Patient disposition.

Figure 4: no-flow and low-flow times in patients with refractory cardiac arrest.

Table 3 Complications and outcomes.

Table 3: Delay times among patients with refractory cardiac arrest.

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Conclusion

Our experience suggests that ECMO implantation performed by an experienced interventional cardiologist team, in a hospital without on-site cardiac surgery facilities, is a feasible treatment approach.