Case reports

Refractory angina with severe left ventricular dysfunction: a case for percutaneous transseptal ventricular assistance supported revascularization

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Angina;
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A 73-year-old female patient with medical refractory angina, severe multivessel disease and a critically depressed left ventricular function (ejection fraction 30%) was admitted to our hospital. Considered a poor candidate for surgical revascularization, she underwent urgent high-risk revascularization supported by use of a novel percutaneous left ventricular assist system.

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Patients with a severely impaired left ventricular ejection fraction (< 30%) and multivessel disease (> 3 vessels) are commonly categorized as being at high risk for percutaneous coronary intervention (PCI). Additionally, many of these patients are considered poor candidates for surgical revascularization and are often turned down by surgeons for coronary artery bypass grafting (CABG) on the basis of the perception of a prohibitively high operative risk[1]. A new ventricular assist device (TandemHeart™ pVAD, CardiacAssist, Inc., Pittsburg, PA, USA) makes it possible to rapidly institute percutaneous mechanical circulatory support in the cath-lab setting. The TandemHeart pVAD, permitting for the stabilization and maintenance of the hemodynamic and metabolic parameters, is designed to effectively facilitate high-risk percutaneous coronary procedures, therefore allowing more time to safely perform revascularization. The main component of the TandemHeart system is a miniaturized centrifugal pump with a combination of hydrodynamic bearing and magnetic suspension of the impeller. Circulatory support is established by a left atrial to femoral artery bypass circuit (Fig. 1).

Case report

A 73-year-old female with medical refractory angina and multivessel disease including a chronically occluded left anterior descending artery with widespread and calcific atherosclerotic disease of the mid and distal segments, severe proximal stenosis of the dominant right coronary artery, occluded in the mid portion, and subtotal proximal left circumflex coronary stenosis (Fig. 2) was admitted to our hospital. The left ventricular ejection fraction was found to be 30%. Due to the poor left ventricular function, peripheral vasculopathy and moderate chronic obstructive pulmonary disease, the patient was considered a poor candidate for surgery. The intra-aortic balloon pump (IABP) was deemed to provide insufficient support to sustain the patient through a percutaneous revascularization procedure. The patient had a history of a carotid transient ischemic attack, hypothyroidism, and two prior myocardial infarctions, and was on treatment for congestive heart failure in NYHA functional class II. Further risk factors included smoking, high cholesterol and hypertension. Two days before the current admission the patient underwent thallium single-photon emission computed tomography that revealed ischemia in the antero-lateral region of the left ventricle and no viability in the inferior region of the left ventricle. Thus, the patient was admitted to our department because of unstable angina (IIIB according to Braunwald's classification) that persisted despite a regimen that included aspirin, intravenous heparin and nitrate and a resting

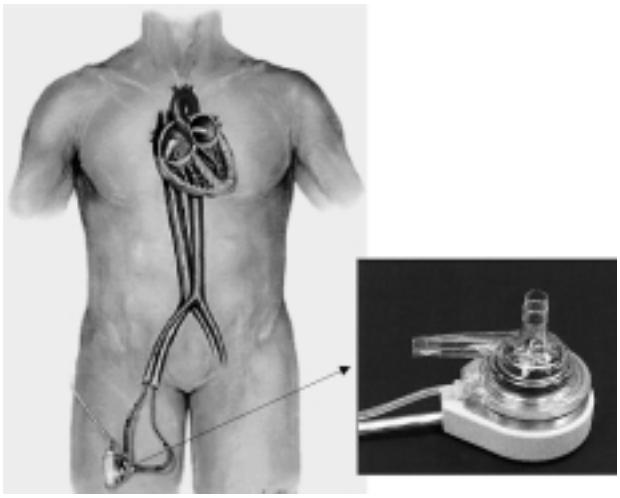

Figure 1. *TandemHeart pVAD centrifugal pump.*

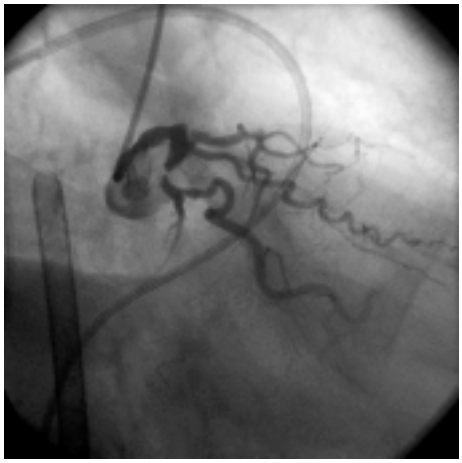

Figure 2. *Stenosis of the circumflex coronary artery.*

heart rate < 70 b/min and a systolic blood pressure < 120 mmHg. The patient underwent cardiac catheterization and, given the high risk of an adverse outcome with CABG, a high-risk angioplasty procedure of the left circumflex artery supported with percutaneous transseptal ventricular assistance was chosen as the best possible alternative to CABG. The off-pump CABG was not considered because refused by the patient. The same day, the TandemHeart was implanted in the cath-lab with the patient under mild general anesthesia. A standard transseptal puncture was performed using a Brockenbrough needle and a Mullin sheath. A valvuloplasty guidewire was placed in the left atrium to facilitate catheter exchanges. The septal puncture was dilated with a 14/21F dilator (Fig. 3). A 21F transseptal cannula and obturator assembly were advanced over the wire and placed in the left atrium and their adequate positioning was confirmed at echography (Fig. 4). The guidewire and obturator were removed, and the cannula clamped. Using the Seldinger technique, a single 14F arterial cannula was placed in the right femoral artery and clamped off. Both cannulae were secured with suture tie-downs. The outflow port of the pump was connected to the arterial cannula using standard 3/8" heparin coated bypass tubing. A further piece of 3/8" tubing was connected to the inflow port of the pump and clamped off. The clamps on the thumbing were released carefully and the pump and tubing backfilled with blood. To close the circuit a wet to wet connection was established between the transseptal cannula and the inflow tubing of the pump. Circulatory support was initiated with a measured flow of 2.65 l/min at 6000 rpm. The mean arterial pressure was increased from 80 to 90-120 mmHg with pump support. The high-risk coronary angioplasty procedure was performed immediately after initiation of support. A single 3/11 stent (Bx Sonic, Cordis, Miami, FL, USA) was implanted and a post-stent dilation performed with a 3.5/10 mm semi-compliant balloon (Tacker, Cordis) (Fig. 5). During balloon inflation, despite the rapid disappearance of the phasic arterial blood pressure, the mean arterial pressure was safely maintained at 80 mmHg with a

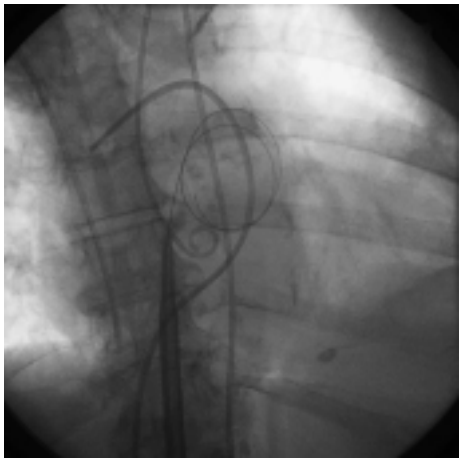

Figure 3. *Dilation of the transseptal puncture.*

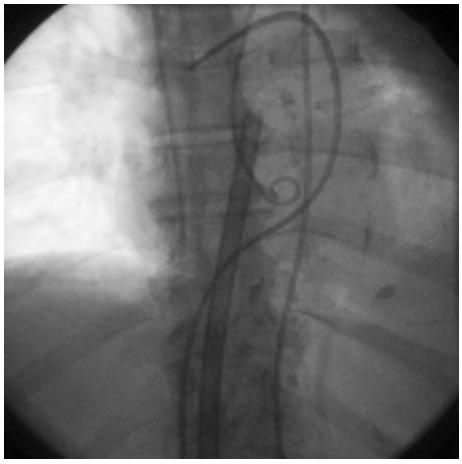

Figure 4. *Transseptal cannula in the left atrium.*

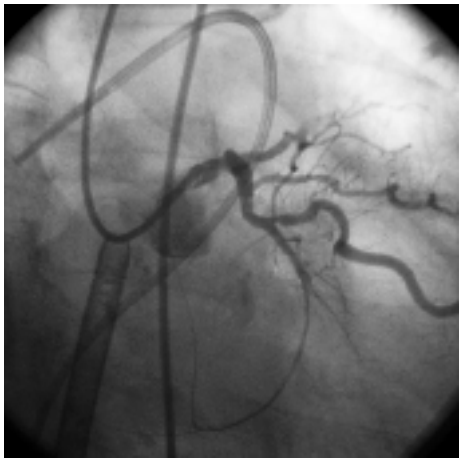

Figure 5. *Result after stenting of the circumflex coronary artery.*

measured pump output of 2.8 l/min. The TandemHeart was explanted immediately following the PCI and the femoral artery was surgically closed in the cath-lab. After explantation of the pump, the patient remained hemodynamically stable with a mean arterial pressure of 87 mmHg, a cardiac index of 2.5 l/min/m^2 and a pulmonary wedge pressure of 8 mmHg. On the day following explantation, the patient was transferred from the intensive coronary care to the general ward. On the third day, the patient was discharged from the hospital. Long-term therapy (at least 9 months) with aspirin and clopidogrel was recommended. At 3 months of clinical follow-up the patient had no angina. At 6 months following discharge a re-catheterization is planned to assess coronary artery patency and left ventricular function.

Discussion

New techniques such as direct stenting along with new products such as embolic protection devices and the increasing use of glycoprotein IIb/IIIa receptor-blocker drugs have tremendously improved the procedural success rate of high-risk PCIs. With regard to this, a recently concluded randomized clinical trial, Angina With Extremely Serious Operative Mortality Evaluation (AWESOME), comparing CABG and PCI survival among patients with medically refractory ischemia having a prior CABG, a recent myocardial infarction, a poor left ventricular ejection fraction or instability necessitating IABP, demonstrated a comparable 3-year survival for the PCI and CABG groups[2]. However, the main limitation of IABP is the lack of active cardiac support and the necessity of a certain level of left ventricular function. In many patients with a severely depressed left ventricular function or persistent tachyarrhythmias, hemodynamic support and left ventricular unloading by means of IABP may offer an insufficient safety margin for a PCI. In such cases, temporary mechanical circulatory support can provide the necessary hemodynamic safeguard, maintaining the blood circulation at near normal levels and preserving the heart muscle, thus prolonging the window during which even long and complicated revascularization procedures can be safely performed. Moreover, this device, providing up to 4.0 l/min of assisted cardiac output and unloading the left ventricle by diverting blood from the left atrium to the systemic circulation, reduces the filling pressure in the left ventricle, the cardiac workload and the oxygen demand and may aid to revert cardiogenic shock after revascularization[3]. Essential requirements for a suitable assist device are: significant circulatory support, a rapid set-up and implantation and explantation without the need of surgery. Only recently has such a device become available. The TandemHeart pVAD offers circulatory support up to 4 l/min and can be implanted percutaneously using standard cath-lab techniques.

It has been reported that it is possible in less than 1 hour and with local anesthesia and no major surgery, for a cardiologist to thread a catheter into the heart, then connect it to the TandemHeart strapped to the patient's thigh or abdomen for restoration of the blood circulation, thus preserving vital organs and giving damaged hearts a chance to heal (www.upmc.edu/NewsBureau/medsurg1/tandemheart.htm). All other ventricular assist devices marketed today are pulsatile flow devices requiring surgery of the chest and abdomen for insertion and removal because of their many moveable components. Because of its small size and weight, TandemHeart can be, on the other hand, inserted and removed using the latest in minimally invasive techniques.

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