Percutaneous aortic valve implantation: A case report

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The present case demonstrates the percutaneous implantation of a bioprosthetic valve in a patient with severe aortic stenosis. An 85-year-old man with significant comorbidities was determined to be at unacceptable risk with traditional surgical valve replacement. Percutaneous aortic valve implantation was performed, was successful and uncomplicated, with significant clinical and hemodynamic improvement. Currently, this procedure is an option only for symptomatic patients who are not appropriate candidates for surgical valve replacement.

Key Words: Aortic stenosis; Percutaneous aortic valve implantation; Percutaneous intervention

In patients with severe symptomatic aortic stenosis, surgical aortic valve replacement is the treatment of choice, offering both symptomatic relief and the potential for improved long-term survival (1). However, a considerable number of patients with aortic stenosis have significant comorbidities – most commonly, advanced age – and may be considered to be at excessive risk for heart surgery. Symptomatic patients managed medically have a poor prognosis (2,3). Although balloon aortic valvuloplasty has been used as an alternative treatment for high surgical risk patients, its benefit is typically short lived and does not alter the natural history of the condition (4,5).

Several groups have pursued percutaneous valve implantation (6-8). The first aortic percutaneous aortic valve implantations were described by Cribier et al (8) using an antegrade approach, involving a trans-septal puncture to sequentially access the right and left atria, and the ventricle and aortic valves (9). In contrast, we have used a retrograde, transarterial technique to perform the first successful North American procedure (10).

CASE PRESENTATION

Patient characteristics

An 85-year-old man with severe aortic valve stenosis presented with class III heart failure (New York Heart Association classification system) and class III angina (Canadian Cardiovascular Society classification system). He had undergone coronary artery bypass surgery 23 years ago, repeat coronary bypass surgery five years ago, and coronary stenting to the proximal left anterior descending and first diagonal artery one month previously. His other medical history included hypertension,

L'implantation d'une valvule aortique percutanée : Un rapport de cas

Le présent cas démontre l'implantation percutanée d'une valvule bioprosthétique chez un patient présentant une grave sténose aortique. Un homme de 85 ans atteint de comorbidités importantes courait un risque inacceptable si on procédait à une chirurgie de remplacement valvulaire classique. On a donc procédé à l'implantation percutanée de la valvule aortique avec succès et sans complications, ce qui a suscité une amélioration clinique et hémodynamique marquée. Pour l'instant, cette intervention n'est envisagée que chez les patients symptomatiques qui ne sont pas des candidats probants à une chirurgie de remplacement valvulaire.

smoking, hypercholesterolemia, chronic myelomonocytic leukemia and hypothyroidism. Echocardiography documented an aortic valve orifice of 0.7 cm², a mean transvalvular gradient of 58 mmHg, an aortic annulus size of 25 mm, mild mitral regurgitation and left ventricular hypertrophy. Left ventricular systolic function was normal.

Formal surgical consultation was obtained and surgical risk was deemed excessive by two cardiac surgeons. Predicted operative mortality was 30% according to the logistic European System for Cardiac Operative Risk Evaluation estimates (11,12). Informed consent was obtained from the patient, and he was formally reviewed and accepted for the procedure by a committee, with independent representation from the cardiac surgery, cardiology and nursing departments. Approval for compassionate use of a percutaneous aortic valve was obtained from the Therapeutic Products Directorate, Health Canada (Ottawa, Ontario).

Procedure

The patient was premedicated with acetylsalicylic acid, clopidogrel, heparin and vancomycin. The procedure was performed under general anesthesia. Before the procedure, contrast angiography and computed tomographic angiography documented patent iliofemoral arteries with a minimum diameter of 9 mm, suitable for the placement of a percutaneous valve. The right and left femoral arteries and the left femoral vein were accessed percutaneously. The stenotic aortic valve was crossed in a retrograde manner using an Amplatz left catheter and a 0.035 in guidewire. The valve was predilated using a standard valvuloplasty balloon.

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Figure 1) The percutaneous valve constructed from a tubular, slotted, stainless steel stent with a trileaflet pericardial valve. The valve when open (A) and when closed (B)

Figure 2) Electrocardiogram showing a decrease in cardiac output and arterial blood pressure, facilitating accurate positioning, caused by rapid pacing during prosthesis implantation. FA Femoral arterial pressure

The percutaneous valve (Edwards Lifesciences Inc, USA) is constructed from a tubular, slotted, stainless steel stent with a trileaflet equine pericardial valve (Figure 1). The stent valve was securely crimped onto a 25 mm diameter valvuloplasty balloon catheter (NuMED Inc, USA) using a specially constructed mechanical crimping device. The right femoral artery puncture site was then sequentially dilated to accommodate a 24F (internal diameter) sheath (Cook Inc, USA). A specially developed steerable catheter (Edwards Lifesciences Inc, USA) was then advanced, retrogradely, to position the prosthesis within the calcified native aortic valve as seen on fluoroscopy. During the actual implantation, rapid right ventricular pacing at 200 beats/min was used to decrease the cardiac output to stabilize the prosthetic position (Figure 2). The prosthetic valve was successfully deployed below the coronary ostia (Figures 3 and 4). Subsequent aortic angiography and echocardiography documented trivial paravalvular aortic regurgitation. The 24F sheath was then electively removed by surgical cutdown and the femoral artery was repaired.

Following an uneventful procedure, the patient was discharged four days later. Echocardiography at one month documented a well-seated and normally functioning prosthesis. The aortic valve area was 1.8 cm², and the mean transaortic pressure gradient was 16 mmHg. The patient remains asymptomatic after 12 months of clinical follow-up.

Figure 3) Aortography showing the percutaneous valve during deployment (A), after deployment from the side (B) and after deployment as seen end on (C)

Figure 4) Ascending aortography. A Before valve implantation. B The valve being successfully deployed in a stable position below the coronary ostia

DISCUSSION

The present case demonstrated that a bioprosthetic valve could be implanted percutaneously within a stenotic native aortic valve. The valve orifice and hemodynamics were similar to those achieved with surgical prosthesis and far superior to those achieved with balloon valvuloplasty alone (13).

However, clinical experience remains limited. In vitro valve durability has been repeatedly documented at 200 million cardiac cycles, which correlates to more than five years of life (10). The potential for complications with this new procedure is not yet well understood, but risks include arterial access site injury, valve malposition or embolization, vascular or cardiac perforation, arrhythmias, stroke, myocardial infarction, infection and death. Mild paravalvular leaks are relatively common, and more severe leaks can occur.

The relatively unproven nature and inherent risks of this new therapy argue for a formal team approach to patient selection and outcome analysis. Surgical consultation and involvement is mandatory to assess surgical alternatives, vascular access issues and surgical options should complications occur. Nursing input has also facilitated periprocedural care planning for these patients. A steep learning curve, risks and risk for oversight associated with an immature technology argue for a limited dissemination to a small number of specialized centres.

It is likely that progressive development of technology, techniques and better understanding of appropriate criteria for patient selection will expand the indications for percutaneous valve procedures. Currently, this procedure is an option for symptomatic patients who are not appropriate candidates for surgical valve replacement.

DISCLOSURE: Dr John G Webb has acted as a consultant for Edwards Lifesciences, USA.

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