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Clinical Report

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Transcatheter aortic valve implantation in end-stage renal disease

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Abstract

Valvular heart disease is common in patients with end-stage renal disease and, if symptomatic, may lead to valve replacement surgery. However, some patients with renal failure are deemed unsuitable for cardiac surgery, and in those patients who do undergo surgery, there is a significantly greater morbidity and mortality. Transcatheter aortic valve implantation (TAVI) is recognized as an option for high-risk patients with symptomatic aortic stenosis (AS). Here we describe two patients on haemodialysis who underwent TAVI with satisfactory outcomes. The role of TAVI is evolving and has the potential to play an important role for dialysis patients with AS.

Keywords: aortic stenosis; end-stage renal disease; haemodialysis; transcatheter aortic valve implantation

Background

Abnormalities of the cardiac valves are common in patients with end-stage renal disease (ESRD). Mitral and aortic calcification is seen in 10–55% of patients with ESRD [1–5]. Aortic stenosis (AS) is the most commonly seen symptomatic valve lesion [6]. Surgical valve replacement for symptomatic patients is indicated for those of acceptable risk, but there are others who are unsuitable or at high risk because of technical contraindications, multiple comorbidities or physical frailty. Transcatheter aortic valve implantation (TAVI) with a bioprosthetic valve is increasingly employed as an alternative therapy for high-risk or inoperable patients with severe AS.

Percutaneous TAVI was first described in 2002 [7]. Its subsequent commercial development and refinement have allowed transcatheter treatment of AS in selected patients. These have shown benefit compared to standard medical care [8] and similar early and medium-term outcomes compared to the surgical approach [9]. Minimal data exist regarding patients on renal replacement therapy treated by TAVI. In this report, we describe two patients with ESRD who underwent TAVI and discuss its role in this clinical setting.

Case 1

A 46-year-old man was born with complex congenital heart disease including transposition of the great arteries, situs inversus, atrial and ventricular septal defects and stenosis of the pulmonary outflow tract. He underwent several cardiac operations throughout childhood. In 1997, he underwent an orthotopic heart transplantation due to severe failure of the systemic (morphologic right) ventricle. He developed progressive renal impairment, requiring dialysis, despite withdrawal of the calcineurin inhibitor. Upper arm fistulae could not be created due to heart disease, previous thoracic operations and altered vasculature. The patient commenced peritoneal dialysis in 2006, but this was complicated by peritonitis requiring catheter removal. He was eventually established on home haemodialysis through a right femoral fistula in 2007, with an intention to proceed to a live donor renal transplant. However, he developed rapidly progressive AS: in 2005, the maximum aortic velocity on transthoracic echocardiogram (TTE) was 2.1 m/sec, increasing to 5.1 m/sec in 2008, with a mean aortic valve gradient of 66 mmHg. The situation was considered inoperable due to technical considerations. Balloon aortic valvuloplasty was performed in July 2009 but was of limited success: the mean gradient 1 day before and after the procedure fell from 69 to 53 mmHg. One month later, TAVI was performed from the left femoral artery, with left radial artery cannulation for aortography. A 29-mm CoreValve prosthesis (Medtronic, Minneapolis, MN) was inserted with a fall in mean gradient to 18 mmHg and mild paravalvular aortic regurgitation. A DDD pacemaker was inserted shortly afterwards for intermittent complete heart block and symptomatic ventricular standstill. A year later, the patient received a live donor renal transplant and remains independent of dialysis. A repeat TTE in September 2011 showed normal aortic valve function with mild aortic regurgitation.

Case 2

An 85-year-old man, with anti-neutrophil cytoplasmic antibody-positive vasculitis, developed ESRD and was

commenced on haemodialysis, but continued to experience New York Heart Association Class IV symptoms. A TTE showed severe AS with no regurgitation (maximum aortic velocity 4.3 m/sec, a mean gradient of 42 mmHg, aortic valve area <0.8 cm^2). The patient underwent preemptive dual chamber pacemaker implantation for bifascicular block, followed 4 days later by TAVI with a 26 mm Edwards SAPIEN prosthesis (Edwards Lifesciences, Irvine, CA). He remains dialysis dependant but has noted a significant improvement in his exercise tolerance; he is able to walk 4 km without hindrance and recently celebrated his 60th wedding anniversary. A repeat TTE, 4 months after TAVI, showed a stable bioprosthetic valve with a mean aortic gradient of 8.5 mmHg and no regurgitation.

Discussion

Moderate AS is seen in up to 9% of ESRD patients [10, 11, 12], with symptomatic AS seen in 3% of haemodialysis patients [11]. Dialysis patients have a high incidence of risk factors that are recognized to predispose to cardiovascular disease, such as hypertension, dyslipidaemia and diabetes mellitus. In addition, patients with ESRD have specific risk factors that contribute to this increased incidence. These include the uraemic milieu, inflammation, secondary hyperparathyroidism, increased calcium-phosphate product, use of calcium-based phosphate binders and abnormal vascular calcification [13]. Heart valve disease appears to occur 10–20 years earlier in ESRD patients than in the general population [6, 10, 11] and progresses more rapidly [11, 14, 15].

Surgical valve replacement is the established treatment for symptomatic AS. It is accepted that patients given a bioprosthetic or mechanical valve have a better outcome than those treated medically or by balloon valvuloplasty. In the general population, AS is predominantly a disease of the elderly, many of whom have multiple comorbidities; at least a third of all patients are deemed unsuitable for surgery [16]. It is unclear how many patients with ESRD and clinically symptomatic valvular heart disease are either not referred or are declined for cardiac surgery. In addition, patients with ESRD who undergo cardiac surgery have an increase in both morbidity and mortality [17, 18]. For patients deemed unfit for surgery, the treatment options are limited and there is a high mortality rate and significant reduction in quality of life [19].

TAVI is an emerging technology that allows implantation of a prosthetic valve without the need for a median sternotomy or cardiopulmonary bypass (Figure 1). It is currently employed in patients with symptomatic AS in whom comorbidities or technical issues make the patient inoperable or at high risk for surgical valve replacement. The early experience reported a technical success of 75% and 30-day mortality of 22% [20]. Improved patient selection, increased operator experience and newer implantable valves of lower profile with better delivery systems have all contributed to steadily improving outcomes. Recent registries report technical success in over 98% and 30-day survival in over 87% of patients [21, 22, 23]. Accepted indications and contraindications for TAVI have now evolved [24]. TAVI is associated with an improvement in aortic valve area, aortic valve gradient, quality of life, functional capacity and 6-min walk distance [25].

There are significant risks associated with TAVI. Valve frame compression of the conduction system may cause heart block, requiring a permanent pacemaker. This is particularly likely in patients with pre-existing conduction disease, and those treated with the CoreValve prosthesis, 30–40% of whom will need pacing [26]. A clinically apparent stroke is described in up to 5% of patients [8, 9]. However, more subtle neurologic impairment is likely to be more frequent with systematic magnetic resonance imaging studies demonstrating new cerebral perfusion defects in 72–91% of patients [27, 28]. Coronary obstruction causing myocardial ischaemia or infarction has been reported in up to 4% of patients [25]; that incidence is likely to fall with more rigorous assessment of aortic sinus dimensions and coronary height during pre-procedure patient evaluation. A mild paravalvular leak is common after TAVI [25]. More significant regurgitation may require further balloon dilatation or implantation of another valve. Vascular access site complications associated with the large-bore access sheath are also common, although the incidence is less with current generation 18F than earlier 24F [25].

The initial results from clinical trials have suggested that TAVI is a promising therapy when used in selected patients. Here, we describe two patients with ESRD, who underwent TAVI for symptomatic AS, an encouraging short-term outcome of TAVI in this particular high-risk population. Ongoing assessment of the valve function in our patients continues as long-term data for patients undergoing TAVI are unavailable and accelerated degeneration of surgical bioprosthetic valves has been reported in ESRD [29]. TAVI represents an important emerging therapeutic option for patients with ESRD.

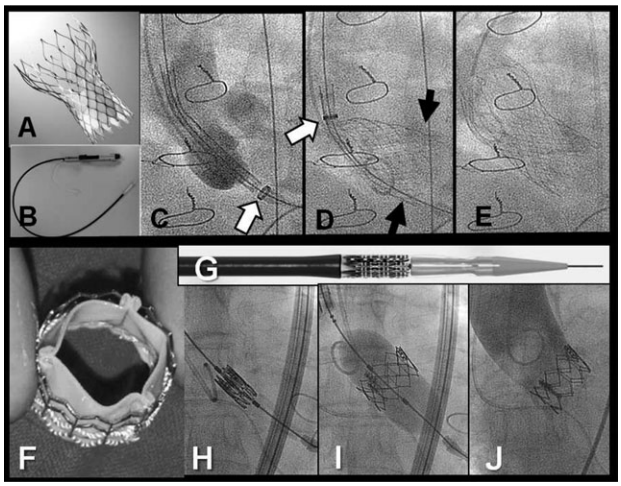

Fig. 1. TAVI in ESRD. Shown in (**A**) is the CoreValve percutaneous aortic prosthesis with leaflets fashioned from porcine pericardium hand sewn into a nickel titanium (nitinol) self-expanding frame. The valve is crimped down and loaded into a sheath in (**B**). The delivery system is placed across the stenosed valve in (**C**) (the white arrow indicating the end of the delivery sheath). In (**D**), the sheath is partially retracted (white arrow), allowing partial expansion of the nitinol frame (black arrows). In (**E**), the sheath has been fully retracted allowing full-frame expansion and valve deployment. (**F**) Depicts the Edwards Sapien valve fashioned from bovine pericardium, hand sewn onto the stainless steel balloon-expandable frame. (**G**) Depicts the valve mounted on the delivery balloon, which in (**H**) lies across the diseased valve. Balloon inflation expands the valve, (**I**). (**J**) After balloon removal, shows a competent aortic prosthesis.

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Conflict of interest statement. None declared.

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