COMMENTARY

Patient selection for transcatheter aortic valve implantation (TAVI) in South Africa

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ABSTRACT

Patient selection is likely to be the most important determinant of a successful long term outcome of the TAVI procedure. It requires careful assessment of the indications for aortic valve replacement, clinical status of the patient, associated co-morbidities and, importantly, the cognitive function and motivation of the patient. This assessment must be made by a multi-disciplinary team consisting of at least a cardiologist, cardiac surgeon, anaesthetist and general physician. Careful imaging of the relevant anatomy with ultrasound and CT scanning is critical. Experience improves patient selection and ultimate outcome. Funding remains a challenge and many patients worthy of the procedure are denied because of costs. SAHeart 2012; 9:90-95

INTRODUCTION

Severe symptomatic aortic stenosis carries a very poor prognosis with 1 year survival in the region of only 75%.[1] Surgical aortic valve replacement (sAVR) improves survival.[2] However, as the co-morbidities and age of patients with aortic stenosis increase so does the operative mortality while one-year survival decreases such that octogenarians with a logistic EuroSCORE of >20% have a 1 year survival of only around 70% after sAVR.[3,4]

Transcatheter aortic valve implantation (TAVI) is a catheter based technique which allows replacement of the aortic valve without requiring sternotomy or cardiopulmonary bypass. It has been designed to treat patients who are high risk for conventional surgery. The first TAVI procedure was performed by Alain Cribier in 2002.[5]

Currently 2 TAVI devices are available. The Medtronic™ CoreValve™ is a self-expanding device which delivers a porcine pericardial valve. The Edwards SAPIEN™ device is balloon expandable and delivers a bovine pericardial valve. Details of these technologies are dealt with in accompanying articles in an earlier edition of this journal [SA Heart 2012; 9 (1)].

TAVI programmes are generally delivered by a multi-disciplinary team (MDT) consisting of interventional cardiologists, cardiac surgeons, cardiac anaesthetists and imaging specialists. Increasingly it is also recommended that a physician with an expertise in the care of the elderly should be included in the team. The selection of optimal patients is one of the most critical factors contributing to the success of a TAVI programme, requiring the expert assessment of each member of the MDT.

CLINICAL ASSESSMENT

Aortic valve replacement is generally recommended for patients who are symptomatic. Careful clinical assessment is mandatory to ensure that the signs and symptoms are indeed due to severe aortic stenosis and that replacing the valve is expected to improve the patient's condition.

The risk of sAVR must then be assessed. As this is an operative risk assessment, it is essential to include the opinion of a cardiac surgeon in the process.

SURGICAL RISK ASSESSMENT

Thus far, no risk score has been designed specifically for TAVI. Traditionally the logistic EuroSCORE[6] and Society of Thoracic

Surgeons (STS)[7] scores have been used to assess suitability for TAVI and as guidelines for registries and trials (with a logistic EuroSCORE of >20% and an STS score of >10 being considered indications for TAVI), but both are far from ideal with especially the EuroSCORE overestimating risk. There are a number of factors which increase the risk of surgery that are not adequately reflected in the traditional risk scores e.g. mobility, frailty and a porcelain aorta. For this reason using a logistic EuroSCORE of >20% as the indication for TAVI will result in some "appropriate" patients being excluded and vice versa. A specific risk score for TAVI needs to be developed.

Once the patient has been considered a high risk for surgery he/she must then undergo a number of screening investigations which will allow the MDT to decide whether sAVR, TAVI or medical therapy is the most appropriate route to follow.

SCREENING INVESTIGATIONS

Screening investigations should include echocardiography, angiography, CT scanning, lung function tests, carotid Doppler, blood tests that include an assessment of renal function and an assessment of frailty.

Echocardiography gives useful information about aortic valve function and morphology, left ventricular function and size, mitral valve function and the presence or absence of a septal bulge. Measurement of the aortic annulus diameter is critical. There is no real consensus on how best to measure the aortic annulus but many favour transoesophageal echocardiography. It is widely accepted that the annulus is elliptical rather than circular, which may contribute to the frequent paravalvar leaks seen after TAVI implants, hence increasing the need for more accurate assessment by 3D echocardiography and/or CT scanning. The final decision on prosthetic valve size to be implanted should not be based on a single measurement of annular size, but rather on assessment of the whole of the aortic root including annulus size, morphology and degree of calcification of the native leaflets, size of the sinuses of Valsalva and the degree of aortic calcification. The placement of a large valve in women with a porcelain aorta runs a risk of annular rupture, a disastrous and usually fatal complication.

The coronary anatomy and also (potentially) the peripheral vasculature may be assessed by angiography. Not only is the size of the femoral and iliac vessels important, but also the extent of tortuosity and the degree of calcification. CT scanning of the whole of the aorta with or without contrast should be used in addition to peripheral angiography. In the presence of renal dysfunction, due caution must be taken to avoid contrast-induced nephropathy. Even contrast free CT scanning yields important information about the degree of calcification of the thoracic aorta (to diagnose porcelain aorta) and also the femoral and iliac circulation. Accurate interpretation of the CT images requires an experienced radiologist whose input to the MDT can be most useful.

Elderly patients with aortic stenosis and poor lung function represent a particularly challenging group. It is not only important to assess the relative contribution of respiratory and aortic pathology to breathlessness but also whether the degree of respiratory problems might lead to major post-procedural pulmonary problems and ultimately respiratory death. Detailed pulmonary function tests should be performed. A number of factors assist in judging the cause of a patient's dyspnoea. A short history and an elevated proBNP suggest cardiac rather than respiratory pathology. Also, initially assessing the response to balloon aortic valvuloplasty (BAV) can be useful. An important symptomatic improvement after BAV suggests that a subsequent TAVI will benefit the patient. However, despite these measures, patients with poor lung function remain a considerable problem. After TAVI, 10-15% of patients who die between 30 days and one year suffer a non-cardiac respiratory death.[8] It is clear that more sensitive measures of lung function are required in order to identify these at-risk patients before the procedure.

Patient frailty is difficult to estimate but may have an important bearing on the immediate and longer term success of a TAVI procedure. There is no standardized risk score model for frailty as an index of risk for general surgery or TAVI. Various models have been proposed incorporating a number of factors such as walking distance/speed, weight loss, strength and balance, nutritional status and independent daily living activities (washing, dressing driving etc.). With better equipment, percutaneous closure of groin sites and anticipated greater use of the transaortic approach, the actual trauma to the patient is becoming less and physical frailty less of an obstacle.

As teams become more experienced the "eyeball" test becomes quite accurate and we consider factors such as mental and emotional status, particularly as to whether the patient understands the implications of the procedure and is enthusiastic towards going through with it, as important factors towards yielding a successful outcome. The MDT member with expertise in care of the elderly is most suited to carry out this assessment. However thus far no consensus has been reached on which of the variety of the measures used previously or presently under development should be employed for TAVI.[9]

MEETING OF THE MULTI-DISCIPLINARY TAVI TEAM (MDT)

The patient data should be presented to a joint meeting of the MDT once the screening tests have been completed, from which 1 of 3 possible recommendations could be made:

- The patient may be considered inappropriate for either sAVR or TAVI. The team may feel that the benefits to the patient would be small and the risks exceedingly high due to co-morbidities or frailty. For example, patients with cancer who have a prognosis of less than one year should not be offered TAVI. In the South African experience, 20% of patients who are discussed are found not to be appropriate for surgery or TAVI (Figure 1). These tend to be the highest risk patients with the poorest outcome. A palliative BAV might be considered in this group in an attempt to alleviate symptoms in the short term.

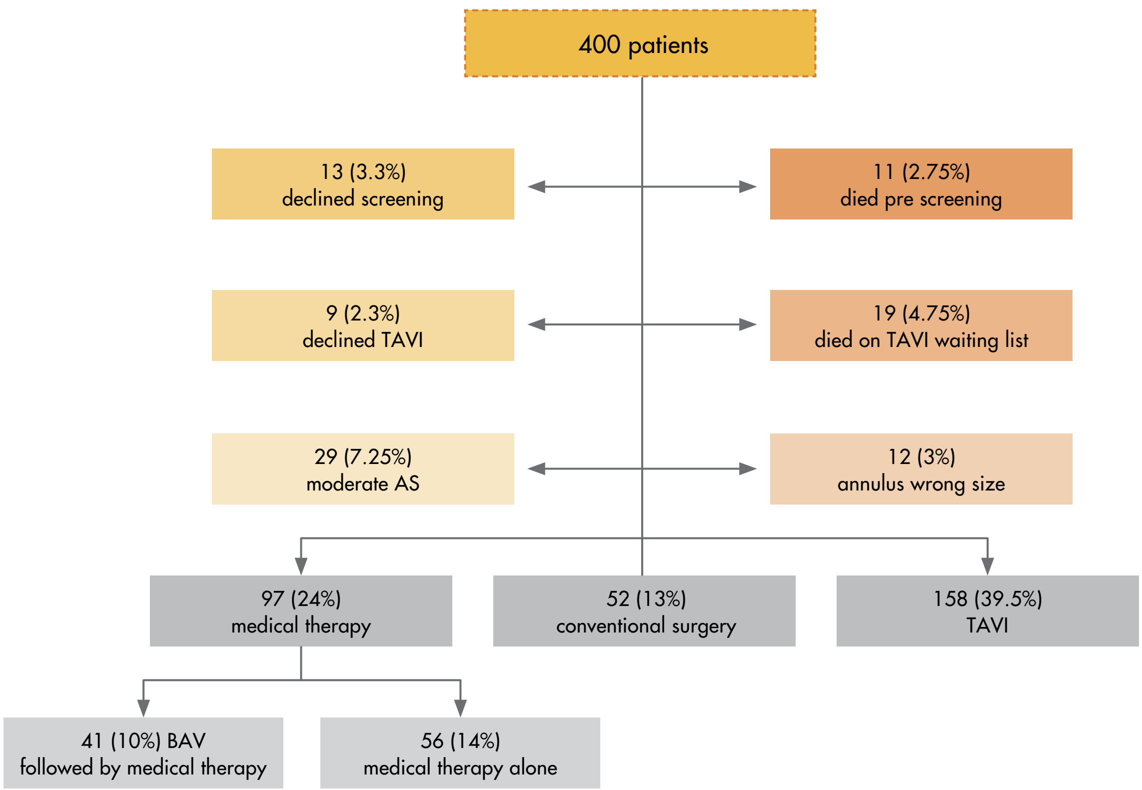

FIGURE 1: Outcome of 400 patients referred into the TAVI programme at St Thomas' Hospital, London for assessment by the multi-disciplinary team (MDT).

Definition

The incremental cost effectiveness ratio (ICER) defines what additional cost is to be invested to gain one additional unit of effectiveness (e.g. quality-adjusted life year, QALY) with a new therapy as compared to an alternative therapy.

Quality Adjusted Life Years (QALYs)

- Is a common measure of benefit that combines quantity and quality of life.
- Is calculated by weighing each year of life with a quality of life score (called "utility"). A utility of 1 means perfect health while a utility of 0 means death.

Example: Severe aortic valve stenosis

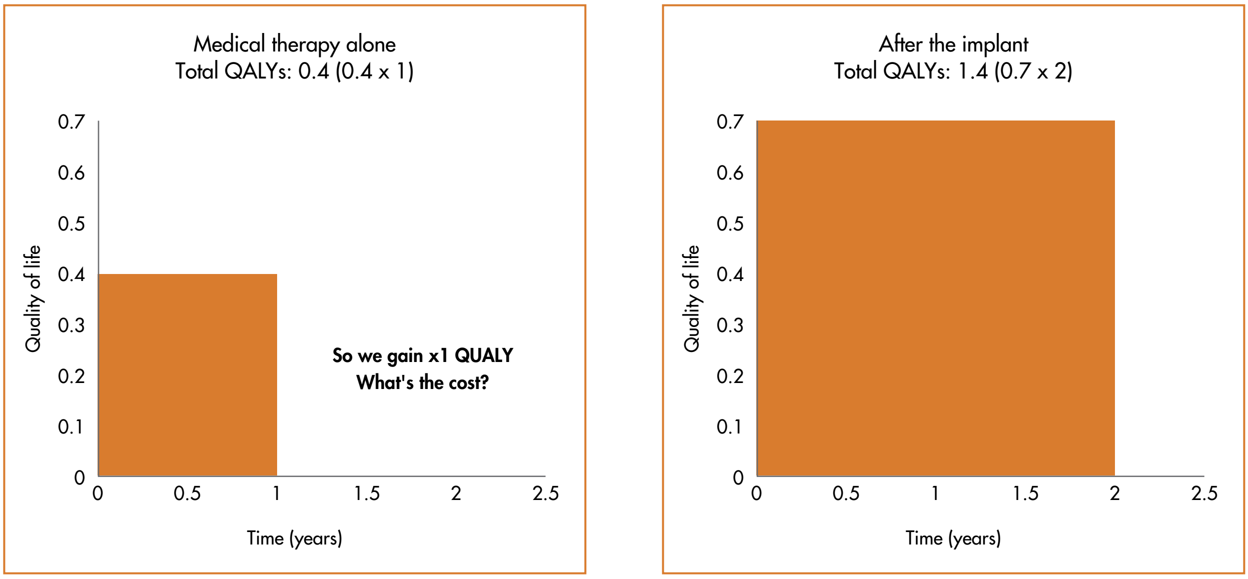

FIGURE 2: How to measure cost effectiveness.

- The patient may be assessed as suitable and appropriate for TAVI. About 60% of patients referred to the TAVI programme are considered to be appropriate candidates for TAVI. However, only 40% of these eventually undergo the procedure because of funding difficulties or patients declining. The MDT must also decide on the access route for the TAVI; transfemoral, transapical, subclavian or transaortic. Most units adopt the default position of transfemoral first, and there is some evidence that the outcomes of transfemoral access are better than transapical which is not entirely due to the increased co-morbidities of patients treated via the transapical route. Patients requiring a preparatory procedure such as coronary angioplasty or BAV should have this performed in staged fashion prior to TAVI.
- About 20% of patients may be appropriate for open surgical AVR.

CORONARY ANGIOPLASTY PRIOR TO TAVI

The majority of TAVI patients present with breathlessness or syncope rather than chest pain. During sAVR it is traditional to bypass any major epicardial stenosis. Despite this the need for revascularisation prior to TAVI in the absence of chest pain is unclear. Theoretically revascularisation of important proximal major coronary artery lesions could improve the safety of the procedure or the longer term outcome but as yet there is no objective data to support this.

Systematic angioplasty of coronary lesions in this circumstance is probably not justified. Because of the danger of resistant ischaemia during rapid pacing and TAVI deployment, a pragmatic approach may be to consider PCI to left main or proximal LAD lesions. In order to improve LV function prior to TAVI, an even more extensive PCI strategy may be considered if the left ventricular function is poor. Both strategies are intended to improve the safety of TAVI. However, the effect of revascularisation on longer term outcomes requires further investigation.

BAV PRIOR TO TAVI

The benefits of standalone BAV are short-lived and the risk is not insignificant. Thus BAV became a forgotten technique at a time when there was no definitive follow-on procedure. There has been an important resurgence of BAV in the TAVI era. BAV can now be considered as a staging procedure prior to TAVI in patients who present with syncope, poor LV function, or those in whom the relative significance of cardiac and pulmonary dysfunction is unclear.

COST-EFFECTIVENESS

Patient selection and pre-procedural risk have major effects on the cost-effectiveness of TAVI. Cost-effectiveness is generally measured as cost per quality adjusted life year gained (cost/QUALY). A QUALY is measured as a product of survival and quality of life.

Figure 2 shows a theoretic situation comparing medical therapy with a TAVI in patients with severe symptomatic aortic stenosis. A medically treated patient lives for 1 year with a notional quality of life of 0.4 (with 1 being normal). This patient therefore has a QUALY of 1 x 0.4 = 0.4. If TAVI is performed the patient may live for two years with a quality of life improved at 0.7. This patient's QUALY is 2 x 0.7 = 1.4. The patient therefore gained 1 QUALY.

From the healthcare perspective, the question is at what the cost of this benefit is achieved. The acceptable price of this benefit will vary between different health economies. In the United Kingdom the National Institute of Clinical Excellence has decreed that £20 000 - £30 000 is acceptable for this level of benefit. A cost-effectiveness analysis of the PARTNER Cohort B trial comparing TAVI with medical therapy in high risk symptomatic patients with aortic stenosis showed that in the TAVI group total costs were significantly lower at 12-month follow up ($29 352 vs. $52 724 p<.001) with a cost-effectiveness ratio of $50 212 per life-year gained[10] close to the $50 000 regarded as acceptable for new technologies in USA.[10] Cost effectiveness data from the PARTNER Cohort A patients comparing TAVI with surgical AVR is keenly awaited.

TAVI is not available yet to any State funded patients. In the private sector, the financial situation of each patient has a major bearing on patient "selection". South Africa, with its fragmented private health funding system, has no guidelines as to what an economically acceptable cost threshold may be. To date, the financial arrangements for each patient considered for TAVI have been negotiated between the patient and the particular funder. Different funders have different regulations. In most cases the patients have had to agree to some form of co-payment. Some have been declined outright and a few have been accepted at

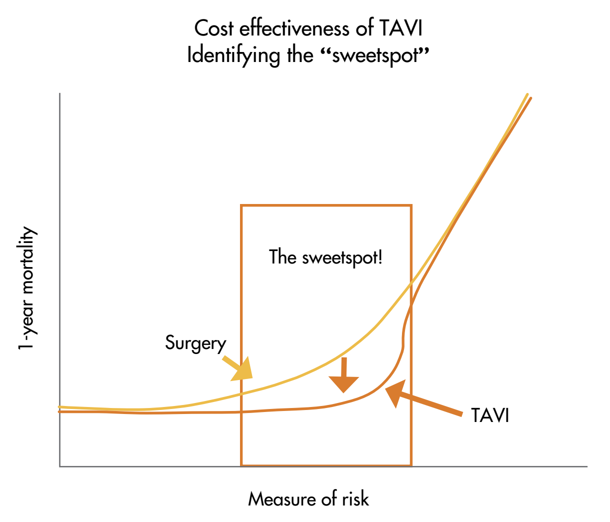

FIGURE 3: Identifying the "sweet spot" of risk may aid cost effectiveness.
(Adapted from a graph presented at Transcatheter Cardiovascular Therapeutics 21st Annual Scientific Symposium [TCT 2009] September 21 - 26, 2009; San Francisco, California.)

"fee-for-service" rates despite the lack of specific codes for the procedure.

In the case of TAVI the aim of patient selection is to identify the "sweet spot" of risk where TAVI may have a mortality benefit and quality of life benefits equal to surgery (Figure 3). It is likely that very high risk patients will derive little benefit from either TAVI or sAVR. In very low risk patients (for whom sAVR is relatively inexpensive with excellent outcomes) it will be very difficult for TAVI to become a more cost-effective option given the current cost of the devices. The equation is expected to change as competitors enter the market and drive device costs down.

CONCLUSIONS

Optimal patient selection for the TAVI procedure is central to obtaining success with the procedure. Declining a very high risk case is preferable to a procedure which ends in failure. Patient selection must be made by a MDT. Optimising risk selection ensures that maximal cost-effectiveness will be obtained from the procedure.

Conflict of interest: none declared.

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