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Original Research Article

Surgical AVR, Revisited

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Abstract
Introduction: *Other aortic interventions are often compared to surgical aortic valve replacement (SAVR), which is the current gold standard[1]. In view of the increasing interest in transcatheter aortic valve replacement (TAVR), in our study we analysed the relevance of surgical AVR*
Materials and Methods: *We analysed 108 consecutive patients who underwent SAVR in a year at our institute in terms of demography, indications, surgical approach and complications. We searched the available literature for comparative studies between surgical and catheter based aortic valve replacement and the outcomes using the MeSH terms aortic valve replacement, TAVI, TAVR.*
Results: *Surgical AVR continues to be the gold standard in the management of aortic valve disease. TAVR is not entirely risk-free and has high incidence of paravalvular leak, risk of pacemaker implantation and vascular complications.*
Conclusions: *In low, intermediate as well as high-risk patients surgical AVR continue to be the gold standard of treatment.*
Keywords: *AVR, TAVI, TAVR, surgical AVR, MICS AVR.*

Introduction

With the increasing use of transcatheter techniques and availability of sutureless valves, newer interventional strategies for aortic valve replacement are on the rise, especially for aortic valve stenosis[2]. Cavalier trial[3] of Perceval sutureless aortic valve and PARTNER[4] trial of transcatheter placement of aortic valve have contributed to increased spectrum of treatment of aortic valve disease.

Surgical aortic valve replacement (SAVR)

The classical operation is performed through median sternotomy under cardiopulmonary bypass. Valve is anchored either at the annular or supra-annular location, using pledgeted, non pledgeted interrupted or continuous sutures. The valve is either a mechanical valve or stented or stentless bioprosthetic valve. The mechanical valves have excellent durability rates. The rates of freedom from structural valve failure in stented bioprostheses are 70 to 90% at 10 years and 50 to

80% at 15 years[5]. Given the outstanding short- and long-term outcomes, SAVR is deemed to be the gold standard operation for aortic valve disease and represents the benchmark against which new therapies are compared[1]. SAVR remains the only option in several hostile conditions such as endocarditis, anomalies of coronary origin, bicuspid or redo surgery after homograft implantation in the congenital population[2]. Patients presenting with pulmonary or renal comorbidities or those otherwise fit patients with unfavourable anatomical features like porcelain aorta, small aortic annulus, previous chest wall irradiation may be deemed unfit or denied surgical AVR.

Transcatheter aortic valve replacement (TAVR)

First human application of this technique was by Cribier et al[6]. Initially applied to only high surgical risk AVRs, the procedure found application to intermediate and low risk patients as well. TAVR is performed most commonly using a trans-femoral approach. Approach through subclavian arteries (right or left), and trans apical approach are also described. Because of procedural complications, its use is still restricted.

Materials and Methods

We analysed 108 consecutive aortic valve replacement (AVR) performed at our institute over a period of one year, from May 2017 to May 2018. We recorded the demography, surgical aspects, postoperative period, their follow-up at six months and one year. Our study population comprised of 44 (41%) females, 64 (59%) males. The study population (12- 72 years) had 13 (12%) patients younger than 18 years, 77 (71%) patients between 19 to 50 years, and 18 (17%) patients older than 50 years.

Table 1: Patients' demographics

Total number	<18 years	19-50 years	>50 years
n=108	13	77	18
Males		64 (59%)	
Females		44 (41%)	
	<18 years	19- 50 years	>50 years
Median age	15	35	57.5
Mean (SD)	15.6 (1.93)	35.8 (8.85)	59.2 (6.90)

All patients who required aortic valve replacements (AVRs) either as an isolated valve replacement or as a part of concomitant cardiac procedures like double valve replacement, coronary artery bypass grafting (CABG) aortic root replacement and surgery for congenital defects were included in the study. Those requiring AVR as part of emergency surgeries such as surgery for aortic dissection were excluded from the study.

Of the 108 patients in the study, twelve patients (11%) had bicuspid aortic valves, two of them had aneurysmal ascending aorta requiring a "Wheat procedure" (supra coronary ascending aorta replacement with AVR). One patient with bicuspid aortic valve (BAV) had aneurysmal LVOT, which was augmented with pericardial patch at the time of AVR.

A total of 44 patients (40.7%) required AVR as part of isolated aortic valve disease (stenosis, incompetence or mixed lesion), or along with CABG 4 (3%) or congenital surgery 2 (1.85%) or along with replacement of ascending aorta 2 (1.85%). 64 patients (59.3%) underwent SAVR as a double valve replacement. Four required concomitant CABGs, out of which one patient had left main disease and three had single vessel disease (2 with left anterior descending stenosis and one with right coronary artery stenosis) along with aortic stenosis. One patient required a double valve replacement due to infective endocarditis with incompetent aortic and mitral valves. Two patients, one outlet right ventricle (DORV) and another with ventricular septal defect with aortic regurgitation (VSD-AR) required AVR. (Table 2)

Table 2: Associated lesions requiring concomitant procedures along with AVR

BAV	12 (11%)
CAD	4 (3%)
Congenital heart disease requiring simultaneous AVR	2 (1.85%)
IE	1 (0.92%)

Table 3: Type of surgeries performed

Isolated AVR (including those with additional procedures like CABG, Wheat procedure, congenital surgeries)	44 (40.7%)
DVR± TV repair (including one case of infective endocarditis)	64 (59.3%)
Root enlargement	3 (2.8%)
Replacement of ascending aorta	2 (1.85%)
Coronary artery bypass grafting	4 (3.7%)

Surgical technique

Median sternotomy was the standard approach 103 (95.3%). Minimally invasive approaches including thoracotomy through right third intercostal space 3 (2.7%), upper median sternotomy 1 (0.92%), lower median sternotomy 1 (0.92%) approaches were also utilised. Mechanical valves (St. Jude Regent mechanical valve^{TM}) were put in 105 patients (97.2%). Three patients (2.8%) received bioprosthetic valves (St. Jude Epic^{TM} bioprosthetic valve). It was left to discretion of the operating surgeon whether to use interrupted or continuous suturing technique. Six (5%) patients received 17 mm valve[7]. Three patients (2.8 %) required aortic root enlargement[8]. In 5 (5%) cases, the valve was put in a supra-annular location. This facilitated putting a 21 sized valve in one patient, 19 mm valve in two patients and 17 mm valve in two patients in the supra-annular location. Supra-annular and annular position is also at the discretion of the surgeon.

Table 4: Type of surgical approach

Median sternotomy	103 (95.3%)
Right thoractomy	3 (2.7%)
Upper median sternotomy	1 (0.92%)
Lower median sternotomy	1 (0.92%)

Table 5: Valve parameters

Mechanical valves	
Total	105 (97.2%)
17 mm	6 (5.7%)
19 mm	43 (40.95%)
21 mm	36 (34.28%)
23 mm	15 (21.9%)
25 mm	5 (4.7%)
Median size used valve	21 mm
Most commonly used valve	19 mm

Bioprosthetic valves	
Total	3 (2.8%)
19 mm	2
21 mm	1

Valve in annular position	103 (95.3%)
Supra-annular position	5 (4.7%)

Results

The mean cardiopulmonary bypass time was 233 ± 68 minutes and clamp time was 179 ± 60 minutes. Immediate postoperative period was uneventful. The mean ICU stay was 2.7 ± 0.86 days (3- 19 days). Mean hospital stay from the day of surgery was 5.9 ± 1.25 days (5- 33 days). Rhythm disturbance was noticeable in those within the rheumatic etiology with pre-existing AF. One patient developed DSWI (Deep Sternal Wound Infection) and required prolonged intensive care management before she succumbed. One patient deteriorated rapidly and died of MRSA (Methicillin-Resistant Staphylococcus aureus). None of our patients had demonstrable cognitive disturbance or stroke in the postoperative period.

Follow-up

Two patients developed a stuck valve within three months for which they required thrombolysis. Eight patients presented with deranged coagulation profile with minor bleed which require short re-admissions. One patient presented with intracranial bleed, underwent neurosurgical intervention, but succumbed. Echocardiography at one year did not identify any patient with PPM. In 16 patients however, the mean gradients were found to be 23.62 ± 1.9 (20- 26). But the patients were asymptomatic. So are under follow up.

Table 6: Immediate post-operative complications

DSWI	1 (0.92%)
Deranged coagulation	8 (7.4%)
Stuck valve	2 (1.85%)
Death	3 (2.85%)

Discussion

Surgical AVR has impact on patient's psychology. The fear of sternotomy, of open-heart surgery, blood transfusions, need for prolonged ventilation, risk of stroke, AKI, all lead to delay in seeking surgical assistance. As long as one is dealing with mixed lesions of aortic valve, or lesions that need to be addressed alongside AVR, SAVR is the only

option. When one is dealing with isolated symptomatic aortic stenosis that requires intervention, but deemed to be of formidable risk for surgery, catheter-based procedures come in to play. The further discussion of TAVR or TAVI will be only in the context of isolated symptomatic aortic stenosis which requires no additional cardiac intervention. Initially utilised for inoperable aortic stenosis patient, the indications of TAVR is now extended to intermediate and even low risk patients. But whether a patient requires TAVR is decided by a "Heart team".

The recently published European guidelines on the treatment of valvular heart disease have placed the "Heart Team", a multidisciplinary team of cardiologists, cardiac surgeons, anaesthetists, care of the elderly physicians and non-medical cardiac care specialists, at the centre of the decision process to select the most appropriate therapy for individual patients[10]. While it is recognised that low-risk patients with AS (STS score <4%, logistic Euro SCORE I <10%) should be directly considered for SAVR and those who are inoperable offered TAVI, therapy in patients with higher risks for SAVR should be determined by the Heart Team.

The PARTNER trial had two arms, Transcatheter aortic valve replacement (TAVR) with the Edwards SAPIEN valve was superior to medical therapy in the treatment of inoperable patients with aortic stenosis (cohort B) and It was not inferior to standard surgical aortic valve replacement in patients with advanced symptomatic aortic stenosis who are high risk for surgical therapy (cohort A). Two large multi-centre trials—Surgical Replacement and Transcatheter Aortic Valve Implantation (SURTAVI)[10, 11] and PARTNER 2A[4] —have demonstrated non-inferiority of TAVI versus SAVR for treatment of severe AS in patients at intermediate surgical risk. Compared with SAVR, the SURTAVI also showed that percutaneous technology produced better haemodynamics and significantly lower rates of all stroke at 30 days, acute kidney injury and atrial fibrillation[1]. In low-risk patients, the latest results of the PARTNER study series demonstrated lower rates of death or stroke and new-onset atrial fibrillation in TAVR than surgery at 30-day follow-up, and the composite of death, stroke or rehospitalisation at 1 year significantly favoured TAVR over surgery. There were no significant differences in major vascular complications, new permanent pacemaker insertions, or moderate or severe paravalvular regurgitation among the two groups[11]. These results should be weighed against the still-unknown long-term durability of TAVR. SAVR continues to have absolute lower rates of residual paravalvular leakage, major vascular complications and new permanent pacemakers compared to TAVR (reported as ranging from 13.2 to 17.1%)[13].

Comparison of TAVR with SAVR[14]

	TAVR	SAVR	P
Major vascular complications	11%	3.2%	<0.001
Stroke	8.3%	4.3%	<0.05
Mortality at one year	33.9%	35%	0.78
Paravalvular leak at two years	6.9%	0.9%	<0.001

Our results of SAVR are on par with other published literature of surgical management of aortic valve diseases.

Conclusions

Surgical AVR has always the upper hand as this can tackle incompetent aortic valve apart from aortic stenosis. Simultaneously other procedures like replacement or repair of other valves, CABG, ascending aorta replacement or aortoplasty can be accomplished during the same sitting. TAVR on the other hand is tested in severely stenosed aortic valve, has better results compared to medical management and equal, if not inferior results than SAVR. In selected severe AS, TAVR can be only an alternative to SAVR as of now.

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