

Clinical Experience on TTK Chitra Tilting Disc Valve in Government General Hospital, Guntur.

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Abstract

Introduction: TTK Chitra heart valve prosthesis (CHVP) is a tilting disc artificial heartvalve which has an ultra-high-molecular-weight polyethylene disc, Haynes-25 alloycage, and polyester suture ring. Because of its low cost and proven efficacy, apart from its use in India, the TTK-Chitra valve is also being exported to other countries.

Material & Methods: This prospective observational study was carried out between period April 2015 to December 2018 in the department of cardiothoracic and vascular surgery, Government General Hospital, Guntur.

Results: In the study period, a total of 167 TTK Chitra valves were implanted in the aortic and/ or mitral positions. 80 patients underwent Mitral Valve Replacement (MVR), 19 underwent Aortic Valve Replacement (AVR) and 28 underwent Double Valve Replacement (DVR). Coronary artery bypass grafting (CABG) with MVR was done in 9 patients and CABG with AVR was done in 7 patients. The age of the patients ranged from 18 – 65 years. Majority of the patients (48%) were in the age range 31 – 50 years. There was male preponderance in the study population with 58% being males and rest females.

Conclusions: TTK Chitra valve is hemodynamically stable and affordable which performs well in both the Mitral and Aortic valve positions.

Keywords: TTK Chitra valve, Mitral Valve Replacement, Aortic Valve Replacement, evaluation

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I. Introduction

In India, large numbers of people suffer heart valve damage as a result of rheumatic heart disease. This condition is produced when some bacterial throat infections, especially in children, evoke a severe immune response known as rheumatic fever. Without valve replacement patients with rheumatic heart disease are at risk of heart failure and death.

The Indian Council of Medical Research has estimated that six out of every 1,000 children between the ages of five and fifteen in the country suffer from rheumatic fever. Over one million children in the country could therefore be at risk of developing valvular disease.

The artificial valve must withstand the stress of opening and closing some 40 million times a year. The materials used for the valve have to be compatible with blood and human tissues. When open, the valve should allow the blood to flow smoothly through. Once closed, the back flow of blood had to be minimal. Characteristics of mechanical valves most commonly implanted in patients with valvular heart disease^[1].

TTK Chitra heart valve prosthesis (CHVP) is a tilting disc artificial heartvalve designed and developed by Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST). It has an ultra-high-molecular-weight polyethylene disc, Haynes-25 alloy (Haynes International Inc., USA) cage, and polyester suture ring. Because of its low cost and proven efficacy, apart from its use in India, the TTK-Chitra valve is also being exported to other countries^[2].

Implantation of tilting-disc valves is routinely performed in many centers all over the world. A mechanical tilting-disc valve consists of an annular metallic stent, which is sutured to the native valve annulus with a sewing ring.

The occluding mechanism is a circular disc, which is suspended from the annular ring by a single strut. The strut attaches the disc eccentrically so that the back pressure on larger segment of the disc will tend to close the valve. The disc occluder pivots open 60 to 75 degrees. Eccentric disc position produces two orifices of different size and shape; a major orifice and a minor orifice. The complex flow pattern across the valve, wherein 70% of flow passes through major orifice and 30% through the minor orifice, creates impedance to forward flow and a large area of stagnation on the downstream surface of the disc^[3,4].

II. Materials And Methods

STUDY DESIGN: This prospective observational study was carried out between period April 2015 to December 2018 in the department of cardiothoracic and vascular surgery, Government General Hospital, Guntur.

INCLUSION CRITERIA:

- Adult patients subjected to elective valve replacement
- CHVP without repair or replacement of other valves.

EXCLUSION CRITERIA

- Left ventricular ejection fraction < 40%.
- Patients requiring re-institution of CPB after successful weaning from CPB, due to inadequate surgical results like severe prosthetic mitral valve regurgitation, inadequate motion of occluder disc etc.
- Concomitant repair or replacement of other valves.

PROCEDURE

Informed consent was taken before the start of the study. Preoperatively all patients underwent detailed clinical examination, ECG, chest x-ray and color doppler examination.

Surgical Technique:

Surgery was performed through a midline sternotomy incision using standard cardiopulmonary bypass techniques at moderate hypothermia, using membrane oxygenator, antegrade intermittent cold blood cardioplegia. The route of administration varied according to the valve to be replaced. For AVR and DVR patients, cardioplegia was administered by coronary ostial cannulation after transverse aortotomy and for MVR, cardioplegia was delivered through the aortic root.

All aortic valves were excised totally and then replaced. Initial patients for MVR had total valve excision. In subsequent patients the subvalvular apparatus was partially preserved.

The size of prosthesis used for mitral valve replacement was between 23 and 31 mm. For aortic valve replacement valve size ranged from 17 mm to 25mm.

Anticoagulation was achieved with Warfarin. This was commenced on the first post-operative day. INR was maintained between 2– 2.5 after AVR and 2.5 – 3.5 for MVR and DVR. All patients were advised regarding anticoagulation.

FOLLOW UP

The follow up was done starting after second month till about three and half years. Follow up evaluation included clinical examination, adequacy of anticoagulation and valve function assessment. During the follow up visits, patients were evaluated clinically. Color doppler was done at least once.

Statistical analysis: Data entry and analysis was done using Microsoft excel 2010 version. Data was presented in proportions and percentages. Descriptive statistics was expressed as mean (\pm SD).

III. Results

In the study period, a total of 167 TTK Chitra valves were implanted in the aortic and/ or mitral positions. 80 patients underwent Mitral Valve Replacement (MVR), 19 underwent Aortic Valve Replacement (AVR) and 28 underwent Double Valve Replacement DVR. Coronary artery bypass grafting (CABG) with MVR was done in 9 patients and CABG with AVR was done in 7 patients.

The age of the patients ranged from 18 – 65 years. Majority of the patients (48%) were in the age range 31 – 50 years. There was male preponderance in the study population with 58% being males and rest females. Eighty nine of the patients were in the New York Heart Association functional class III, forty patients in class II and remaining in class IV.

In the mitral valve position, available sizes were 23, 25, 27, 29 and 31 mm. Out of the total 115 TTK implantations, majority (40.8%, n=47) received 29 mm chitra valve followed by 27 mm in 36 patients. Other valves included 25 mm (%), 31 mm (%) and 1 case received 23mm.

In the aortic valve position, available sizes were 17, 19, 21, 23 and 25mm. Among the positions, majority (38.5%, n=20) received with 21 mm chitra valve followed by 19 mm in 18 patients.

Table 1:Chitra Valve sizes implanted in the Mitral position

| Valve size (in mm) | Number | Percentage |
|--------------------|--------|------------|
| 23 | 01 | 0.9% |
| 25 | 18 | 15.7% |
| 27 | 36 | 31.3% |
| 29 | 47 | 40.8% |
| 31 | 13 | 11.3% |
| Total | 115 | 100% |

Table 2: Chitra Valve sizes implanted in the Aortic position

| Valve size (in mm) | Number | Percentage |
|--------------------|--------|------------|
| 17 | 03 | 5.8% |
| 19 | 18 | 34.5% |
| 21 | 20 | 38.5% |
| 23 | 08 | 15.4% |
| 25 | 03 | 5.8% |
| Total | 52 | 100% |

The gradients across the TTK chitra valve in both mitral position and aortic position were depicted in tables 3 and 4. The mean diastolic gradient across the TTK valve in mitral position ranged from 5-6 mm across the various valve sizes ranging from 23 to 31 mm. The peak velocity ranged from 1.6 to 1.8 m/sec and effective orifice area from 3.1 to 3.2 cm² (Table 3).

With regards to valve gradient in Aortic position, the mean diastolic gradient across the TTK valve ranged from 10-11 mm across the various valve sizes ranging from 17 to 23 mm with peak velocity ranging from 2.6 to 2.8 m/sec (Table 4).

Table 3: Valve gradients in Mitral position

| Valve size (in mm) | Mean Gradient (in mm) | Peak Velocity (in m/sec) | Effective orifice area (in cm ²) |
|--------------------|-----------------------|--------------------------|--|
| 23 | 6±5 | 1.8±0.5 | 3.2±0.8 |
| 25 | 6±4 | 1.8±0.4 | 3.1±0.5 |
| 27 | 5±3 | 1.6±0.2 | 3.1±0.6 |
| 29 | 5±3 | 1.6±0.2 | 3.2±0.2 |
| 31 | 5±4 | 1.6±0.3 | 3.2±0.4 |

Table 4: Valve gradients in Aortic position

| Valve size (in mm) | Mean Gradient (in mm) | Peak Velocity (in m/sec) |
|--------------------|-----------------------|--------------------------|
| 17 | 10±5 | 2.8±0.7 |
| 19 | 11±4 | 2.8±0.3 |
| 21 | 11±4 | 2.8±0.5 |
| 23 | 10±3 | 2.6±0.6 |
| 25 | 10±6 | 2.6±0.5 |

IV. Discussion

Chitra heart valve prosthesis (CHVP), a tilting-disc valve developed by SCTIMST, Kerala, has gained an immense popularity in the developing countries because of its low cost, high quality and durability. Thousands of patients with valvular heart diseases have been benefited after implantation of Chitra valves. Previous studies ^[5,6,7] have demonstrated a proven clinical efficacy of the CHVP in the postoperative follow up studies. The Doppler parameters obtained with a CHVP in the mitral and aortic position are comparable with those obtained with the different tilting-disc prosthetic valves in common use.

In the present study, a total of 167 TTK Chitra valves were implanted in the aortic and/ or mitral positions during the study period. Almost half the proportion of the cases(48%) were in the age range 31 – 50 yearswith male preponderance (58%). Out of the total 115 TTK implantations, majority (40.8%, n=47) received 29 mm chitra valve followed by 27 mm in 36 patients. Other valves included 25 mm (%), 31 mm (%) and 1 case received 23mm.In the aortic valve position, available sizes were 17, 19, 21, 23 and 25mm. Among the positions, majority (38.5%, n=20) received with 21 mm chitra valve followed by 19 mm in 18 patients.

Talwar et al ^[8] on Tissue heart valve implantation in India observed that Out of the 457 patients, 209 (45.7%) were male and 248(54.3%) were female. The age ranged from 20 -77 yearswith a mean age of 55.5±9.3 years and a median age of 55 years.Of these,200 (43%) were mitral valve replacements (MVR), 154(33.7%)

aortic valve replacements (AVR), 102 (22.3%) double valve replacements (DVR) and one (0.2 %) tricuspid valve replacement (TVR).

Study by Pawan et al^[5] found that Mitral valve replacement was performed in 348 patients, Aortic valve replacement in 92 patients and a combined mitral and aortic valve replacement in 107 patients. Valve sizes available in Mitral position in their study were 25, 27 and 29 mm and in Aortic position were 21 and 23 mm compared to the present study.

In the present study, the mean diastolic gradient across the TTK valve in mitral position ranged from 5-6 mm across the various valve sizes ranging from 23 to 31 mm with peak velocity ranging from 1.6 to 1.8 m/sec and effective orifice area from 3.1 to 3.2 cm². With regards to valve gradient in Aortic position, the mean diastolic gradient across the TTK valve ranged from 10-11 mm across the various valve sizes ranging from 17 to 23 mm with peak velocity ranging from 2.6 to 2.8 m/sec.

Similar kind of study by Rajan Modi et al^[9] observed that the mean gradient for 25mm TTK-Chitra® valve in Mitral position was 4.8mmHg and for the 27mm valve it was 3.7mmHg. The mean gradient for 21mm valve in the Aortic position was 16.4 mmHg and for the 23mm valve, it was 15mmHg.

In concurrence to the study findings, Pawan et al^[5] found that In the mitral position, for valve sizes 25, 27 and 29 mm, the mean gradients (in mm Hg) are 5±3, 4±2 and 4±2, and the Effective orifice areas (in cm²) are 2.8±0.8, 3.1±0.7 and 2.9±0.7 respectively. In the aortic position, for valve sizes 21 and 23 mm, the gradients (in mm Hg) are 10±5 and 9±4, and the Effective orifice areas (in cm²) are 1.5±0.5 and 1.8±0.3 respectively.

Another study by Sreenivasa et al^[10] observed that in the mitral position, for valve sizes 25mm, 27mm and 29mm, the mean gradients (in mmHg) were 4.9±2.4, 4.6±1.8 and 3.8±1.7 respectively and effective orifice areas (in cm²) were 2.7±0.8, 2.9±0.5 and 3.0±0.6 respectively. In the aortic position, for valve sizes 19mm, 21mm and 23mm, the mean gradients (in mmHg) were 15.0±4.1, 13.8±2.9 and 12.5±2.7 and the effective orifice areas (in cm²) were 1.5±0.5, 1.8±0.1, 1.9±0.5 respectively.

V. Conclusion

In patients suffering from significant cardiac valvular lesions, an intervention on the valve with repair, valvuloplasty or replacement may be necessary. Although for mitral and tricuspid regurgitant lesions valve repair is frequently performed, valve replacement remains a common choice for many adult patients. TTK Chitra valve is hemodynamically stable and affordable which performs well in both the Mitral and Aortic valve positions.

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