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Echocardiographic Profile of Normaly Functioning TTK Chitra Tilting Disc Prosthetic Valves

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Abstract
Background and aim of the study:
TTK Chitra is a tilting disc prosthetic cardiac valve being used in India. We present the echocardiographic and Doppler evaluation of normally functioning valve in mitral and aortic positions.
Methods: *A total of 120 patients with 134 valves implanted in the aortic and/or mitral position were studied. All patients underwent a detailed echocardiographic and Doppler evaluation for estimating trans-valvular gradients and effective orifice area.*
Results: *In the mitral position, for valve sizes 25mm, 27mmand 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 cm^2) 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 cm^2) were 1.5±0.5, 1.8±01, 1.9±0.5 respectively.*
Conclusion: *The TTK Chitra valve has got comparable haemodynamic profile with other mechanical prosthetic cardiac valves.*
Keywords: *prosthetic cardiac valve, trans-valvular gradients, effective orifice area.*

I. Introduction

The TTK Chitra is a tilting disc type mechanical prosthetic valve, an indigenously developed remedy which holds a lot of promise in developing countries like India because of its low cost. The technology was conceived and crafted by the Sree Chitra Tirunal Institute Of Medical Sciences and Technology (SCTIMST), Thiruvananthapuram. After the results of a multicenter trial, the commercial production of the valve was started in 1995 by TTK Chitra Healthcare.

The Chitra valve has 3 components: 1. A monolithic frame carved out of a single block of chrome cobalt alloy, 2. An occluder made from ultra high molecular weight high density polyethylene. 3. A sewing ring made from implant tested unfilled 100% polyester fabric[1].

So far, various clinical studies have been reported[1,2,3,4] but hemodynamic studies are far and few. Doppler echocardiography can provide information on the gradients across and the mitral valve area (MVA), which are comparable with those obtained at invasive cardiac catheterization[5,6]. The data on normal echocardiography profile of these valves is limited. Hence we undertook this study to assess the hemodynamic profile of the TTK Chitra prosthetic valve.

II. Aims And Objectives

To assess the echocardiographic profile of normally functioning TTK Chitra tilting disc prosthetic valves

III. Materials And Methods

We undertook a study of echocardiographic profile of normally functioning TTK Chitra valve. We analyzed 120 patients from September 2014 to November 2015. This was a one-point study in that the patients underwent detailed echocardiographic evaluation either pre-discharge after valve replacement or during their follow-up on out-patient basis.

Patients with the following characteristics were excluded from the study:

1. other types and make of prosthetic valves
2. valve replacement along with CABG
3. echocardiographic evidence of valve dysfunction, thrombosis/ pannus (TEE was done in case of diagnostic difficulty)
4. atrial fibrillation with fast ventricular rate (>120/min)

We used VIVID-6(GE) echo machine for the study. Apical 4 chamber and 5 chamber views were used for parallel alignment of continuous wave cursor with trans-mitral and trans-aortic flow respectively. The same set of Cardiologist performed all the examinations. Mitral valve area (MVA) was calculated using pressure-half time and Aortic valve area (AVA) by continuity equation. We also looked at other echocardiographic parameters like left ventricular ejection fraction (LVEF), presence of trans-valvular regurgitation and valve disc excursion.

IV. Results

The study group consisted of 120 patients. 74 (61.7%) were males and 46 (38.3%) were females. Age of the patients ranged from 16 to 50 years (mean 28.4 years). Etiology was rheumatic in majority of the patients. Time of surgery dated back from 7 days to 10 years (mean 3.7 years) 79 patients had mitral valve replacement (MVR), 27 had aortic valve replacement (AVR) and 13 had double valve replacement (DVR). Although 90% of patients were on regular oral anticoagulation, therapeutic INR (2.5 -3.0 for AVR and 3.0-3.5 for MVR and DVR) was observed only in 76.7% of patients. A total of 93 mitral and 41 aortic prostheses were evaluated. Trans-valvular gradients and effective orifice area of chitra valve in mitral and aortic position are given in Table2 and Table3.

V. Discussion

The TTK Chitra valve was developed as a low cost high quality prosthesis after 15 years of painstaking research. One important feature of any prosthetic valves is that they are inherently mildly stenotic. The concept of patient- prosthesis mismatch was explained as early as 1978. We could not assess the same because of the study design. For the same reason, other parameters like durability of the valve, complications and the need for re-do surgery were not evaluated.

Doppler echocardiography is an essential tool in evaluation of prosthetic valves. It allows accurate assessment of trans-valvular gradients, flow patterns, peak flow velocities and the effective orifice area. However, deviation from parallel alignment of the ultrasonic beam along with flow across the valve may result in significant underestimation of the flow velocities and thus the transvalvular gradients. To minimize these errors, standard protocols were used in the study.

Mean gradients (and not the peak gradients) computed by the Doppler techniques are reproducible by the catheterization study. There are many studies which have shown the probable gradients to be considered normal for different mechanical prosthetic valves[7](Table4& Table5). Nagarajan et al[8] reported mean gradients of 5.09±2.14 mmHg in the mitral position and 14.37±5.07 mmHg in aortic position for TTK Chitra valve.

VI. Conclusion

This study shows that the haemodynamic profile of the TTK Chitra prosthetic valve is comparable to other mechanical prosthetic valves and gives the probable echocardiographic parameters that can be considered normal, which will help in defining valve dysfunction in case of Chitra valve in both mitral and aortic positions. However, large studies with long term follow-up are needed before diagnostic cut-off values can be set for the same.

Tables

Table1. Demographic Profile

		NUMBER	PERCENTAGE
SEX	MALE FEMALE	74 46	61.7% 38.3%
ATRIAL FIBRILLATION		47	39.2%
REGULAR ANTICOAGULATION		108	96.0%
PATIENTS WITH THERAPEUTIC TARGET INR		92	76.7%

Table2. Trans-Valvular Gradients And Effective Orifice Area Of Chitra Valve In Mitral Position

SIZE(IN MM)	NUMBER	PEAK GRADIENT(in mm Hg)	MEAN GRADIENT(in mm Hg)	VALVE AREA(in cm^2)
25	48	12.1±3.6	4.9±2.4	2.7±0.8
27	35	10.8±2.9	4.6±1.8	2.9±0.5
29	10	9.6±2.3	3.8±1.7	3.0±0.6
OVERALL		10.2±3.6	4.8±2.1	2.0±0.8

TABLE3. Trans-Valvular Gradients And Effective Orifice Area Of Chitra Valve In Aortic Position

SIZE(IN MM)	NUMBER	PEAK GRADIENT(in mm Hg)	MEAN GRADIENT(in mm Hg)	VALVE AREA(in cm^2)
19	07	30.2±5.8	15.0±4.1	1.5±0.5
21	18	25.7±4.7	13.8±2.9	1.8±0.3

23	16	24.0±4.5	12.5±2.7	1.9±0.5
OVERALL		28.7±6.6	15.2±4.7	1.7±0.5

Table4. Comparison Of Normal Values For Doppler Evaluation Of Mitral Prosthesis

VALVE	SIZE(in mm)	PEAK GRADIENT(in mm Hg)	MEAN GRADIENT(in mm Hg)
TTK CHITRA	• 25 • 27 • 29	12.1±3.6 10.8±2.9 9.6±3.6	4.9±2.4 4.6±1.8 3.8±1.7
BJORK-SHILEY[7]	• 25 • 27 • 29	12±4 10±4 7.83±2.93	6±2 5±2 2.83±1.27
ST JUDE MEDICAL[7]	• 27 • 29 • 31	11±4 10±3 12±6	5.8±2 4.15±1.8 4.46±2.22
STAR EDWARD[7]	• 30 • 32	12.2±4.6 11.5±4.2	6.99±2.5 5.08±2.5

Table5. Comparison Of Normal Values For Doppler Evaluation Of Aortic Prosthesis[7]

VALVE	SIZE(in mm)	PEAK GRADIENT(in mm Hg)	MEAN GRADIENT(in mm Hg)
TTK CHITRA	• 19 • 21 • 23	30.8±5.8 25.7±4.7 24.0±4.5	15.0±4.1 13.8±2.9 12.5±2.7
BJORK-SHILEY[7]	• 21 • 23 • 25	38.9±11.9 28.8±11.2 23.7±8.2	21.8±3.4 25.7±5.3 13.0±5.0
ST JUDE MEDICAL[7]	• 21 • 23 • 25	22.61±4.5 16.2±9.0 12.7±8.2	10.7±7.2 8.2±4.7 6.3±4.1
STAR EDWARD[7]	• 23 • 24	32.61±2.8 34.11±0.3	22.0±9.0 22.1±7.5

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