

Original article

Bileaflet Versus Tilting Disc Valves in Valve Replacement Surgery: Analysis of Thromboembolic Events, Anticoagulation Requirements, and Survival Outcomes

¹Dr Nimesh Srivastava, ²Dr S.E.H. Naqvi *, ³Dr Mayank Agarwal

¹Senior Resident, Cardio Vascular Thoracic Surgery, GIPMER / GB Pant Hospital, New Delhi

²Professor, Cardio Vascular Thoracic surgery, GIPMER / GB Pant Hospital, New Delhi

³Senior Resident, Cardio Vascular Thoracic surgery, GIPMER / GB Pant Hospital, New Delhi

Corresponding author*

Abstract:

Background: Mechanical prosthetic valves, particularly bileaflet and tilting disc designs, are widely used in valve replacement surgery. However, differences in thromboembolic risk, anticoagulation requirements, and survival outcomes remain clinically significant considerations.

Aim: To compare bileaflet and tilting disc valves with respect to thromboembolic events, anticoagulation control, and survival outcomes.

Methods: This prospective observational study was conducted over one year in a tertiary care center and included 40 patients undergoing mechanical valve replacement. Patients were divided into two groups: bileaflet valve (n=20) and tilting disc valve (n=20). Data regarding demographic profile, thromboembolic complications, anticoagulation parameters (INR and warfarin dose), and survival outcomes were collected and analyzed using appropriate statistical methods.

Results: Thromboembolic events were lower in the bileaflet group (10%) compared to the tilting disc group (25%), though not statistically significant ($p=0.20$). Mean INR and warfarin dose were significantly higher in the tilting disc group ($p<0.05$). Survival at one year was higher in the bileaflet group (95%) compared to the tilting disc group (85%). Functional outcomes were also better in the bileaflet group.

Conclusion: Bileaflet valves demonstrated favorable trends in thromboembolic risk, anticoagulation stability, and survival outcomes compared to tilting disc valves, suggesting potential clinical advantages.

Keywords: Mechanical valves, Thromboembolism, Anticoagulation

Introduction:

Prosthetic heart valve replacement remains a cornerstone in the management of advanced valvular heart disease, with mechanical valves offering superior durability compared to bioprosthetic alternatives. Among mechanical prostheses, bileaflet and tilting disc valves are the most commonly utilized designs, each characterized by distinct hemodynamic profiles and structural mechanics. Bileaflet valves, with their dual semicircular leaflets, provide near-central laminar flow and lower transvalvular gradients, whereas tilting disc valves employ a single occluder that creates asymmetric flow dynamics.

Despite advances in valve engineering, thromboembolic complications continue to represent a significant cause of morbidity and mortality following valve replacement surgery. The risk of such events is closely linked to valve design, flow characteristics, and the adequacy of anticoagulation therapy. Mechanical valves necessitate

lifelong anticoagulation, but the intensity and management strategies may vary depending on the type of prosthesis used.

Understanding the comparative performance of bileaflet versus tilting disc valves is therefore crucial for optimizing patient outcomes. This study aims to analyze differences in thromboembolic events, anticoagulation requirements, and survival outcomes between these two valve types, thereby providing evidence to guide prosthesis selection and postoperative management in contemporary cardiac surgical practice.

Study methodology

The present study was conducted as a prospective observational study in the Department of Cardiothoracic and Vascular Surgery at a tertiary care center over a period of one year. The study included patients who underwent valve replacement surgery using mechanical prosthetic valves. A total of 40 patients were enrolled in the study and were divided into two groups based on the type of prosthetic valve used: bileaflet valves and tilting disc valves. Institutional Ethics Committee approval was obtained prior to the commencement of the study, and informed written consent was taken from all participants.

Patients diagnosed with valvular heart disease requiring surgical valve replacement and willing to participate were included in the study. Patients with previous valve replacement surgery, coexisting severe comorbid conditions, contraindications to anticoagulation therapy, or those lost to follow-up were excluded. A detailed preoperative evaluation was carried out for all patients, including clinical history, physical examination, echocardiography, and routine laboratory investigations.

All patients underwent valve replacement surgery under standard cardiopulmonary bypass techniques. The choice of prosthetic valve—bileaflet or tilting disc—was based on surgeon preference and patient-specific factors. Postoperative management was standardized for all patients, including initiation and monitoring of anticoagulation therapy using warfarin, with regular monitoring of the International Normalized Ratio (INR) to maintain therapeutic levels.

Patients were followed up at regular intervals during the study period to assess outcomes. Data were collected regarding thromboembolic events, anticoagulation requirements (including INR levels and dose adjustments), and survival outcomes. The collected data were systematically recorded and analyzed using appropriate statistical methods to compare the outcomes between the two groups.

Results:

Table 1: Demographic and Clinical Profile of Study Participants

Parameter	Bileaflet Valve (n=20)	Tilting Disc Valve (n=20)	Total (n=40)
Mean Age (years)	48.6 ± 10.2	50.1 ± 11.5	49.3 ± 10.8
Male (%)	12 (60%)	11 (55%)	23 (57.5%)
Female (%)	8 (40%)	9 (45%)	17 (42.5%)
Mitral Valve Replacement	11 (55%)	12 (60%)	23 (57.5%)
Aortic Valve Replacement	9 (45%)	8 (40%)	17 (42.5%)
Hypertension	6 (30%)	7 (35%)	13 (32.5%)
Diabetes Mellitus	5 (25%)	6 (30%)	11 (27.5%)

Table 2: Comparison of Thromboembolic Events

Outcome	Bileaflet Valve (n=20)	Tilting Disc Valve (n=20)	p-value
Thromboembolic Events Present	2 (10%)	5 (25%)	0.20
Thromboembolic Events Absent	18 (90%)	15 (75%)	
Stroke	1 (5%)	3 (15%)	
Peripheral Embolism	1 (5%)	2 (10%)	

Table 3: Anticoagulation Requirements and INR Control

Parameter	Bileaflet Valve (n=20)	Tilting Disc Valve (n=20)	p-value
Mean INR	2.6 ± 0.4	3.0 ± 0.5	0.01*
INR within Therapeutic Range	16 (80%)	13 (65%)	0.28
INR Fluctuations	4 (20%)	7 (35%)	
Mean Warfarin Dose (mg/day)	4.5 ± 1.2	5.2 ± 1.5	0.04*
Bleeding Complications	2 (10%)	4 (20%)	0.37

(*Statistically significant)

Table 4: Survival and Follow-up Outcomes

Outcome	Bileaflet Valve (n=20)	Tilting Disc Valve (n=20)	p-value
Survival at 1 Year	19 (95%)	17 (85%)	0.29
Mortality	1 (5%)	3 (15%)	
Reoperation Required	0 (0%)	1 (5%)	
Functional Status (NYHA I–II)	17 (85%)	14 (70%)	0.25
Functional Status (NYHA III–IV)	3 (15%)	6 (30%)	

Discussion:

The present study compared bileaflet and tilting disc mechanical valves in terms of thromboembolic events, anticoagulation requirements, and survival outcomes over a one-year follow-up period. The demographic and baseline clinical characteristics between the two groups were comparable, with no significant differences in age, gender distribution, type of valve replaced, or associated comorbidities such as hypertension and diabetes mellitus. This baseline homogeneity ensured that the observed differences in outcomes could be attributed primarily to the type of prosthetic valve rather than confounding factors.

In the present study, the incidence of thromboembolic events was lower in the bileaflet valve group (10%) compared to the tilting disc valve group (25%), although the difference did not reach statistical significance ($p=0.20$). This trend is clinically relevant and may be explained by the superior hemodynamic design of bileaflet valves, which allows more laminar and central blood flow, thereby reducing areas of turbulence and stasis that predispose to thrombus formation. In contrast, tilting disc valves generate asymmetric flow patterns, which may increase the risk of thromboembolism. Similar trends have been reported in previous studies, suggesting improved flow dynamics and reduced thrombogenicity with bileaflet designs.

Anticoagulation management revealed statistically significant differences between the two groups. Patients with tilting disc valves required higher mean INR levels and higher daily doses of warfarin compared to those with bileaflet valves ($p=0.01$ and $p=0.04$, respectively). Additionally, INR fluctuations were more frequent in the tilting disc group. These findings indicate that bileaflet valves may offer a more stable anticoagulation profile, potentially reducing the risk of both thromboembolic and bleeding complications. Although bleeding events were more common in the tilting disc group (20% vs 10%), this difference was not statistically significant, possibly due to the small sample size.

Survival outcomes also favored the bileaflet valve group, with a higher one-year survival rate (95%) compared to the tilting disc group (85%), though this difference was not statistically significant ($p=0.29$). Mortality in the tilting disc group was higher and may be related to increased thromboembolic and bleeding complications. Furthermore, a greater proportion of patients in the bileaflet group achieved better functional status (NYHA Class I–II), indicating improved postoperative quality of life. The need for reoperation was minimal and comparable between groups.

Overall, the findings of this study suggest that bileaflet valves may provide better clinical outcomes in terms of lower thromboembolic risk, more stable anticoagulation requirements, and improved survival trends compared to tilting disc valves. However, the lack of statistical significance in several parameters highlights the limitation of small sample size and short follow-up duration. Larger, multicentric studies with longer follow-up are recommended to validate these findings and guide optimal prosthetic valve selection in clinical practice.

Conclusion:

Bileaflet valves demonstrated favorable trends in thromboembolic risk, anticoagulation stability, and survival outcomes compared to tilting disc valves, suggesting potential clinical advantages.

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