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## PROSTHETIC VALVE DYSFUNCTION IN MITRAL VALVE REPLACEMENT

Sushmitha Anbu<sup>1</sup>, Sendilkumar Balasundaram<sup>2</sup>, Shetty. G.G<sup>3</sup>

<sup>1,2</sup>Vinayaka mission's research foundation-deemed to be university, Salem.

<sup>3</sup>Narayana Hrudayalaya Institute of Cardiac Sciences, Bangalore.

### Corresponding author:

#### 1. Sushmitha Anbu

Assistant professor,

Department of Cardiac Technology,

School of Allied Health Sciences,

VMRF-DU, Salem, Tamilnadu, India.

Email id: [sushmithaanbu95@gmail.com](mailto:sushmithaanbu95@gmail.com)

Contact: 9597292655/8217054916.

#### 2. Sendilkumar Balasundaram

Dean, School of Allied Health Sciences,

VMRF-DU, Salem, Tamilnadu, India.

Email ID: [Director.sahsslm@vmu.edu.in](mailto:Director.sahsslm@vmu.edu.in)

Contact: 9360730433.

#### 3. Shetty.G.G

Senior consultant interventional cardiologist,

Narayana Hrudayalaya Institute of Cardiac Sciences, Bangalore, Karnataka.

Email ID: [info.nics@narayanahealth.org](mailto:info.nics@narayanahealth.org)

Contact: 8071222222/9538589633.

**ABSTRACT:****Background:**

Prosthetic heart valve replacement is the commonest choice in case of valvular failure or functional impairment. Although, they are considered to be ideal choices, they are vulnerable to dysfunction depending on various factors. Arising valvular dysfunctions are mostly related to stenosis or regurgitation.

**Methodology:**

This is a descriptive study including 30 participants out of which 17 are male and 13 are female. Subjects between 20 and 80 years of age with mitral valve replacement were included in the study with their consent. Subjects with other cardiac complications were excluded. The study was conducted for 12 months in the department of Echocardiography in a private institute for Cardiac sciences. Outcomes were assessed using ECG, ECHO, Catheterisation data, complications, type of valve used and symptoms associated with dysfunction.

**Results:**

Hypertension was seen in 50% subjects and mechanical valve was mostly used in subjects about 46.7%. Observing the symptoms associated with dysfunction, syncope was noted majorly in men about 93.3% and dyspnea was commonly seen in women about 63.3%. Dysfunction commonly occurred in 80% men on acitrom medication and 43.3% women on warfarin treatment.

**Conclusion:**

In conclusion we report that mechanical valves tend to cause valvular dysfunction alone or when supported by various other factors like use of drugs, comorbidities, social habits, and other cardiac disturbances. Although they are considered to be potentially a greater choice, they still tend to cause dysfunction which hinders the therapeutic progress. Further studies in larger sections need to be conducted to analyse the results more specifically and provide better therapeutic outcomes.

**Keywords: prosthetic heart valve, mitral replacement, valvular dysfunction, Anti- platelet therapy, Echocardiography.**

**INTRODUCTION:**

An implanted device in the heart of a patient suffering from valvular heart disease is known as a prosthetic heart valve. When one of the four heart valves is functioning, a prosthetic valve must be implanted to replace the natural valve, which necessitates open heart surgery and hemodynamically and in terms of side effects (low thrombogenicity), an artificial valve should perform similarly to a natural one. They come up into three categories, which are tissue-engineered valves (allografts, autografts, stented or stent less and porcine aortic valves), bioprosthetic, and mechanical heart valves (caged ball valve, tilting disc valve, bi-leaflet heart valves).[1], [2], [3], [4]

The most common causes of prosthetic valve failure are regurgitation, stenosis, or combined. Among the leading causes of prosthetic valve stenosis are valve thrombosis and pannus formation in mechanical valves, which leads to valve obstruction, leaflet degeneration in bioprosthetic valves and endocarditis, which results in leaflet destruction. [5]The most serious complications of prosthetic heart valves are tissue hyperplasia, overgrowth, thrombosis, anticoagulant-related bleeding, infection, and valvular failure. Diabetes mellitus, a metabolic disorder, has been related to increased bioprosthetic valve degeneration and appears to predispose to degenerative valve disease.[6], [7], [8], [9]

Additionally, diabetic patients are at high risk for developing infectious disorders due to the increased prevalence of infectious endocarditis in patients with type 2 diabetes mellitus, which significantly contributes to both acute aortic insufficiency and chronic progressive degeneration of valvular tissue. It has been determined that cholesterol lowering medications can slow down the progression of these medical conditions. Long-term high blood pressure increases the risk of aortic valve disease (AVD), which is an abnormality in the valve that regulates blood flow from the heart's left ventricle into the aorta. [10], [11], [12]

The signs and symptoms of a dysfunctional prosthetic heart valve vary depending on the type of valve, its placement, and the severity of the problem. Prosthetic valve endocarditis: Fever, chills, fatigue, malaise, night sweats, signs and symptoms of heart failure if there is disrupted valvular integrity, dyspnoea, cough, pleuritic chest pain, new or changed heart murmur, splenomegaly, septic shock, septic emboli. Acute prosthetic valve failure: Acute heart failure signs such as sudden onset dyspnea, syncope, precordial pain, new heart murmur, and lung crackles on auscultation. Subacute valvular failure: Symptoms of gradually worsening congestive heart failure. Embolic complications (thrombotic or infectious): Symptoms related to the site of embolization (Eg, stroke, myocardial infarction [MI], signs and symptoms of

visceral or peripheral embolization). Anticoagulant-related haemorrhage: Site-specific haemorrhage, gastrointestinal (GI) bleed, muscle hematoma, cerebral haemorrhage. [13], [2] Patients who have a mechanical valve prosthesis must take aspirin and anticoagulants for the duration of their treatment due to the risk of thromboembolism, which is highest in the first year following surgery. When aspirin and anticoagulants are not used as prescribed, the risk of thromboembolism is three to six times higher than the usual risks are. [14], [15], [16]

In our study, we analyse the different causes of a prosthetic valve dysfunction and various modes of diagnosis of valvular dysfunction.

## **METHODOLOGY:**

In this descriptive study, 30 subjects between 20 and 80 years of age were involved with their consent, and all of them were presented with a prosthetic valve dysfunction. This study was conducted in the department of Echocardiography of a private institute for cardiac sciences. This study was conducted for 12 months. Patients with other cardiac complications including tricuspid valve repair, aortic valve replacement, congenital heart disease, ischemia, myocardial infarction, disturbances related to poor acoustic window, other systemic illnesses were all excluded from the study. The study commenced after obtaining approval from the institutional ethics committee and procuring informed consent from all the subjects.

All patient relevant information was acquired by direct interaction with the patient. Required investigations like ECG (obtained using ECG machine), ECHO- both transthoracic and transoesophageal (obtained using echocardiographic system), Catheterisation data (cinefluoroscopic imaging done using advanced Philips system), hematological parameters were all procured and analysed.

Prosthetic valve dysfunction in the enrolled participants was evaluated by assessing certain parameters like trans prosthetic velocity and gradient, effective orifice area, doppler velocity index, pressure half time, cinefluoroscopy and patient prosthetic mismatch. Also, complications like hemolytic anaemia, hypertension, diabetes mellitus, history of alcohol and smoking was analysed. Further, the type of valve used, frequency of symptoms like ECG abnormalities, precordial pain, fatigue, paroxysmal nocturnal dyspnea, orthopnea, dyspnea, syncope and fever was observed and studied.

Pattern of use of medications like aspirin, acitrom, warfarin and clopidogrel as anti- platelet therapy was analysed. Use of central and eccentric jet for regurgitation was analysed. Distribution of leaks involved with the valve, stuck valve, pannus, thrombus, calcification, dehiscence, vegetation, infective endocarditis and haemorrhage were observed.

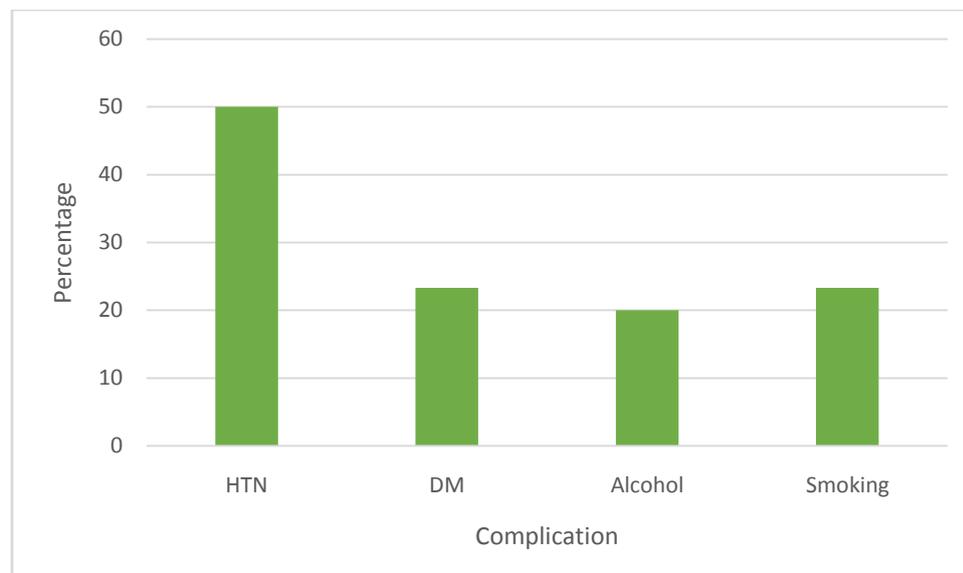
All the data was analysed using SPSS software 22.0 version. Continuous variables were expressed as mean  $\pm$  SD whose normality was analysed using Shapiro-Wilks test. Incase of no normality followed, variables were expressed as median and interquartile range. Chi-square test was used to analyse the homogeneity between categorical variables while independent variables were analysed using Mann- Whitney U- test and Kruskal Wallis test. Also, continuous variables were univariably evaluated using Wilcoxon- signed rank test. Results were considered to be statistically significant if p value  $< 0.05$ .

## RESULTS:

Our study consists of 30 participants, of which 17 (56.7%) were male and 13 (43.3%) were female. On assessing the medical history of the subjects, results reveal that 15 (50%) subjects had hypertension, 7 (23.3%) of them had a history of diabetes mellitus, 6 (20%) of them were alcoholic and 7 (23.3%) subjects were smokers. The results are shown in table 1 and figure 1.

S. NO	Parameter	Present	Percentage (%)	Absent	Percentage (%)
1	Hypertension	15	50	15	50
2	Diabetes Mellitus	7	23.3	23	76.7
3	Alcohol	6	20	24	80
4	Smoking	7	23.3	23	76.7

**Table 1: Frequency of history of subjects based on gender.**



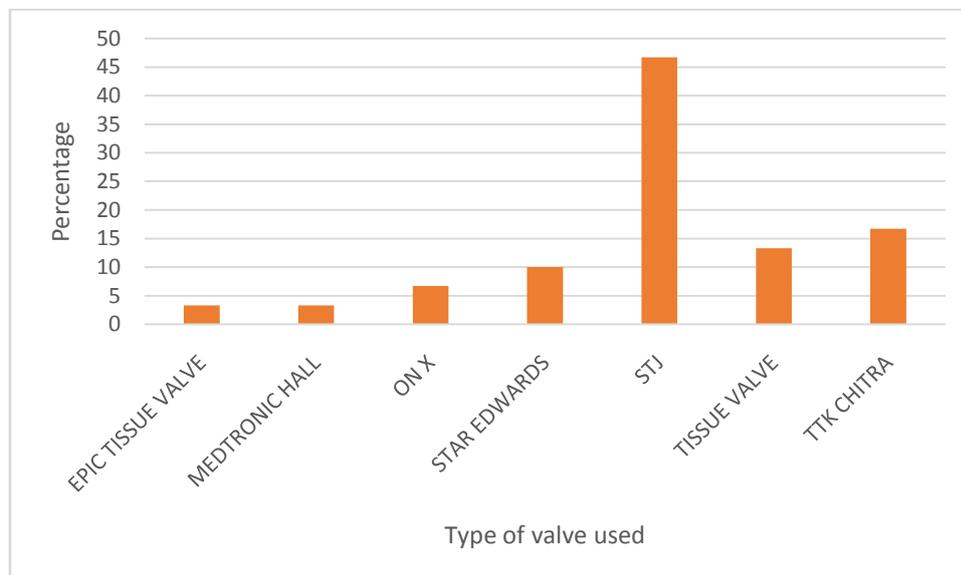
**Figure 1: Frequency of history of subjects based on gender.**

Different types of valves were used in each subject and the most commonly used was St. Jude (STJ) mechanical valve. It was used in 46.7% of the subjects. Followed by TTK Chitra tilting

disc used in about 16.7% and tissue valve used in 13.3% participants. Star Edwards was used in 10% subjects, ON X in about 6.7% and Medtronic valve in 3.3% and Epic tissue valve in 3.3% subjects. A tabulated view of results is shown in table 2 and illustrated in figure 2. The subjects were evaluated for ECG abnormalities to detect a prosthetic valve dysfunction. The results are given in table 3 and figure 3. 36.7% subjects showed abnormal sinus rhythm, 30% subjects showed atrial fibrillation, 23.3% showed sinus tachycardia, 6.7% showed atrial fibrillation with fast ventricular rate and 3.3% participants showed signs of atrial fibrillation with controlled ventricular rate.

S.no	Type of Valve used	Frequency	Percentage (%)
1	EPICTISSUEVALVE	1	3.3
2	MEDTRONIC HALL	1	3.3
3	ONX	2	6.7
4	STAR EDWARDS	3	10.0
5	STJ	14	46.7
6	TISSUEVALVE	4	13.3
7	TTKCHITRA	5	16.7

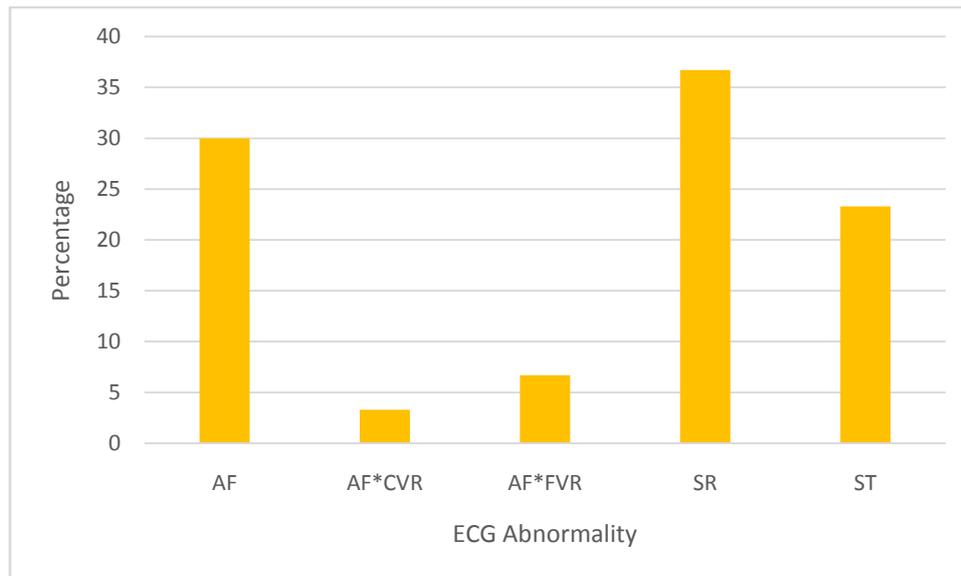
**Table 2: Frequency of type of valve used in participants.**



**Figure 2: Frequency of type of valve used in participants.**

S. NO	ECG abnormality	Frequency	Percentage (%)
1	AF	9	30.0
2	AF*CVR	1	3.3
3	AF*FVR	2	6.7
4	SR	11	36.7
5	ST	7	23.3

**Table 3: ECG abnormalities noted among participants.**

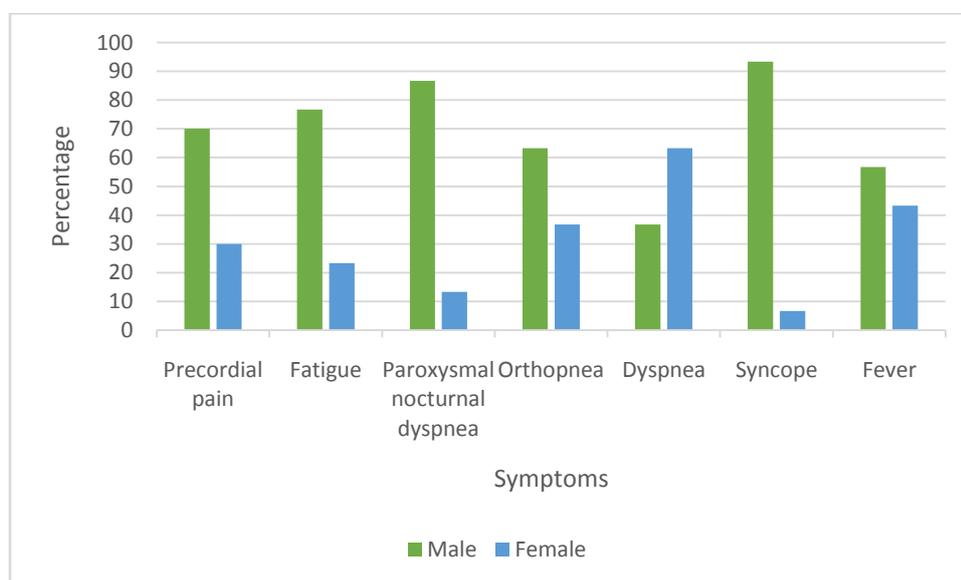


**Figure 3: ECG abnormalities noted among participants.**

The participants were observed for symptoms relating to valvular dysfunction and the results are discussed here and illustrated in table 4 and figure 4. Precordial pain was noted in 70% men and 30% women. Fatigue was found to be common among men who constituted to about 76.7% of having the symptom while 23.3% women experienced fatigue. 86.7% men had paroxysmal nocturnal dyspnea while 13.3% women had the same. Orthopnea was found to be prevalent among 63.3% men and 36.7% women. Dyspnea was experienced by 36.7% men and 63.3% women. 93.3% men had syncope while only 6.7% women had syncope. 56.7% men had fever and 43.4% women had fever.

S. NO	Symptom	Male	Percentage (%)	Female	Percentage (%)
1	Precordial pain	21	70	9	30
2	Fatigue	23	76.7	7	23.3
3	Paroxysmal nocturnal dyspnea	26	86.7	4	13.3
4	Orthopnea	19	63.3	11	36.7
5	Dyspnea	11	36.7	19	63.3
6	Syncope	28	93.3	2	6.7
7	Fever	17	56.7	13	43.3

**Table 4: Frequency of symptoms among participants.**

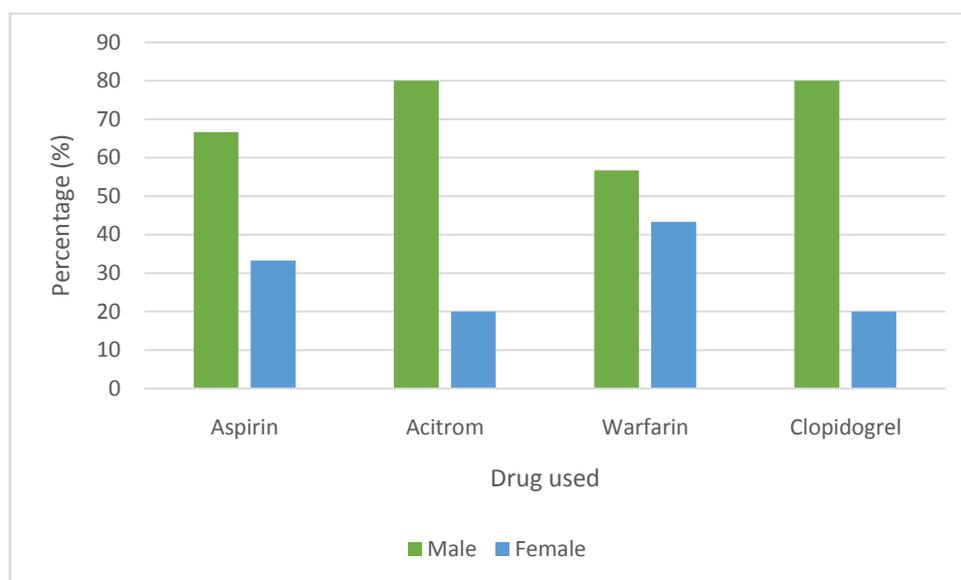


**Figure 4: Frequency of symptoms among participants.**

All participants post their valve placement, had been prescribed with anti- platelet drugs. The use of anti- platelet drugs were documented and analysed among the participants. Aspirin was used by 66.7% men and 33.3% women. Acitrom was used by 80% men and 20% women. Warfarin was taken by 56.7% men and 43.3% women while clopidogrel was used by 80% men and 20% women. Results are shown in table 5 and figure 5. Two types of jets were employed in the subjects to prevent valvular regurgitation. The central jet was used in 33.3% men and 66.7% women while the eccentric jet was used in 53.3% men and 46.7% women. Results are shown in table 6 and figure 6.

S. NO	Drugused	Male	Percentage (%)	Female	Percentage (%)
1	Aspirin	20	66.7	10	33.3
2	Acitrom	24	80	6	20
3	Warfarin	17	56.7	13	43.3
4	Clopidogrel	24	80	6	20

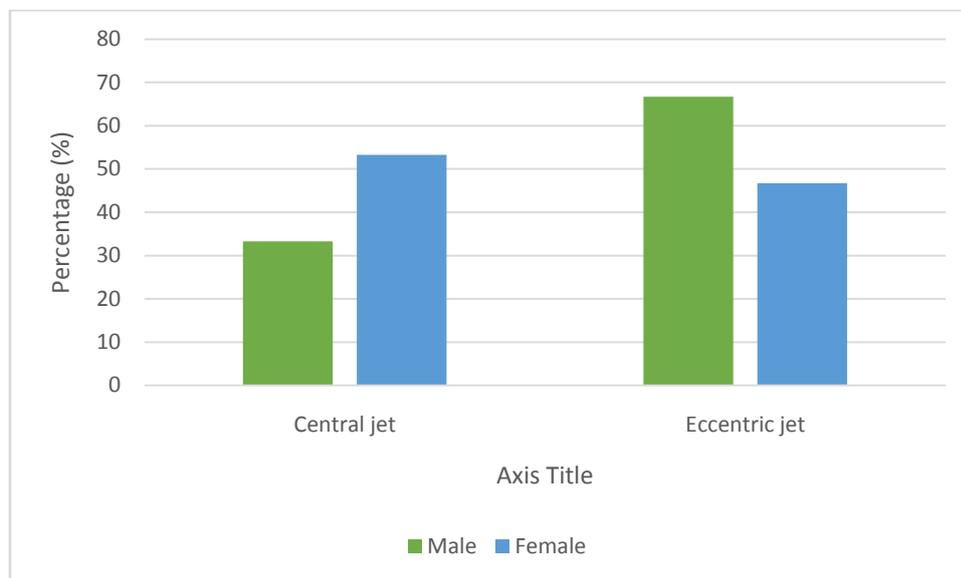
**Table 5: Frequency of Drugs used among participants.**



**Figure 5: Frequency of Drugs used among participants.**

S.No	Type of jet used	Male	Percentage (%)	Female	Percentage (%)
1	Central jet	10	33.3	20	66.7
2	Eccentric jet	16	53.3	14	46.7

**Table 6: Frequency of Jet used among participants.**

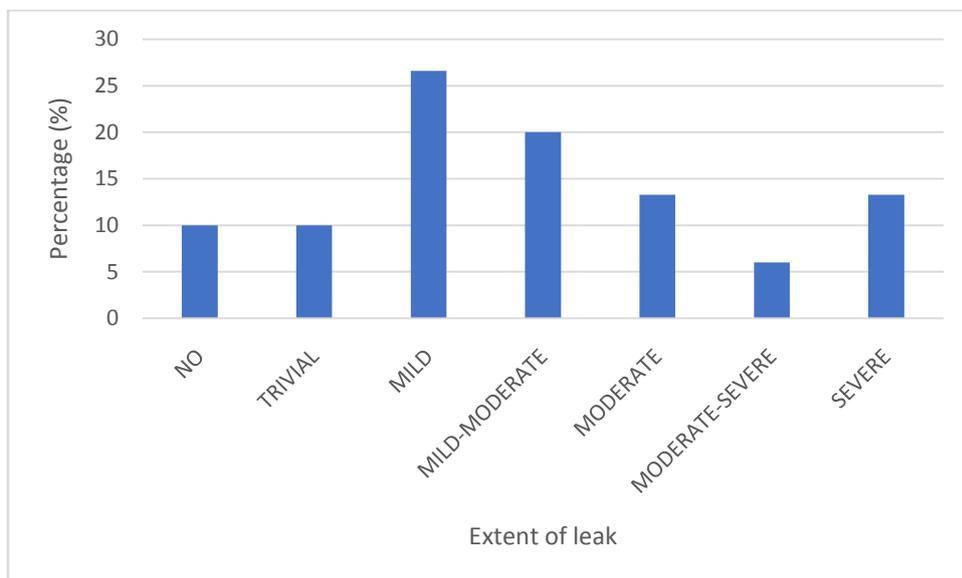


**Figure 6: Frequency of Jet used among participants.**

Valvular leaks or paravalvular leaks involved with the valve was observed among the subjects and the results are shown in table 7 and figure 7. From the results we note that 16.7% subjects had mild/ no leaks and 10% of them had moderate/ mild leaks from the valve. All the other levels of severe leak involved as categorised in the table each was experienced by 3.3% of the subjects. Table 8 and figure 8 show the effect of patient prosthetic mismatch. 3.3% of the participants experienced no effect. 56.7% subjects were suspected of a possible stenosis and 40% subjects reported confirmed stenosis.

S. NO	EXTENT OF LEAK	Frequency	Percentage (%)
1	NO	3	10
2	TRIVIAL	3	10
3	MILD	8	26.6
4	MILD-MODERATE	6	20
5	MODERATE	4	13.3
6	MODERATE-SEVERE	2	6
7	SEVERE	4	13.3

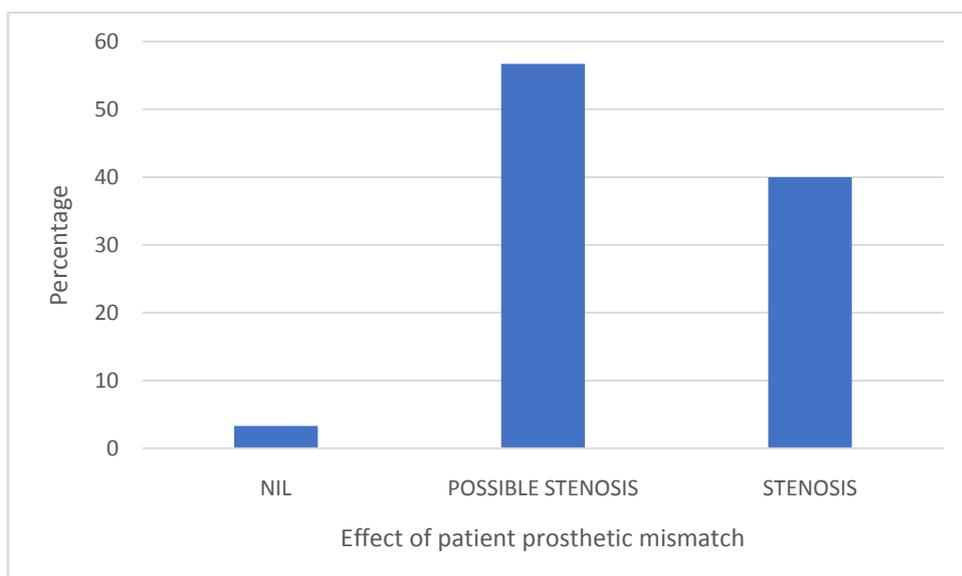
**Table 7: Extent of valvular leak noted among participants.**



**Figure 7: Extent of valvular leak noted among participants.**

S. NO	EFFECT OF PATIENT PROSTHETIC MISMATCH	Frequency	Percentage (%)
1	NIL	1	3.3
2	POSSIBLE STENOSIS	17	56.7
3	STENOSIS	12	40.0

**Table 8: Effect of patient prosthetic mismatch noted among participants**



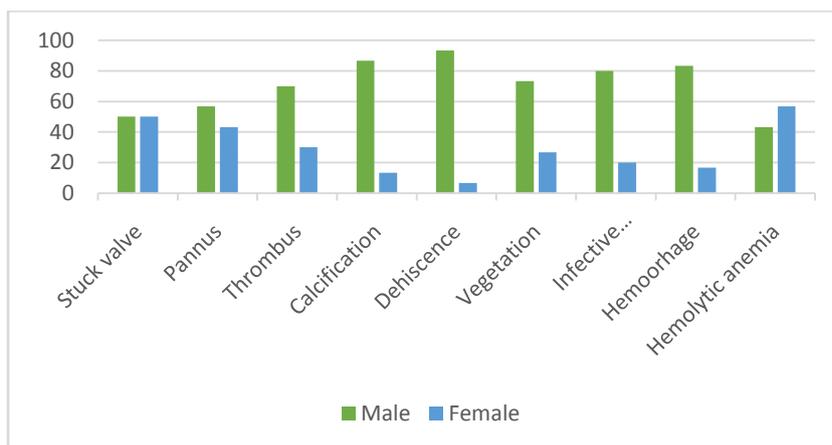
**Figure 8: Effect of patient prosthetic mismatch noted among participants**

Several other issues were associated to prosthetic mitral valve dysfunction and some of the most common ones were studied and the results are given in table 9 and figure 9. 50% men

and 50% women had a stuck valve. 56.7% men and 43.3% women had pannus. 70% men and 30% women experienced thrombus. Calcification was noted in 86.7% men and in 13.3% women. Dehiscence was noted in 93.3% men and 6.7% women. 73.3% men and 26.7% women experienced vegetation. 80% men and 20% women were affected with infective endocarditis. Hemorrhage was seen in 83.3% men and 16.7% women. 43.4% men and 56.7% had hemolytic anemia.

S. NO	Parameter	Male	Percentage (%)	Female	Percentage (%)
1	Stuck valve	15	50	15	50
2	Pannus	17	56.7	13	43.3
3	Thrombus	21	70	9	30
4	Calcification	26	86.7	4	13.3
5	Dehiscence	28	93.3	2	6.7
6	Vegetation	22	73.3	8	26.7
7	Infective endocarditis	24	80	6	20
8	Hemorrhage	25	83.3	5	16.7
9	Hemolytic anemia	13	43.3	17	56.7

**Table 9: Frequency of other factors involved in prosthetic valve dysfunction among participants.**



**Figure 9: Frequency of other factors involved in prosthetic valve dysfunction among participants.**

## **DISCUSSION AND CONCLUSION:**

Prosthetic mitral valve dysfunction is slightly rare but a serious complication following a valve replacement. Valvular dysfunction is associated with varied aetiology and is dependent on several factors. [17] In our study we observe that men were more prevalent to prosthetic valve dysfunction than women were. This is supported by a study conducted by J. T. DesJardin et al., 2022 in which it was stated that men and women are relatively prone to different kinds of valvular dysfunctions but men tend to suffer to a greater extent compared to women. [18]

We also infer from our study that participants with a history of hypertension are more vulnerable to developing a valvular dysfunction compared to diabetes mellitus which is supported by a study conducted by Arsalan Hamid et al., 2023, [19] it was concluded that people didn't associate valvular dysfunction or any cardiac functional or structural disturbances when they had diabetes mellitus, but they were at high risk of developing them in case of hypertension. Also, discussing social habit of the participants, we notice that most people were smokers and developed valvular dysfunction post replacement. A study published by David M. D et al., 2019, [20] backs up this statement. The results of the published article reveal that smoking is not indicated as a direct risk of developing cardiac complications or valvular disturbances. However, on a long term, it fastens the progression of the condition and also hinders healing.

On analysing the symptoms reported by the participants in this study, we see that syncope and dyspnea were highly reported on account of a dysfunctional valve. It has been reported by R.B. Guimaraes et al., 2018 [21] that cardiac structural diseases mainly valvular complications are the main cause for syncope although differential diagnosis is considered essential for assessment of disease severity. [22] Post replacement of the valve, patients are prescribed with a blood thinner as prophylaxis. Acitrom was the most taken drug and we observe that valvular dysfunction has arisen in maximum in the group of patients under acitrom therapy. Acitrom (Nicoumalone) is an oral anticoagulant. It has been proven that in spite of these arising complications, anti-coagulants remain to be the established therapeutic option to prevent thrombotic events. It is also taken to consideration that there are numerous challenges involved with management post valve replacement and there are certain monitoring parameters that needs to be kept in check.[23]

Our results also suggest that patients with calcification and vegetation of the valve can possibly contribute to its dysfunction. Hao Yu Chen et al., 2019, [24] in their article stated

that calcification stands to be a major risk factor to developing valvular disturbances although calcification itself depends on factors like smoking, age, high BMI, renal and hepatic impairment. Vegetation has also been reportedly considered important in valve destruction. This is explained by William J Young et al., 2020 [25] in their study. It was concluded that vegetation increases the risk of valvular dysfunction with increase in its size. It also potentially predicts mortality in infective endocarditis that is therapeutically treated. In our study we have observed that all these factors contributing to valvular dysfunction was associated to the use of mechanical valves compared to bio prosthetic valve. Studies state that mechanical valves are more durable and reliable than bio prosthetic valves but they are highly thrombogenic compared to bio prosthetic valves and therefore require long term therapy with anti- coagulants.[26], [27]

In conclusion we report that mechanical valves tend to cause valvular dysfunction alone or when supported by various other factors like use of drugs, comorbidities, social habits, and other cardiac disturbances. Although they are considered to be potentially a greater choice, they still tend to cause dysfunction which hinders the therapeutic progress. Further studies in larger sections need to be conducted to analyse the results more specifically and provide better therapeutic outcomes.

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