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RESEARCH ARTICLE
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COMPARATIVE STUDY ON TRANSSEPTAL APPROACH VS TRANS LEFT ATRIAL APPROACH FOR MITRAL VALVE PROCEDURE.

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Abstract
Objective: This study aims to compare the two approaches of mitral valve exposure in isolated mitral valve disease for their intra-operative and post-operative outcomes.
Material and Methods: All patients who underwent isolated mitral valve surgery from May 2022 to March 2023 were enrolled in the study, after they met the inclusion and exclusion criteria. Patients include only mitral valve disease. Patient with severe LV dysfunctions and patient with bleeding tendency were excluded. We had taken into account are operating time, post op bleeding and arrythmia.
Results: After analysing total pump time, total aortic cross clamp time, post operative bleeding and arrythmia in both the group, there was no significantdifferences in outcome in any of the methods.
Conclusion: The LA approach is the most used approach which provides satisfactory exposure of the mitral valve and the sub valvar apparatus. However, patient characteristics and circumstances limit the versatility of this approach.The TS approach provides optimal exposure of the mitral valve complex even in the presence of inexperience assistant surgeons or trainee surgeons or hostile anatomical conditions or redo surgeries. Studies have associated the transseptal approach with multiple complications of excessive bleeding, post operative rhythm disturbances and subsequent need for pacemaker implantation. After comparison of multiple intra-operative and post-operative variables, we found that the TS approach is a valuable approach to the mitral valve providing excellent visibility even in hostile anatomy or operative conditions delivering comparable results to the conventional LA approach.

Keywords: Mitral valve complex, LA approach, TS approach

Introduction

Valvular heart disease is a dominant cause of cardiovascular morbidity and mortality posing a significant burden on healthcare services worldwide (1).Rheumatic heart disease has been a major contributing factor in most developing countries and sporadically in developed countries (2). On the

Indian front, reporting of rheumatic heart disease, is still thought to be the tip of an iceberg, as large-scale prevalence and incidence data is lacking. In the existing studies, incidence of RHD varies from 4.54 to 6 per 1000 (3, 4) to estimates being as high as 51 per 1000 (5). Despite the diverse incidence reports, mitral valve continues to be the most commonly involved valve in rheumatic in a developing country like ours. In the developed counterparts of the world, mitral valve is involved in degenerative aetiology (6). The trans-apical approach is now used for transcatheter mitral valve implantations and implantation of neo-chordae for mitral valve regurgitation (10). Though we may have come a full circle from where we began, open heart surgeries to access the mitral valve utilises two common approaches – namely, the conventional left atrial approach and the trans septal approach via the interatrial septum. Surgeons have conventionally used the left atrial approach to access the mitral valve while the trans-septal approach has been known to cause various complications like increased post-operative bleeding and rhythm disturbances. Lately, there has been renewed interest in the trans-septal approach. With the increasing number of mitral valve repairs(11) necessitating the visualisation of mitral valve along with its sub valvular apparatus and the rising number of redo mitral valve surgeries, the transseptal approach has made a comeback for providing better exposure and thus better subsequent surgical outcomes when performed with care. There is extensive data available comparing the approaches to the mitral valve. (12, 13, 14) However, most of these studies come from developed countries where the primary pathology observed and surgically treated is degenerative. This contrasts with our Indian scenario, where the disease burden is rheumatic valvular heart disease in a relatively younger population (15).

Material and Methods

Study population

Patients who underwent mitral valve surgery for isolated mitral valve disease were included in this study. The study population were divided in two groups: Group I - Those who underwent mitral valve surgery via the trans left atrial approach (**Figure 1 and Figure 3**). Group II - Those who underwent mitral valve surgery via the trans septal approach (**Figure 2 and Figure 4**). All patients who underwent isolated mitral valve surgery from May 2022 to March 2023 were enrolled in the study, after they met the inclusion and exclusion criteria. Patients includesAge >18 years. Patients with the ability to understand study procedures and to comply with them for the length of the study. Scheduled cardiac surgery of isolated mitral valve disease. Patients undergoing elective or urgent surgery. Patients undergoing redo-isolated mitral valve surgery.

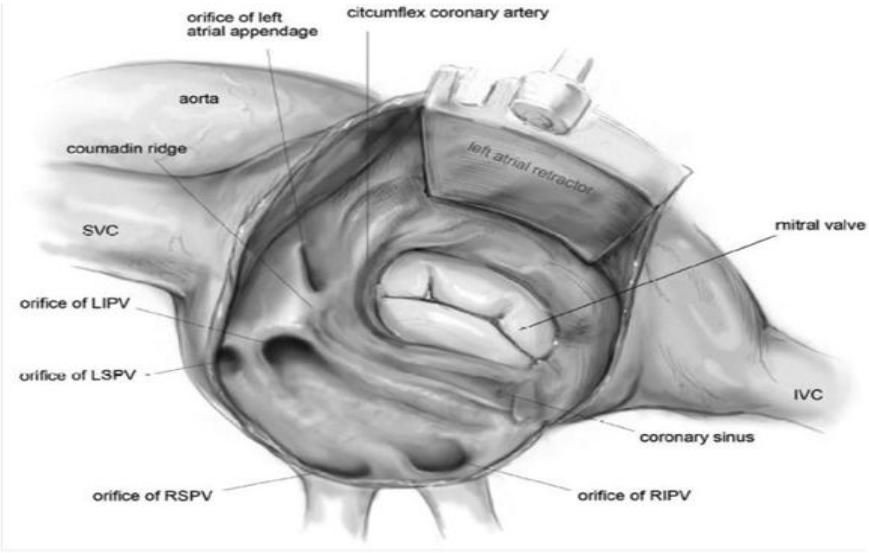

Figure 1: Conventional Trans left Atrial Approach

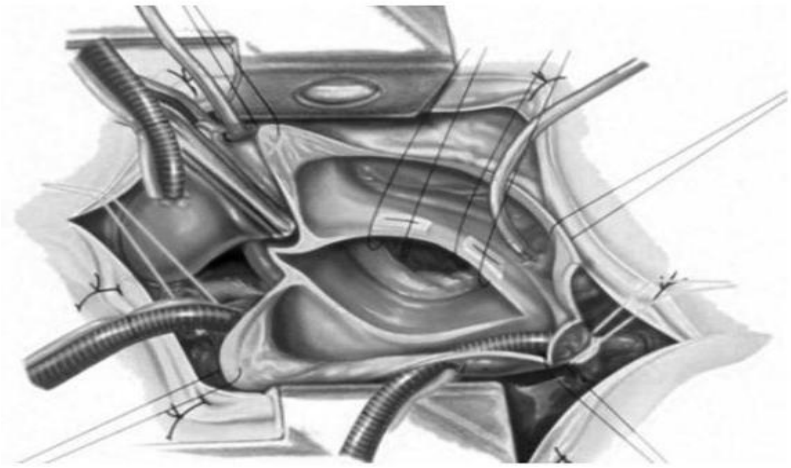

Figure 2: Trans Septal Approach

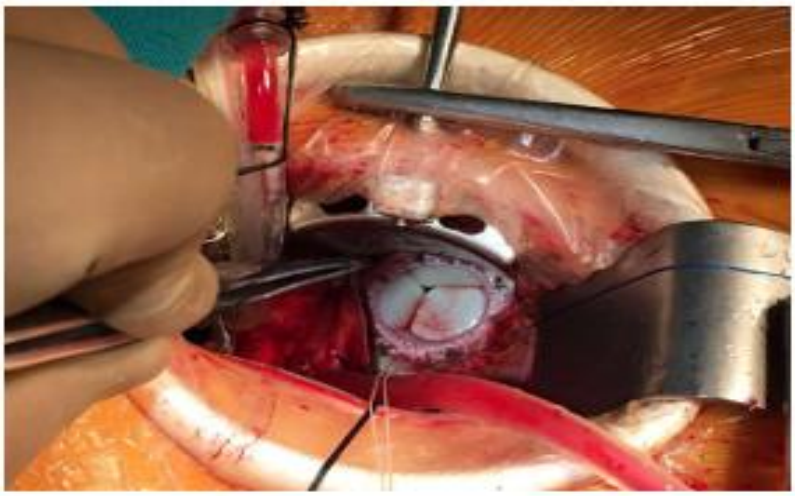

Figure 3: Exposure of Mitral Valve Prosthesis through the Conventional Left Atrial Approach (Minimally Invasive Mitral Valve Replacement via 4th Right Antero-Lateral Thoracotomy

Figure 4: Exposure of Mitral Valve leaflets through Transseptal Approach (Case of Anterior Mitral Leaflet Vegetation causing perforation)

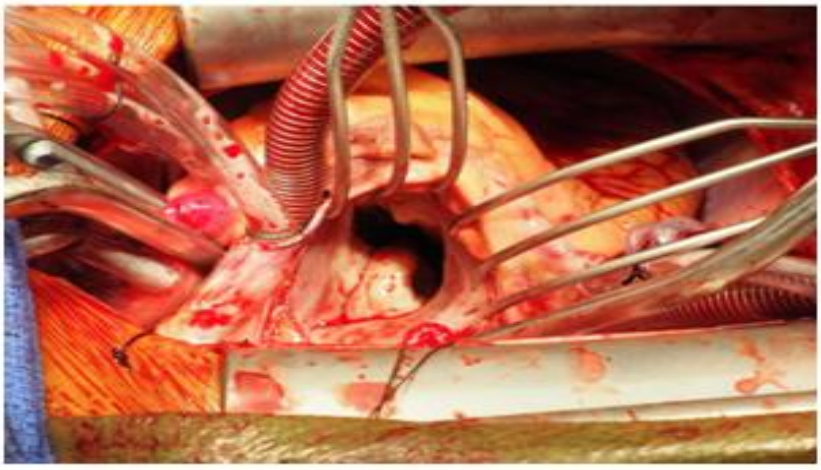

Figure 5: Exposure of Mitral Valve through Left Atriotomy

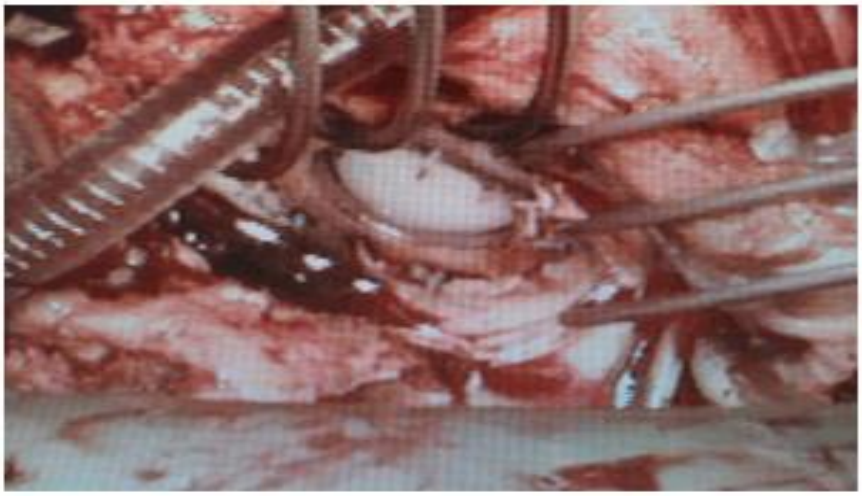

Figure 6: Exposure of Mitral Valve Prosthesis through Transseptal Approach

Primary end-point

1. Operative time (aortic cross clamp time and total CPB time)
2. Post-operative bleeding
3. Post-operative arrhythmias (atrial/ventricular) or heart blocks

Secondary end-point

1. Cardiac tamponade (post-operative)
2. Excessive bleeding requiring re-exploration
3. Atrial Fibrillation (new-onset post-operative)
4. Complete heart block necessitating permanent pacemaker implantation.

They were planned by the operating surgeon to undergo any of the two techniques (trans- septal or trans-left atrial) as routine operative procedures **(Figure 5 and Figure 6).** Their intra-operative data of total bypass time and total aortic cross clamp time was noted. Post-operative amount of blood loss was noted. Patients requiring re-operation for bleeding or tamponade in the immediate post-operative period along with the blood loss occurring at 12 hours post-surgery and total blood loss before chest tube removal in the intensive care unit was taken into consideration. Post-operatively, the patient was monitored for the development of any new-onset atrial or ventricular arrhythmias or heart blocks until discharge. Subsequently patients requiring permanent pacemaker implantation for complete heart blocks were also noted.

Result and Discussion

A total of 150 patients were analysed as part of our study operated from May 2022 to March 2023. Patient characteristics and operative factors have been matched as much as possible for best cohort matching. The age range of subjects was between 29-73 years in the LA approach group whereas 18-71 years in the TS approach group. The mean age was 56.71 years in the LA approach group and 54.32 years in the TS group with the p value =0.149 (not significant). On the basis of gender, our study has significantly more males (62.7% in trans LA group and 82.7% in trans septal group) in both operative approach groups, with p value=0.010 (**Table 1 and Figure 7**).

Table 1: Age Distribution

Age in Years	TRANS LA	TRANS SEPTAL	Total
<40	5(6.7%)	7(9.3%)	12(8%)
40-50	15(20%)	16(21.3%)	31(20.7%)
51-60	24(32%)	26(34.7%)	50(33.3%)
>60	31(41.3%)	26(34.7%)	50(33.3%)
Total	75(100%)	75(100%)	150(100%)
Mean ± SD	56.71 ± 10.02	55.51 ± 10.12	

Samples are age matched with P=0.149, student t test

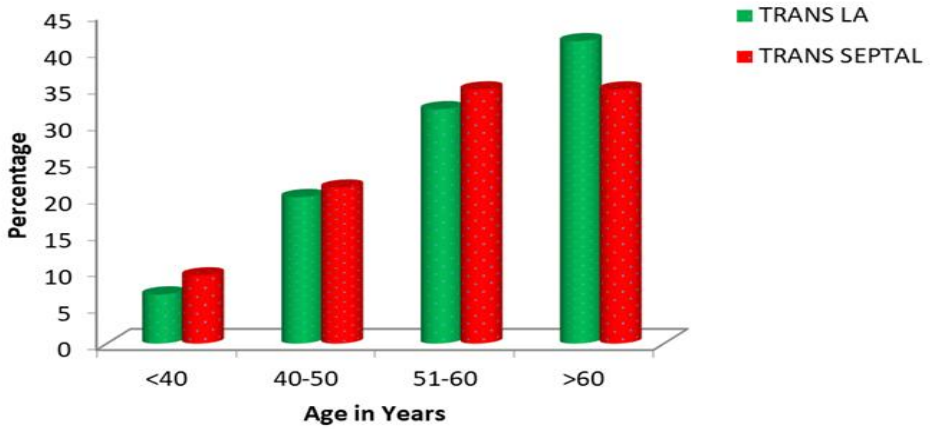

Figure 7: The case percentage of 150 cardiac cases with mitral valve disease.

In the pre-operative history and data collection, it was noted that 16.7% patients had atrial fibrillation as their baseline rhythm. The pre-operative echo parameters were documented, and no significant difference was found amongst the LA size and ejection fraction of the study subjects. The mean LA size in LA approach group was 4.63±0.32 and in the TS group was 4.69±0.28. Patients with moderate to severe LV dysfunction were excluded from the study as LV dysfunction may influence the total CPB time and the overall length of ICU and hospital stay. Hence, to avoid a bias, subjects with LV dysfunction were excluded from the study.

No statistically significant difference was found the total cardiopulmonary bypass (CPB) time and cross clamp time amongst the two groups in our study. The average total CPB time in the TS approach group was 137.89±29.46 minutes and in the conventional trans LA approach group was 135.16±30.08 minutes (p= 0.57). The average total aortic cross clamp time in the TS approach group was 104.56±28.28 minutes and in the conventional LA approach group was 100.59±27.88 minutes (p= 0.388). Studies have claimed to have longer CPB time and aortic cross clamp time in the TS approach mostly due to reconstruction of the inter-atrial septum and the wall of the right atrium in the TS approach (**Table 2, Figure 8 and Figure 9**).

Table 2: Total CPB time in both the group.

INTRA. OP VARIABLES	TRANS LA	TRANS SEPTAL	Total	P Value
TOTAL CPB TIME				

<150	51(68%)	51(68%)	102(68%)	1.000
150-200	23(30.7%)	23(30.7%)	46(30.7%)	
>200	1(1.3%)	1(1.3%)	2(1.3%)	
TOTAL AORTIC CROSS CLAMP TIME				
<100	37(49.3%)	34(45.3%)	71(47.3%)	0.816
100-150	34(45.3%)	35(46.7%)	69 (46%)	
>150	4(5.3%)	6(8%)	10(6.7%)	
Total	75(100%)	75(100%)	150(100%)	

Chi-Square Test / Fisher Exact Test

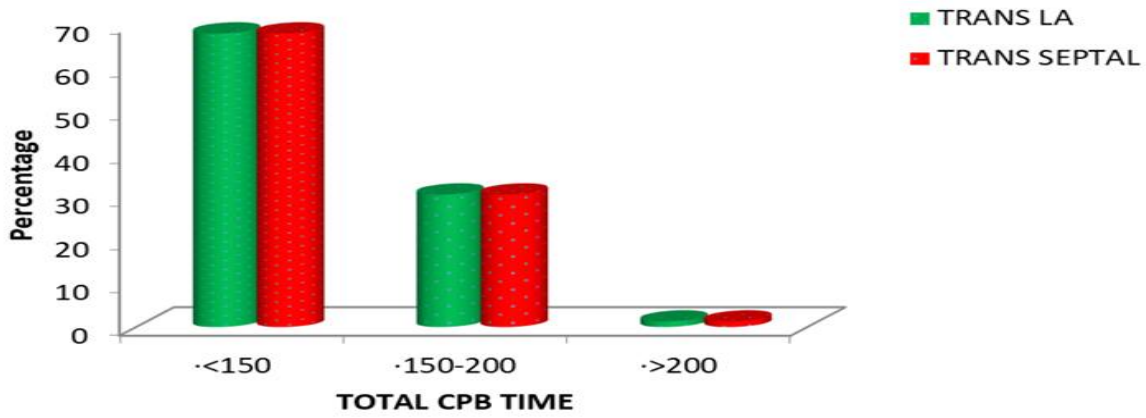

Figure 8: Represents the total CBC time period of Trans LA and Trans Septal groups

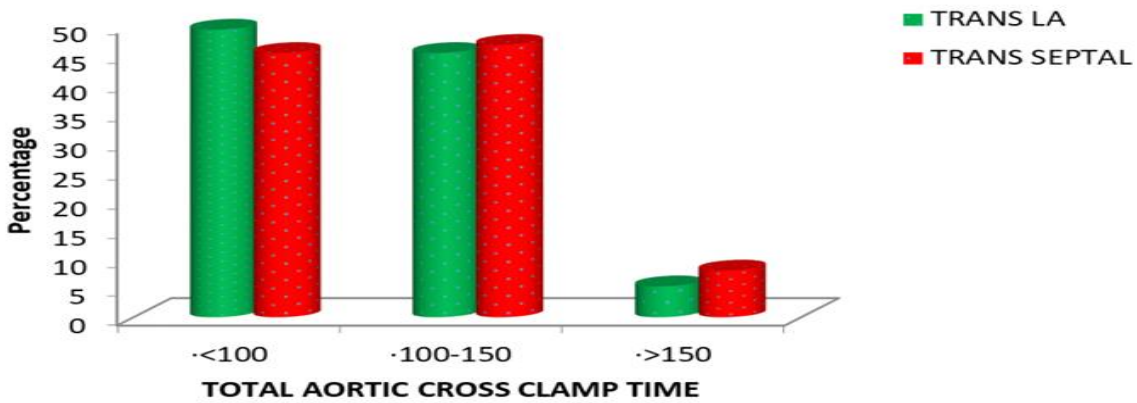

Figure 9: Illustrates the total aortic cross clamp time between Trans LA and Trans Septal groups

With respect to post-operative bleeding, our study has evaluated the two approaches by data collection of drainage from the chest tubes at 12 hours and the total drainage until the chest drains were removed. This data has been recorded on an hourly basis as a part of our immediate post-operative intensive care protocol and has been summated in our study for evaluation at 12 hours on POD-Zero and total drainage at the time of chest drain removal.

No significant difference was found in post-op blood loss between the two approaches. Blood loss observed at 12 hrs was 137±58.45ml in the conventional LA approach and was 146.73±71.81ml in the TS approach group (p= 0.364). Total blood loss observed in the conventional LA approach was 227.53±80.79 ml and was 230.8±90.49 ml in the TS approach group (p= 0.816). Studies in the past have reported higher blood loss in the septal approaches mostly due to greater operative time and

the subsequent need for greater number of blood and blood products (**Table 3, Figure 10 and Figure 11**).

Table 3: Total bleeding in both the group.

POST. OP VARIABLES	TRANS LA	TRANS SEPTAL	Total	P Value
BLOOD LOSS AT 12 HRS				
<150	52(69.3%)	46(61.3%)	98(65.3%)	0.747
150-200	23(30.7%)	21(28%)	44(29.3%)	
>250	4(5.3%)	8(10.7%)	12(8%)	
TOTAL BLOOD LOSS				
<150	10(13.3%)	10(13.3%)	20(13.3%)	0.985
150-250	37(49.3%)	36(48%)	73 (48.7%)	
>250	28(37.3%)	29(38.7%)	57(38%)	
Total	75(100%)	75(100%)	150(100%)	

Chi-Square Test / Fisher Exact Test

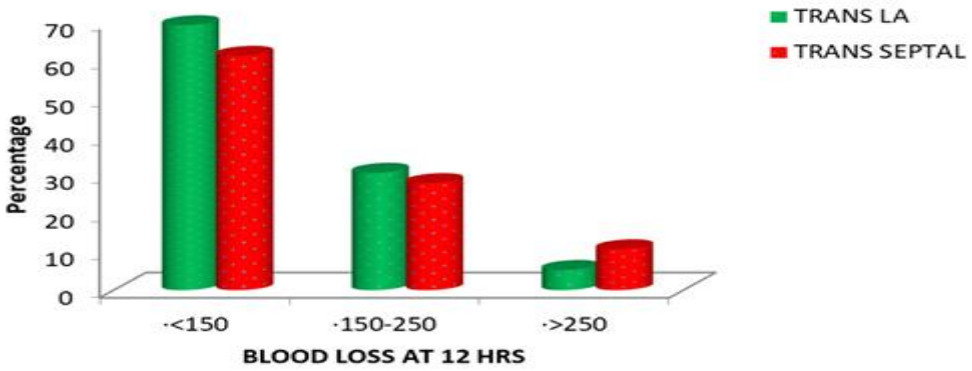

Figure 10: The bar pictorial graph demonstrates the Blood Loss at 12 Hrs between Trans LA and Trans Septal groups.

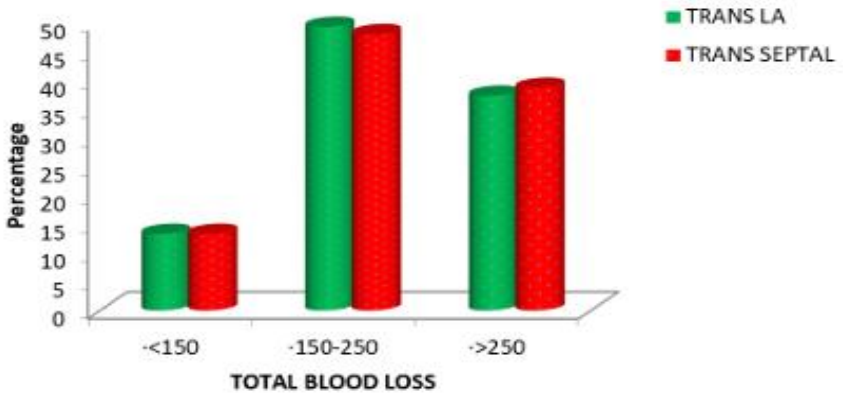

Figure 11: The pictorial graph represents the Total Blood Loss between Trans LA and Trans Septal groups.

It has however been postulated that the operative time needed is a surgeon dependent variable and the preference of a specific approach. Studies have quoted the TS approach to have increased incidence of blood loss and hence increased incidence of re-exploration for bleeding or tamponade. So far arrythmia is concerned new onset AF is noted in the LA approach mostly due to handling and retraction of the LA using a retractor. Likewise, the septal approaches have been known to have higher incidence of new AF as it involves manipulation and injury of both the left and right atria.

The resultant scarring thus has direct arrhythmogenic effects.(16,17)In our study, out of the 75 patients who underwent mitral valve surgery through the LA approach, 16 patients had pre-op atrial fibrillation. Out of the remaining 59 patients, 11 patients (18.6%) developed new onset atrial fibrillation post-operatively. In the TS approach group out of 75 patients, 9 patients had atrial fibrillation as their baseline pre operative rhythm. Out of the remaining 66 patients, 9 patients (13.6%) developed new onset atrial fibrillation post-operatively. On comparing this data of new onset atrial fibrillation, no significant difference was found between the two approaches. The incidence of new onset atrial arrhythmias thus cannot be attributed to approach used alone. We found 13 patients (17.3%) in the LA approach group and 15 patients (20%) in the TS approach group to have varying degrees of heart blocks respectively. Amongst these(18) patients in each group developed transient 1st degree heart block which returned to normal sinus rhythm by the time of discharge. patients in the conventional LA approach group and 7 patients in the TS approach group developed transient 2nd degree heart block which returned to normal sinus rhythm by the time of discharge. patients (2.7%) in the trans LA approach group and 3 patients (4%) in the TS approach group developed complete heart block post operatively and had to undergo permanent pacemaker implantation (**Table 4**).

Table 4: Post Operative Various Complications**.**

	TRANS LA	**TRANS SEPTAL**	**P Value**
NEED FOR REEXPLORATION FOR BLEEDING/ GAMPONADE			
No	74(98.7%)	75(100%)	1.000
Yes	1(1.3%)	0. (0%)	
NEW ONSET ATRIAL ARRYTHMIAN			
No (NSR)	48	57	0.445
Yes (AF)	11	9	
NEW ONSET ATRIAL ARRYTHMIAS			
No	73(97.3%)	71(94.7%)	0.681
Yes (VPC)	2(2.7%)	4(5.3%)	
NEW ONSET HEART BLOCKS			
No	62(82.7%)	60(80%)	0.841
Yes	13(17.3%)	15(20%)	
1st Degree	5(6.7%)	5(6.7%)	
2nd Degree	6(8%)	7(9.3%)	
3rd Degree	2(2.7%)	3(4%)	
POST. OP NEW PP IMPLANATION			
No	72(96%)	72(96%)	1.000
Yes	3(4%)	3(4%)	

The overall length of ICU stay and total duration of hospital stay was assessed in the two approaches. The average length of ICU stay was found to be 3.43±0.74 days in the conventional LA approach group and 3.2±0.55 days in the TS approach group (**Table 5 and Figure 12**).. On application of Chi-square/ Fisher Exact test, the p-value obtained, is found to be significant with the TS approach having lesser ICU stay.

Table 5: Post operative ICU stay in both the group.

Variables	**TRANS LA**	**TRANS SEPTAL**	**P Value**
TOTAL ICU STAY	3.43 ± 0.47	3.2 ± 0.55	0.034*
TOTAL HOSPITAL STAY	6.59 ± 1.08	6.45 ± 0.86	0.404

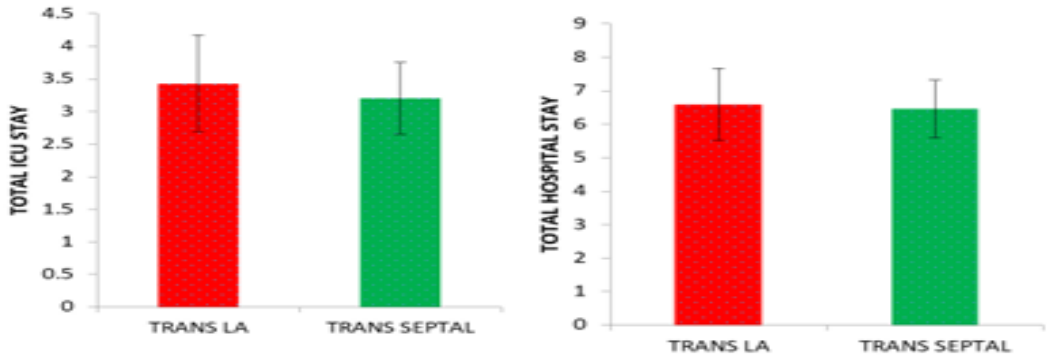

Figure 12: Illustrate the post operative ICU stay in Trans LA and Trans Septal groups

Conclusion

Our study has found equivocal outcomes on all most all variables comparing the two traditional approaches to the mitral valve. The TS is a valuable approach to the mitral valve providing excellent visibility irrespective of the size of the RA especially with the advent of growing number of beating heart mitral valve surgeries. Hence, we recommend surgeons to adopt a case-based approach. The approach must be planned pre-operatively keeping in mind the pre-operative medical history and the requirement of concomitant procedures, if any. History of previous lung resection, previous cardiac surgery (especially patent saphenous vein grafts and mammary arteries), combined mitral and tricuspid access, Studies have associated the trans septal approach with multiple complications of excessive bleeding, post operative rhythm disturbances and subsequent need for pacemaker implantation. Our study was intended to establish causal relationship between the type of surgical approach used for mitral valve exposure and the development of post operative complications. Hence, we compared the two most commonly used approaches to the mitral valve for its intra-operative (total CPB time and total aortic cross clamp time) and post-operative outcomes (post-operative bleeding, post-operative rhythm disturbances, post-operative need for permanent pacemaker implantation, total duration of ICU and hospital stay).From this study we intended to establish causal relationship between the type of surgical approach used for mitral valve exposure in isolated mitral valve diseases and development of post-operative complications to provide objective and useful understanding when planning our strategy to operate on the mitral valve.

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Data availability

The data sets analyzed in this study are accessible from corresponding author on valedictory reasonable request.

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Ethics approval

The ethical approval was obtained from IMS and SUM Hospital with approval number: DMR/IMS/IEC-2022/054

Conflict of interest

The authors have declared no conflict of interest.

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