ORIGINAL ARTICLE

Comparison of Semi-continuous Technique and interrupted technique for replacing mitral valve replacement (MVR) in terms of Cross-clamp Time.

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ABSTRACT… Objective: To compare the cross-clamp times between the semi-continuous and interrupted techniques for mitral valve replacement. Study Design: Retrospective Cohort study. Setting: Peshawar Institute of Cardiology Tertiary Cardiac Centre in Lower Middle-Income Country with high rheumatic heart disease burden. Period: January 2021 to June 2024. Methods: The patients were divided into two equal groups: Group I patients underwent semi-continuous technique for mitral valve replacement, and Group II underwent interrupted technique. All patients older than 18 years with isolated mitral valve replacement for rheumatic mitral disease (confirmed either with gross features or biopsy) were included. Results: A total of 110 patients were included in the analysis, consisting of 46 males (41.8%) and 64 females (58.2%). The mean age of the cohort was 39.8 years (SD = 11.5), with a mean body mass index (BMI) of 23.3 (SD = 4.2). The mean cross-clamp time for the semi-continuous technique was 68.75 minutes (SD = 22.2), which was significantly lower than the mean cross-clamp time of 91.7 minutes (SD = 27.3) for the interrupted technique. Conclusion: Study showed that the semi-continuous sutures gave a similar outcome to the interrupted sutures, with significantly better operative time regarding cross-clamp time without increasing mortality.

Key words: Mitral Valve, Rheumatic Heart Disease, Interrupted Technique, Mechanical Valve.

INTRODUCTION

Heart valve replacement is a proven and safe procedure with a low risk of death, offering significant advantages to patients suffering from chronic valve disease. Mitral stenosis is a type of valvular heart disease, often resulting from rheumatic heart disease, and is defined by the narrowing of the mitral valve opening in the heart.[1] Mitral valve replacement (MVR) is performed using either semi-continuous (SC) technique or interrupted suture technique. The SC technique is faster, leading to shorter durations for aortic cross-clamping and cardiopulmonary bypass.[2] The semi-continuous suture technique is appropriate for all kinds of prosthetic valve replacements, particularly for cases involving rheumatic valve disease, as well as in situations with a small left atrium or a small aortic annulus.[3]

The rate of detecting paraprosthetic leakage (PPL) after mitral valve replacement (MVR) is about 15% when using transesophageal echocardiography (TEE) in the immediate post-operative period, whereas it is around 12.5% when TEE is not used.[4,5] The primary factors contributing to paraprosthetic leakage (PPL) include the degree of annular calcification, the presence of infection, the type of suture technique used, and the size and type of prosthesis employed.[6] It has been reported that paraprosthetic leakage (PPL) is more common with the running suture (SC) technique compared to the interrupted suture technique following surgery. However, PPL tends to be less frequent in cases of rheumatic valvular disease due to the thick and fibrotic nature of the annulus in such conditions.[7,8]

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There are few studies that compare cross-clamp time in semi-continuous vs interrupted technique to replace mitral valve in patients with rheumatic heart disease. Our Study aims to find out whether semi-continuous technique to replace mitral valve reduces cross-clamp time in patients with rheumatic heart disease compared to interrupted technique.

METHODS

This retrospective study was conducted at Peshawar Institute of Cardiology from January 2021- June 24. 55 consecutive patients with mitral valve replacement through semi continuous technique and 55 consecutive patients with mitral valve replacement through interrupted technique were studied during this period (n=110). All patients older than 18 years with isolated mitral valve replacement for rheumatic mitral disease (confirmed either with gross features or biopsy) were included. Mitral disease due to other etiologies, repair of the mitral valve and concomitant other valve replacement or CABG were excluded from the study. All patients had median sternotomy, cardiopulmonary bypass (CBP) was initiated via central aortic and bicaval cannulation with snares around the vena cava and venting through aortic root. Aorta was cross-clamped and blood cardioplegia was administered in antegrade fashion. Moderate hypothermia was used. LA cavity was opened through different approaches depending upon the case. Mitral valve was assessed and anterior leaflet was excised and posterior leaflet preserved fully or partially in all cases. Mitral valve was replaced either with semicontinous or interrupted technique depending upon surgeon preference. In semi continuous technique three or more polypropylene 2/0 or Ethibond 2/0 were used depending on valve size. For the interrupted suture technique, 14 to 17 alternate plegeted 2.0 Ethibond sutures were used. In both techniques suture were passed from annulus and prosthetic valves and then valve was parachuted to the annulus by pulling sutures.

Patients' data were collected from the hospital management information system (HMIS), which were subsequently verified with physical files kept in the hospital records room. The study was approved by the institutional research review board (IRC/24/105, Nov 2024).Our study utilized SPSS (Statistical Program of Social Science) version 20 for analysis of our dataset, applying a variety of statistical tests to extract meaningful insights. Statistical analysis, including Chi Square tests, analysis of variance (ANOVA) and independent t-tests, were performed.

RESULTS

The study population comprised 46 male (41.8%) and 64 female (58.2%) patients. The mean age of the sample population was 39.8 years with a standard deviation of 11.5 and the mean BMI is 23.3 with a standard deviation of 4.2. The disease of Mitral valve was observed as Mitral stenosis (MS) alone was less frequently encountered, documented in 22 patients (20.0%) with mitral regurgitation (MR) being the most prevalent condition, observed in 40 patients (36.4%) both MS and MR, was identified in 48 patients (43.6%). Table-I

Parameters	Frequency (n)	Percentage
Male	46	41.8
Female	64	58.2
Age (Year)	39.8±11.5	--
BMI (Mean)	23.3±4.2	--
Disease Classification		
Mitral Stenosis	22	20.0
Mitral Regurgitation	40	36.4
Mixed	48	43.6
Table-I. Suture technique overall analysis (n=110)		

In the semi technique group, 1 patient (0.9%) experienced operative mortality, while an equivalent number was observed in the interrupted technique group, also constituting 0.9% of patient. operative mortality accounted for 1.8% of the total, with no statistically significant difference between the two techniques (p = 1.0). Table-II

Parameter	Semi n (%)	Interrupted n (%)	Total n (%)	Sig (P)
Operative Mortality	1 (0.9)	1 (0.9)	2 (1.8)	1.0
Table-II. Operative mortality in semi continuous vs interrupted technique				

Among patients treated with the semi technique,

22 individuals (20.2%) were classified as NYHA Class I, denoting minimal limitation of physical activity, while 31 patients (28.4%) were categorized as NYHA Class II, indicating slight limitations. Conversely, in the interrupted technique group, 26 patients (23.9%) and 24 patients (22.0%) were classified under NYHA Classes I and II, respectively. In semi technique group, 2 patients (1.8%) were classified as NYHA Class III, indicating moderate limitations, while in the interrupted technique group, 4 patients (3.7%) fell into the same category. total of 6 patients (5.5%) were classified as NYHA Class III the majority of patients across both techniques fell into NYHA Classes I and II, comprising 44.0% and 50.5% of the total sample size. Table-III

Parameter	Semi n (%)	Interrupted n (%)	Total n (%)
NYHA I	22 (20.2)	26 (23.9)	48 (44.0)
NYHA II	31 (28.4)	24 (22.0)	55 (50.5)
NYHA III	2 (1.8)	4 (3.7)	6 (5.5)
Table-III. NYHA Classification			

In the semi technique group, no patients had EF less than 35%, while in the interrupted technique group, 2 patients (1.8%) had EF less than 35%. Among patients with EF between 35% and 50%, 6 (5.5%) were in the semi technique group, and 4 (3.6%) were in the interrupted technique group. The majority of patients in both groups had EF greater than 50%, with 49 patients (44.5%) in each group. Overall, EF greater than 50% was the most common category, observed in 98 patients (89.1%) out of the total. Table-IV

Parameter	Semi n (%)	Interrupted n (%)	Total n (%)
EF<35%	0.0	2 (1.8)	2 (1.8)
EF 35-50	6 (5.5)	4 (3.6)	10 (9.1)
EF>50%	49 (44.5)	49 (44.5)	98(89.1)
Table-IV. EF in semi continuous vs interrupted technique			

Ethibond 2.0 was used in all interrupted technique cases. However in Semi continuous technique, 21 (38.2%) received Prolene sutures, while 34(61.8%) received Ethibond sutures.

Table-V shows comparison of the mean X-clamp times (± standard deviation) between patients who received Prolene and Ethibond sutures during their surgical procedures. Among the 21 patients who received Prolene sutures, the mean X-clamp time was 75.1 minutes, with a standard deviation of 27.4. whereas 34 patients who received Ethibond sutures, the mean X-clamp time was 64.7 minutes, with a standard deviation of 17.7 . While there appears to be a numerical difference in mean X-clamp times between the two groups, the difference did not reach statistical significance (p = 0.09).

Parameter	N	X-clamp Mean ± SD	Sig
Prolene	21	75.1±27.4	0.09
Ethibond	34	64.7± 17.7	
Table-V. Suture Type Vs X-Clamp time			

Among the sample, the mean parameter value for the semi technique was found to be 68.75 with the standard deviation of 22.2, was lower than the mean value of 91.7 with the standard deviation of 27.3 observed for the interrupted technique. The variation between two groups underscores the potential impact of procedural methodology on outcomes, with the interrupted technique demonstrating higher mean value. Furthermore, the significant p-value of less than 0.001 suggests a robust statistical difference in outcomes between the two techniques, emphasizing the importance of methodological considerations in achieving optimal results. Table-VI

Parameter	N	Mean ± SD	P-Valve
Semi	55	68.75 ± 22.2	<0.001
Interrupted	55	91.7± 27.3	
Table-VI. Suture Technique Vs X-Clamp time			

The comparison between valve size and its corresponding outcomes underscores the impact of valve dimensions on procedural results. Among the various valve sizes evaluated, distinct differences in X-clamp time mean values were observed. For the 25mm valve size, the X-clamp time mean value was determined to be 92.2 with the standard deviation of 26.3, indicating a relatively higher as compared to other valve sizes. Conversely, valve sizes of 27mm, the X-clamp mean value was determined to be 79.9 with the standard deviation of 32.9 and, 29mm valve size the mean of X-clamp value was determined to be 75.8 with the standard deviation of 27.7, similarly

the valve size of 31mm the mean value was determined to be 79.9 with the standard deviation of 22.1, and 33mm valve size with the mean of 83.3 with the standard deviation of 27.7. The p-value of 0.4 suggests no statistically significant difference outcomes across the different valve sizes. Table-VII

Valve Size	N	Mean + SD	Sig B/W groups
25 mm	11	92.2±26.3	
27mm	18	79.9±32.9	
29 mm	44	75.8±27.7	0.4
31 mm	25	79.9 ± 22.1	
33 mm	12	83.8± 27.7	
Table-VII. Valve Size Vs X-Clamp Time			

DISCUSSION
Mitral valve disease causing severe mitral stenosis or regurgitation requires mitral valve repair or replacement. Mitral valve replacement (MVR) is performed using either semi continuous (SC) or interrupted technique. The semi-continuous suture technique is appropriate for all kinds of prosthetic valve replacements, particularly for cases involving rheumatic valve disease, as well as in situations with a small left atrium.[9] The SC technique is safe and faster, leading to shorter durations for aortic cross-clamping and cardiopulmonary bypass.[10]

Our study included 55 cases of semi continuous and 55 cases of interrupted technique for mitral valve replacement. 46 (41.8%) were males while 64 (58.2%) were females. Mean age was 39.8±11.5 years. Overall mortality was 2 (1.8%) i-e 1 (0.8%) in each group. Most of the patients presented with shortness of breath NYHA II. Ejection fraction was more than 50% in 98% cases in both groups. The mean cross clamp time was 68.75 ± 22.2 minutes in semi continuous technique while in interrupted technique it was 91.7± 27.3 minutes and the results are statistically significant (P<0.001). This indicates that semi continuous technique reduces cross clamp time by quite a margin without affecting mortality. Cross clamp also depend on valve size. As the valve size increases, so does cross clamp time.

Ali et al.[11], conducted similar study in which they included 100 patients. Mean age was 39+3.32 years which is nearly similar to our study. 65% were males while 35 % were females. They also showed mean cross clamp time was less in semi continuous group as compared to interrupted group.(38.97 ±9.89 vs 53.14± 8.54 minutes respectively). However their study was prospective contrary to our retrospective study. Their low mean cross clamp times compared to our study can be explained by institute and surgeons variability.

Azam et al.[12] also reported lower cross clamp time for semi continuous group as compared to interrupted group. (49.18±13.21 minutes vs 80.34±14.89 minutes respectively). However this study is also prospective. Both of these studies also did not include all rheumatic mitral disease.

Mosallom et al.[13] included 31 rheumatic mitral cases for MVR. Their mean cross clamp time for semi continuous group was 39.77± 10.61 vs 52.74± 8.43 for interrupted group. These studies indicate that semi continuous technique reduces cross clamp time, thus reducing ischemic heart time.

The findings of this study are based on a single-centre study, sample size is small and study was retrospective. Multicentre and large sample size Clinical trials are recommended to generalise the finding.

CONCLUSION
This study showed that the semi-continuous sutures gave a similar outcome to the interrupted sutures, with significantly better operative time regarding cross-clamp time without increasing mortality.

CONFLICT OF INTEREST
The authors declare no conflict of interest.

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AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Yasir Bilal:** Writing of the manuscript.
2	**Ubaid ur Rahman:** Writing of the manuscript, data collection.
3	**Aamir Iqbal:** Data collection.
4	**Rizwanullah:** Data analysis.
5	**Sultan Zaib:** Data collection.
6	**Abdul Nasir:** Idea, data collection, writing of the manuscript.