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Semi-Continuous versus Interrupted Suture Techniques for Mitral Valve Replacement: A Prospective Postoperative Analysis

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ABSTRACT

Aim and Objectives: Mitral valve disease is associated with severe mitral valve stenosis, and mitral valve regurgitation warrants a mitral valve repair or surgical replacement. Cardiothoracic surgeons use semi-continuous sutures or interrupted suture techniques in Mitral valve replacement. The study's primary aim was to compare the efficacy of the semi-continuous and interrupted suture techniques of prosthetic valve replacement in mitral valve replacement surgeries during the early postoperative period.

Materials and Methods: a prospective randomised comparative study was conducted at the CTVS Department , GB Pant Hospital, New Delhi,India. The 100 patients with mitral valve disease (with any pathology) were included in the study from Jan 2020 to Dec 2021. They were divided randomly into two groups, group1 included patients who underwent semi-continuous technique for MVR (45 cases), and group2 included the patients who underwent interrupted technique (55cases). Data related to complete history, general examination including vital signs, investigations including complete blood count, chest X-ray (CXR), 12 lead Electrocardiography (ECG), echocardiography and coronary angiography were recorded preoperatively, and if the patient was more than 40 years old, operative data including total bypass time, aortic CCT of both groups were recorded and postoperative outcome including ICU stay and inotrope use, postoperative complications, pulmonary hypertension and echo findings as immediate postoperative and echo after 1 and 3 months postoperative was also recorded. Data were analysed with the help of SPSS 20 software

Results: Both the groups were comparable in terms of age, gender and preoperative echocardiographic characteristics ($p>0.05$ each). Total bypass and cross-clamp times were significantly higher in patients who underwent interrupted technique.

Conclusions: Semi-continuous technique was found to be a safe and reliable method of mitral valve replacement. It was found that the mean total bypass time and cross-clamp times were significantly higher among the interrupted group compared to the semi-continuous suturing group.

Keywords: mitral valve replacement, Semicontinuous, interrupted, Suture, Mitral valve prosthesis, Mitral valve surgery.

Introduction

Mitral valve replacement (MVR) is the most commonly performed cardiac surgery for mitral valve heart disease. Patients (20%) with acute rheumatic fever develop varying degrees of acute and chronic rheumatic

heart diseases¹, and in 65-70% of cases, the mitral valve is most commonly affected². Heart valve replacement is a well-established and safe procedure with low mortality risk and results in considerable benefits to patients with chronic valvular disease.³ New advanced surgical techniques in cardiac surgery aim for better postoperative results and faster patient recovery. Mitral valve replacement (MVR) is performed using either the semi-continuous (SC) technique or the interrupted suture technique. The interrupted suture technique is the classical surgical technique for mitral valve replacement. This technique has provided excellent prosthesis anchorage, reduced the incidence of paravalvular leak (PVL) and rarely resulted in prosthesis dehiscence. However, it is a lengthy procedure and takes a long time to implant the prosthesis hence longer aortic cross-clamp (ACC) time and cardiopulmonary bypass (CPB) time, resulting in deleterious systemic side effects⁴.

On the other hand, the semi-continuous (SC) technique is quicker, with shorter aortic cross-clamp and cardiopulmonary bypass times⁵, with a very low incidence of para prosthetic leakage (PPL), only about 15% after MVR in the immediate postoperative period.⁶⁻⁹ The degree of annular calcification, infection, type of suture technique, and size and type of prosthesis contribute to PPL.^{8,10} Studies have reported a high rate of PPL in the SC method following the surgery¹¹ as compared to the interrupted suture technique.

The present study was conducted to compare the efficacy of the semi-continuous and interrupted suture techniques of prosthetic valve replacement in mitral valve replacement surgeries during the early postoperative period.

Patients and Methods

The present study is a prospective randomised comparative study conducted at CTVS Department, GB Pant Hospital, New Delhi. The 100 patients with mitral valve disease (with any pathology) were included in the study from Jan 2020 to Dec 2020. They were divided randomly into two groups; group 1 included patients who underwent semi-continuous technique for MVR (45 cases), and group 2 included the patients who underwent interrupted technique (55 cases). All operations were performed through median sternotomy, cardiopulmonary bypass and moderate hypothermia. The patients were followed for 1 and 3 months after surgery. The presence of a new holosystolic regurgitant murmur after MVR was considered an indication of PPL, which was further evaluated using a trans-thoracic Echocardiogram (TEE) in the early postoperative and follow-up period.

Preoperative data included

A) Complete history including

1. Personal and demographic data
2. Presence symptoms (Fatigue, exercise intolerance, dyspnea, chest pain, paroxysmal nocturnal dyspnea, heart failure)
3. Comorbidities if any

B) General examination, including vital signs and general condition of the patient.

C) Investigations include complete blood count, chest X-ray (CXR), 12 lead Electrocardiography (ECG), echocardiography and coronary angiography if the patient is more than 40 years old.

D) Operative data, including total bypass time, aortic CCT

E) Postoperative outcomes, including Immediate postoperative data as ICU stay and inotrope use. Postoperative complications, if any. Postoperative pulmonary hypertension. Postoperative echo findings as immediate postoperative and echo after 1 and 3 months postoperative.

Permission to conduct the study was taken from the head of the department. The confidentiality and anonymity of data and patients were maintained. Informed written consent was taken from the study subjects before enrolling them in the study. The Institutional Ethics Committee approved the study

The sample size was calculated using the prevalence rate of PPL in MVR patients. At a level of significance (α) of 0.05 and a maximum tolerable error of 0.1, the calculated sample size was 44 individuals. Data were analysed using SPSS 20. Shapiro-Wilk's test was used to check if the quantitative variables were skewed. The data were expressed as mean and standard deviation (SD), frequencies and percentages. Chi-square test, Fisher's exact test, independent sample t-test and Mann-Whitney U test were used to compare the variables.

Results:

In the present study, 100 patients presenting with mitral valve disease were enrolled. The study subjects were divided into two groups. The subjects of group one underwent semi-continuous suturing (45), and the second group was subjected to interrupted suturing (55). The mean age of study participants was 39+3.32 years. Of the 100 patients, 35 were female, and the rest were male. Both groups were matched and were comparable in terms of age, sex and other demographic variables, with no significant differences observed. The majority of cases (68) had sinus rhythm, and 32 cases had AF (20 from the semi-continuous group and 12 from an interrupted group). Twenty-eight cases had hypertension, out of which 12 cases had DM as comorbidity. Based on NYHA classification, 12 cases had NYHA class II, 74 had NYHA class III and 14 had class IV. Among preoperative complications, arrhythmias were the most commonly seen in 44 cases, followed by palpitation in 25 cases and stroke in 02 cases.

The groups were found to be comparable with regard to the preoperative ECHO data (table 1). All of the preoperative Echo measures, i.e., LVIDD(CM), LVIDS (CM), LA, AO ROOT, EF, IVSD, LVPWD, and MVR, were matched between the two groups, and no significant differences were observed between the study groups.

The mean total bypass time was higher duration among the interrupted group (106 minutes) compared to the semi-continuous one (90 minutes), and the difference was statistically significant with P-value: 0.00001. Also, aortic CCT was higher among the interrupted group than the semi-continuous one, with a significant difference (P value:0.001). However, the postoperative intubation time is significantly higher in the semi-continuous group (P value:0.001). In the case of inotrope use during ICU stay, the difference was non-significant among both the groups (p=0.5047). The immediate postoperative Echo measures were similar between the two groups in immediate postoperative Echo findings, with non-significant differences. In the immediate postoperative Echo valve findings, all cases also showed normally functioning valves with a non-significant difference between the groups. In 1 month, postoperative follow of Echo findings, all of the Echo findings were similar between both the groups, with non-significant differences between them.

Regarding postoperative Echo valve findings after one month, valves were normally functioning among all the cases, with a non-significant difference between the groups. In 3-month postoperative Echo findings, LVPWT and findings showed non-significant differences between the two groups. In Three month, postoperative Echo valve findings, all cases had normally functioning valves, with a non-significant difference between the two groups. After three months of surgery, the surgery associated with Tricuspid Regurgitation is seen in the majority of cases had either TR (seen in around 64 cases); which was either mild (38 cases) or moderate(21cases) in most of the cases, and severe only in 5 cases, with the non-significant difference between the two groups (Table 3).

Table 1. preoperative ECHO data of study subjects

	Group	Mean	SD	T test	P value
LVIDD(CM)	Semi-continuous	5.13	0.707	0.281	0.7789
	Interrupted	5.08	1.005		(NS)
LVIDS(CM)	Semi-continuous	3.33	0.535	0.516	0.6069
	Interrupted	3.40	0.770		(NS)
LA	Semi-continuous	5.35	0.839	0.271	0.7866
	Interrupted	5.31	0.634		(NS)
AO ROOT	Semi-continuous	3.2	0.419	0.131	0.8964
	Interrupted	3.1	0.347		(NS)
EF	Semi-continuous	58.75%	8.06%	0.324	0.7468
	Interrupted	58.25%	7.36%		(NS)
IVSD	Semi-continuous	0.960	0.181	1.716	0.0894
	Interrupted	0.909	0.114		(NS)
MVP	Semi-continuous	1.318	0.733	2.323	0.0223
	Interrupted	1.073	0.249		(NS)

Table 2: Intraoperative and postoperative data of study subjects.

	Group	Mean	SD	T test	P value
Total Bypass Time	Semi-continuous	91.50	15.58	5.291	< .00001.
	Interrupted	106.82	13.37		
Cross clamp time	Semi-continuous	38.97	9.89	7.687	< .00001.
	Interrupted	53.14	8.54		
Inotropic required	Semi-continuous	7.9	8.2	0.670	0.5047
	Interrupted	9.2	10.7		
Postoperative intubation time (hours)	Semi-continuous	12.1	1.1	4.686	< 0.0001
	Interrupted	10.9	1.4		
Hospital stay (days)	Semi-continuous	10.5	1.8	0.882	0.3801
	Interrupted	10.2	1.6		

Table 3: Prosthetic valve replacement surgery associated with Tricuspid Regurgitation.

		Group		Total	
		Semi-continuous	Interrupted		
	Associated TR	Non	10	10	38
		Trace TR	8	10	18
		Mild TR	18	20	38
		Moderate TR	9	12	21
		Severe TR	0	05	5

Discussion

Mitral valve disease is associated with severe mitral valve stenosis, and mitral valve regurgitation warrants a mitral valve repair or surgical replacement. Mitral valve replacement (MVR) is performed using either semi-continuous (SC) technique or interrupted suture technique.¹²The continuous suture technique has numerous advantages as a simple, quick, and effective method for valve replacement. The semi-continuous suture technique is a modification of the continuous technique aiming to avoid its technical disadvantages. This method combines the advantages of continuous and interrupted suture techniques.

The study's primary aim was to compare the efficacy of the semi-continuous and interrupted suture techniques of prosthetic valve replacement in mitral valve replacement surgeries during the early postoperative period. A prospective randomised comparative study was conducted at the Cardiothoracic Surgery Department in a tertiary care hospital in North India. The 100 patients with mitral valve disease. They were divided randomly into two groups, group1 included patients who underwent semi-continuous technique for MVR (45 cases), and group2 included the patients who underwent interrupted technique (55cases). A study was done by Azam et al. 2015 also included 100 patients with 50 patients in each group¹³

In the present study, the mean age of participants was 39+3.32 years. Of the 100 patients, 35 were female, and the rest were male. The majority of cases(68) had sinus rhythm, and 32 cases had AF (20 from the semi-continuous group and 12 from the interrupted group). Twenty-eight cases had hypertension, out of which 12 cases had DM as comorbidity. Based on NYHA classification, 12 cases had NYHA class II, 64had NYHA class III, and 24 had class IV. Among preoperative complications, arrhythmias were the most commonly seen in 44 cases, followed by palpitation in 25 cases and stroke in 12 cases. Both groups were comparable in terms of preoperative data and demographic variables. All of the preoperative Echo measures, i.e. LVIDD(CM), LVIDS (CM), LA, AO ROOT, EF, IVSD, and MVR, were matched between the two groups, and no significant differences were observed between the study groups. Azam et al. (2015) and Mosallom et al. (2019)¹⁴ also conducted respective studies with the two groups comparable and having non-significant differences between the groups regarding the preoperative echocardiographic characteristics and other demographic and clinical variables.

The mean total bypass time was higher duration among the interrupted group (106 minutes) compared to the semi-continuous one (90 minutes), and the difference was statistically significant with P-value: 0.00001. Also, aortic CCT was higher among the interrupted group compared to the semi-continuous one, with a significant difference (P value:0.001). However, the postoperative intubation time is significantly higher in the semi-continuous group (P value:0.001)

In the case of inotrope use during ICU stay, the difference was non-significant among both the groups (p=0.5047). The immediate postoperative Echo measures were similar between the two groups in immediate postoperative Echo findings, with non-significant differences. In the immediate postoperative Echo valve findings, all cases also showed normally functioning valves with a non-significant difference between the groups. In One month postoperative follow of

Echo findings, all of the Echo findings were similar between both the groups, with non-significant differences between them. Regarding postoperative Echo valve findings after one month, valves were normally functioning among all the cases, with non-significant differences between the groups. In 3-month postoperative Echo findings, EF recorded

showed non-significant differences between both the groups the two groups. In Three month postoperative Echo valve findings, all cases had normally functioning valves, with a non-significant difference between the two groups. After three months of surgery, the surgery associated with Tricuspid Regurgitation is seen in the majority of cases had either TR (seen in around 64 cases); which was either mild(38 cases) or moderate(21cases)in most of the cases, and severe only in 5 cases, with the non-significant difference between the two groups (Table 3).

Azam et al.(2015)and Mosallom et al. (2019) also reported similar results about intraoperative and postoperative data of two groups. The findings of the study are based on a single-centre study, and the sample size is small. 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 total bypass time, cross-clamp time and Postoperative intubation time (hours).

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