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Incidence of Permanent Pacemaker Implantation after SAVR: A Comparison between Semi-Continuous and Interrupted Suturing Techniques at Peshawar Institute of Cardiology

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ABSTRACT

Objectives: To compare the incidence of permanent pacemaker implantation between semi-continuous and interrupted suturing techniques after SAVR. **Study design:** Retrospective cohort study. **Place and duration of study:** Peshawar Institute of Cardiology, from January 2022 to December 2024. **Methods:** A total of 196 patients undergoing isolated SAVR were included in this study using hospital's electronic medical record. Based on suturing technique, patients were divided into SCS Group (semi-continuous suturing group) (n=81) and IS Group (interrupted suturing group) (n=115). All the relevant demographics, clinical characteristics, and postoperative outcomes were recorded. The primary outcome was set as the incidence of permanent pacemaker implantation in the two groups within 30 days following the procedure. The primary outcomes were compared by applying the Fisher's Exact Test, considering a p-value <0.05 as statistically significant. **Results:** Mean age of patients was 54.4 ± 6.9 years with 76% males in overall study population. Permanent pacemaker implantation occurred in 3 patients (2.6%) in the interrupted group, while no case was reported (0%) in the semi-continuous group and the difference did not reach statistical significance (Fisher's Exact Test, p=0.28). Indications for implantation of three permanent pacemaker in the interrupted group were complete heart block (66.6%) and high-grade atrioventricular block (33.33%). **Conclusion:** Both suturing techniques were associated with a low/no incidence of permanent pacemaker implantation after SAVR, with no significant difference observed between two techniques. Selection of suturing technique may therefore be guided by surgeon/ institution own preference and operative considerations.

INTRODUCTION

Surgical aortic valve replacement (SAVR) is among the commonly performed procedure in cardiac surgery units. SAVR is in fact considered the gold standard in patients presenting with severe symptomatic aortic valve disease like severe aortic stenosis and regurgitation (AVD), and become candidates for open-heart surgery.[1] The recently published ESC/EACTS guidelines also recommend SAVR in young low surgical risk operable patients not suitable for transcatheter aortic valve implantation (TAVI) or in cases where long term durability is the prioritized goal.[2] Both SAVR and TAVI provide good long term outcomes in terms of survival and improved quality of life (QoL); however, post-operative (post-op) complication still impact the overall outcomes in a notable proportion of patients. Among these, the development of high-grade atrioventricular (AV) block which necessitates the implantation of permanent pacemaker (PPM) is a serious and well-recognized adverse event. The complication is reported in 3-5% cases following SAVR, while for TAVI the reported cases are a bit high ranging from 10 to 15%.[3,4]

This implantation of PPM not only increases morbidity and healthcare costs but the burden of device dependency also has psychological impact these patients.[5] Moreover, patients requiring PPM are at the risk of potential long-term complications related to permanent pacing, including lead-related complications and the risks of infections. In addition, presence of PPM influence the future treatment decisions, particularly regarding anticoagulation strategies and the feasibility of any future need of cardiac interventions.[6]

The close proximity of the aortic valve, particularly beneath the right and non-coronary cusps and the cardiac conduction system forms a vulnerable anatomical relationship. Surgical maneuvers during SAVR such as suture placement, decalcification, and valve excision may

directly cause risks of hemorrhage, or edema to this area. This vulnerable anatomical relationship inherently predisposes the patients to conduction disturbances.[7]

Risk factors associated with post-SAVR conduction disturbances include pre-existing conduction abnormalities, advanced age, small aortic root dimensions, and severe annular calcification. Moreover, procedural factors such as prolonged cardiopulmonary bypass (CPB) time, prosthesis–patient mismatch, prosthesis type, surgical technique, and the extent of annular debridement also contribute to this abnormality. Among these, surgical technique, especially the suturing method used during SAVR is an important modifiable factor which can influence post-op conduction outcomes.[8]

Suturing methods vary depending on the practice and preferences of the surgeon. The interrupted suturing (IS) (Interrupted noneverting mattress suture) technique is typically used in conventional surgical aortic valve replacement and is the most often used implantation method. The technique is however linked to noticeably longer CPB times. The semi-continuous suture (SCS) technique, which offer a shorter cardiac bypass and cross clamp time, is a less common technique. Some research has linked the SCS approach to increased incidences of post-op paravalvular (PV) leak and the need for reoperation.[9,10]

Hence, each technique carries its own benefits and limitations in clinical practice and the choice between interrupted and SCS in SAVR remains debated among cardiac surgeons. The IS is a precise valve positioning method that may reduce PV leak through individual suture adjustment. In contrast to that, SCS is a quicker technique that causes less tissue trauma, and may lower conduction disturbance rates with minimal manipulation near the conduction system.

This study was therefore planned to compare the incidence of PPM implantation following SAVR using SCS versus IS techniques at Peshawar Institute of Cardiology. These findings will help our cardiac surgeons to choose the optimal suturing technique and reduce post-operative complications thereby minimizing pacemaker dependency and improving patient outcomes.

METHODOLOGY

This retrospective cohort study was conducted at the Peshawar Institute of Cardiology, Peshawar. The hospital record of patients (n=196) who were underwent isolated SAVR between January 2022 and December 2024 was added in this study.

Patients with inadequate data, those who received additional cardiac surgery procedures, or those who were operated for infective endocarditis were excluded from the study.

Patients were divided into two groups based on the suturing technique employed during SAVR. And patients who underwent semi-continuous suturing (n= 81) were included in Group SCS while patients with interrupted suturing (n=115) were included in Group IS.

Digital electronic records of the hospital were used to collect all the required data. All the demographic details, preoperative characteristics, operative details, and post-op outcomes including implantation of PPM were recorded from this available data. Categorization of patients was done on the basis of preoperative ejection fraction (EF) as reduced EF (<35%), mildly reduced EF (35–50%), or preserved EF (>50%).

Endotracheal general anesthesia and cardiopulmonary bypass (CPB) were implemented in a conventional fashion. In the right atrium, a two-stage venous cannula was inserted. The degree of hypothermia was moderate, ranging from 28°C to 30°C. Initially, cold blood cardioplegia was injected either straight into the aortic root or into the coronary ostia. The calcified material in the aortic annulus was carefully cleared, and the damaged aortic valve was gently excised. Extra precautions were taken to keep debris out of the left ventricular chamber and/or coronary ostia. Following the selection of a suitable prosthetic valve, it was positioned using semi-continuous or interrupted prolene or ethibond sutures. Closure of the aortotomy after completing the procedure was performed using a double layer of 4-0 or 5-0 polypropylene sutures.

Post-op follow up was arranged at regular interval at two weeks, six months, and annually thereafter in out-patient clinic and to INR clinic for INR management. Echocardiographic examinations were performed preoperatively, after the procedure before discharge and then at each follow up visit. In patients who had undergone bioprosthetic valve replacement, anticoagulant medication was administered for at least three months before being discontinued. Similarly, anticoagulation therapy was continued in patients with mechanical valves or atrial fibrillation. The primary outcome was set as the incidence of PPM implantation within 30 days following SAVR.

The data were entered and analyzed using SPSS version 25. Continuous variables were presented as mean ± standard deviation (SD) and categorical variables were expressed as frequency and percentages. To compare the outcome variables between the two groups, chi-square test or the Fisher's Exact Test (whichever appropriate) was applied. A p-value <0.05 was considered statistically significant.

RESULTS

Mean age of patients in this study was 54.37± 6.85 years ranging from 43 to 69 years. The male gender was 149 (76%) while female gender was 47 (24%) out of total study population. The group wise details of demographics and clinical characteristics are shown in Table-I.

Table I

Demographics and baseline clinical characteristics (n = 196)

Demographics and clinical variables at baseline		Group SCS (n=81)	Group IS (n=115)
Age (Mean± SD) years		55.09±7.09	53.86±6.64
Gender	Male n (%)	60 (74.07)	89 (77.39)
	Female n (%)	21 (25.93)	26 (22.61)
Obesity (BMI≥30 Kg/m²)		21 (25.93)	24 (20.87)
Diabetes mellitus n (%)		17 (20.99)	22 (19.13)
Hypertension n (%)		21 (25.93)	37 (32.17)
History of myocardial infarction n (%)		16 (19.75)	20 (17.39)
Aortic valve disease	Aortic stenosis n (%)	48 (59.26)	59 (51.3)
	Aortic regurgitation n (%)	30 (37.04)	46 (40)
	Mixed n (%)	3 (3.7)	10 (8.7))

NYHA class	I n (%) II n (%)	54 (66.67) 27 (33.33)	73 (63.48) 42 (36.52)
Ejection fraction	< 35% 35% to 50% >50%	5 (6.17) 12 (14.81) 64 (79.01)	6 (5.22) 20 (17.39) 89 (77.39)
Underlying cause of Aortic valve disease	Rheumatic n (%) Non-Rheumatic n (%)	55 (67.9) 26 (32.1)	73 (63.48) 42 (36.52)
Suture-type used	Prolene n (%) Ethibond n (%)	32 (39.51) 49 (60.49)	55 (47.83) 60 (52.17)

The results of primary outcomes of the study show that PPM implantation occurred in 3 patients (2.6%) in the Group IS, whereas no cases (0%) were observed in the Group SCS. This difference did not reach statistical significance as calculated by Fisher's exact test (p = 0.28).

Table II

Incidence of PPM implantation (Primary outcome) (n= 196)

Incidence of PPM implantation	Group SCS (n=81)	Group IS (n=115)	95% CI	p-value*
Yes n (%)	0 (0)	3 (2.6)	SCS: 0-4.5% IS: 0.5-7.4%	0.28
No n (%)	81 (100)	112 (97.39)		

*Fisher's Exact Test

The indications for PPM implantation recorded in these patients were complete heart block and high-grade AV block as shown in Table-III.

Table III

Indications for PPM implantation (n= 3)

Indications of PPM implantation	Group SCS (n=0)	Group IS (n=3)
Complete heart block n (%)	0 (0)	2 (66.66)
High-grade AV block n (%)	0 (0)	1 (33.33)

DISCUSSION

The results of our study showed that PPM implantation occurred in 3 patients (2.6%) in the IS group, while no case was reported (0%) in the SCS group and the difference did not reach statistical significance (Fisher's Exact Test, p=0.28). Indications for implantation of three permanent pacemakers in the IS group were complete heart block (66.6%) and high-grade atrioventricular block (33.33%).

The findings of our study are consistent with the existing literature which reports no association of PPM implantation and suturing technique following SAVR, and support the safety profile of both the suturing techniques used in this research. Most of the studies suggest that suturing technique may not be the primary determinant of post-op conduction disturbances leading to PPM implantation, though the overall literature shares mixed conclusions over this topic. The findings of our study are consistent with the recent literature which reports no association of PPM implantation and suturing technique following SAVR. The suture lines have anatomical proximity to the conduction system, and may theoretically influence the risk of iatrogenic conduction disturbances related to suturing technique.

Sen O et al. compared the IS versus CS suturing techniques for structural cardiac interventions and need for implantation of PPM. IS were used in 74 patients while CS in 212 patients. The results showed requirement of PPM due to complete AV block in 6.8% cases in group IS versus 5.2% in group SCS, showing no significant difference between these suturing techniques. This reinforces the concept that technique choice may not be the primary determinant of conduction system complications.[11]

Bilal Y et al. compared SCS versus IS techniques for outcomes in cardiac valve replacement procedures. Among 110 patients, both techniques were similar regarding overall outcomes; however, SCS technique achieved significantly shorter cross-clamp times compared to IS offering a superiority to the surgeons while deciding the suturing method.[12]

This finding is further supported by mitral valve replacement studies, where Ali M et al. compared SCS versus IS techniques in surgical replacement of mitral valve among 100 patients. The efficacy of these techniques was evaluated during early postoperative period and the results showed that SCS had significantly shorter bypass time compared to IS technique. Hence despite no difference regarding the incidence of PPM, SCS proved safer and more reliable method for mitral valve replacement.[13] Ahmed HO and Meselhy MMA compared IS versus SCS in replacement of aortic valve in relation to PPM requirements. The study favored the SCS method with significantly better results than IS regarding the pacemaker usage.[14]

However, conflicting evidence exists in the literature. Soliman RF et al. compared IS vs continuous suture regarding the PPM implantation rates. IS required 3.9% implants due to heart block while this rate was 6.5% in the continuous suture group, showing no significant difference regarding this incidence associated with the suturing methods (p=0.702).[15]

Datta G investigated suturing techniques in cardiac surgeries and their relation to pacemaker-related outcomes. SCS was used in 2200 patients, while IS in 1096 patients. This study focused on post-implantation infection rates rather than implantation necessity; however, it supported the concept that suturing technique choice may not significantly impact the complications related to PPM implants.[16]

Ayık MF et al. compared continuous versus combined suturing techniques for ventricular septal defects closure regarding implantation of PPM. Implantation rates of PPM showed no significant difference between the two suturing techniques (p=1.0), and thereby demonstrated comparable safety profiles for both suturing methods.[17]

The absence of PPM in the SCS group in our study may indicate a trend favouring the technique in SAVR procedures. Moreover, SCS may be beneficial in terms of lowering operative time and minimizing foreign material in the annulus. Taken together, these studies suggest that while individual reports may show trends favoring one technique over another, the overall evidence indicates that suturing method is not a major determinant of PPM requirement.

This was a single center study with a retrospective design with a moderate number of cases included in the data. These factors restrict generalizability of these results over large scale population. Future work on the topic with larger number of patients and prospective approach may further validate these results.

CONCLUSION

Both SCS and IS techniques during SAVR are safe with a low risk of PPM implantation. Selection of suturing technique may therefore be guided by surgeon/ institution own preference and operative considerations.

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