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Outcome of Semicontinuous, Non Pledgetted Mono Filament Suture Technique for Aortic Valve Replacement

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Abstract

Context: The semi continuous monofilament suturing technique has been proposed as a viable alternative to interrupted pledgetted technique for aortic valve replacement. It is a quick, simple technique and may reduce prosthetic material exposure. *Aims:* To compare outcome of semi continuous versus interrupted pledgetted suturing techniques for aortic valve replacement. *Settings and Design:* Prospective study to compare suturing techniques for aortic valve replacement in our institution. *Methods and Material:* 330 patients who underwent isolated aortic valve replacement were included of which 220 patients underwent interrupted (group I) and 110 (group II) semicontinuous technique. Patient characteristics, operative and early post operative data were compared. *Statistical analysis used:* Baseline characteristics were compared using Z test. Student's t test was used to compare operative data and complication rates. A p value of <0.005 was considered significant. *Results:* Analysis showed that the CPB and cross clamp time was significantly shorter and valve size used was atleast one size larger in the semicontinuous group. Valve thrombosis was seen in 3 patients in group I and no patient in group II. They were managed conservatively. Paravalvular leak was seen in 2 patients in group II. Both the patients had native annulus >25mm and regurgitation type with minimal fibrosis of the annulus. Both patients were subsequently re-operated.*Conclusions:* Semicontinuous suturing technique for aortic valve replacement is viable with lesser CPB and cross clamp time with larger size valve implantation. It is associated with lesser valve thrombosis. Careful selection of patients can avoid complication of paravalvular leaks.

Keywords: Aortic Valve Replacement; Continuous Suturing; Paravalvar Leak.

Introduction

The continuous suture technique has been proposed as a viable alternative for aortic valve replacement (AVR) [1]. Being simple, quick it could result in faster surgery. Due to elimination of pledgets, braided sutures it also results in less exposure to thrombogenic material. However, the reported higher incidence of paravalular leaks after continuous suture technique has prevented it from being the first choice with many surgeons preferring the pledgetted interrupted suturing technique. The semicontinuous technique was then proposed as a modification to avoid trauma to the tissues due to excessive tension to reduce this complication[2]. Additionally due to place-ment of the valve onto the native annulus without pledgets, rather than wedged into it as during interrupted suturing technique, it could also result in ability to implant a larger size valve.

In our country, where valve disease is common and with patients usually presenting late in a decompensated state, decreasing the ischemia time, duration of cardiopulmonary bypass (CPB) time, ability

to put a larger size valve can result in better outcome.

In this study we compared the semi-continuous suture technique using mono filament polypropylene in patients undergoing isolated aortic valve replacement with the conventional interrupted suture technique.

Subjects and Methods

This prospective study was conducted between January 2014 and February 2017, at Sri Jayadeva Institute of Cardiovascular sciences and Research, Bangalore. All patients who underwent isolated AVR were included in this study. Patients who underwent reoperations, concomitant coronary artery surgery were excluded. Ethical clearance was taken and informed consent was taken from each patient. A total of 330 patients were eligible. They were divided randomly into two groups according to the suture technique used for AVR. Group I of the conventional interrupted suture type, wherein the interrupted horizontal mattress suture technique with buttressing pledgets on aortic side using 2/0 Dacron sutures was used to place the valve prosthesis in the aortic position; and group II in which the semi-continuous suture technique with monofilament polypropylene was used. Preoperatively, trans thoracic echocardiography was performed to evaluate the cardiac lesion, heart structure and function in detail. Other investigations as deemed necessary for each patient were done.

Fig. 1: Operative photograph showing first suture being applied.

Group I consisted of 220 patients of which 144 were male and 76 were females with a mean age of 39 years. Most of the patients (205) presented with NYHA class III/IV symptoms. Group II (110 patients), there were 67 males and 43 females, with a mean age 40.2 years. Most patients (100) had NYHA class III/IV symptoms.

The etiology of valve lesions in the majority of patients in both groups was rheumatic, with 88 patients degenerative (48 in group I and 30 in group II) and 16 congenital bicuspid aortic valves (10 in group I and 6 in group II).

Operative technique

Endotracheal general anaesthesia, median sternotomy, 2 stage aortic cannulation, and cardiopulmonary bypass with antegrade cardioplegia were instituted in the standard manner in all cases.

All cardiac valve prosthesis in our group II were inserted with nearly similar technique as described by Watanabe Go et al [2]. We use an over-and-over semi-continuous suture with the valve prosthesis held above the native annulus. After excision of the native annulus and thorough decalcification, three double-armed initial sutures of 3-0 Polypropylene on a 17 mm taper-cut needle were used for the aortic valve. This was different from the original technique described so as to have a smaller needle hole and allow for easier manipulation while taking suture bites. The prosthetic valve was held firmly 5 cm above the native valve annulus. The prosthesis is secured with a "hoist" lowering technique. For the first suture, the stitch was passed through the commissure between the right and left coronary cusps, and then was passed through prosthetic ring and the next stitch was inserted into the aortic annulus and again passed through the prosthetic ring. The suture was continued until one stitch before the next adjoining commissure. The first suture was thus completed. Similarly another suture was taken and passed through the adjoining annulus till the remaining commissure was reached whereupon the third suture was used to reach the beginning suture. During suturing it is important not to allow the sutures to slack but to maintain tension. A gathering stitch was used like a sling to prevent tangling of the suture loops to prevent wastage of time and also acted as a

hoist lowering technique. Four to five suture bites were made between the two commisures. At each stitch care was taken to anchor sufficient tissues including the ring. Part of adjoining aortic wall was included if sufficient tissue was not available.

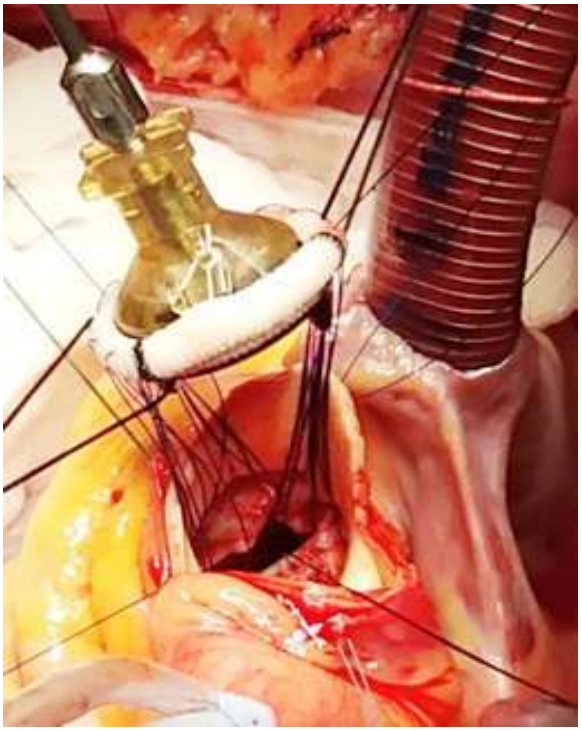

Fig. II: Operative photograph showing final suture line being started.

Next the prosthetic ring was lowered into its position by manipulating the parachute suture. The prosthesis is lowered onto the valve annulus by progressive gentle traction exerted sequentially on each end of the sutures. Counter traction is applied for uniform suture tension until the prosthesis is seated. The valve holder is then removed. A nerve hook is then used to sequentially tighten each suture loop to maintain adequate traction on the suture. A thorough inspection of the sewing cuff is made, checking for any free loops that could be removed by gentle traction on the related suture. The valve leaflets are gently opened to look for any loops on the ventricular side also. Now each suture can be tied with multiple throws leaving finally only three suture knots. Patients are then de-aired, weaned off CPB and intraoperative trans oesophageal echocardiogram was used to confirm acceptable outcome.

Postoperative follow-up

Echocardiographic studies were performed preoperatively, intraoperatively, immediately after the operation, at the postoperative third month, sixth month, and then half yearly thereafter. An angiotensin receptor blocker with or without a calcium-channel blocker was used to maintain the systolic blood pressure at less than 130 mm Hg to help in re-modelling the left ventricle. Anticoagulant therapy was given for at least 3 months and then discontinued in the patients who had undergone bioprosthetic valve replacement. For patients with a mechanical valve or atrial fibrillation, anticoagulation was continued lifelong.

Results

In our study, both groups were comparable with regards to age, sex, valve pathology, preoperative NYHA class, and cardiac function, as shown in table I. Most of the patients had mixed pathology and were in NYHA class III/IV prior to surgery.

The two groups were then compared based upon their intraoperative findings, early and midterm outcomes, depicted in Table 2. Statistical analysis was done using Student's t test and p value of <0.005 was considered significant. It showed that the aortic cross clamp time, cardiopulmonary bypass time (CBP), and operation time, were significantly decreased in group II (semicontinuous group), than in group I (conventional interrupted group). And

Table I: Preoperative data in both the groups (P value by Z test).

Patient's Data		Group 1	Group 2	Z Calculated	P Value	Inference
Parameter		**Interrupted**	**Semi-Continuous**			
Sample Size		220	110			
Age	Mean Age	39	40.2	1.0191	0.3089	Not Significant
Gender	Male	144	67	0.5715	0.5681	Not Significant
	Female	76	43			
NYHA Class	II	22	12	0.3114	0.7557	Not Significant
	III/IV	198	98			
Aortic Lesion	Stenosis	60	32	0.6228	0.5338	Not Significant
	Regurgitation	72	30	1.8684	0.0626	Not Significant
	Combined	88	48	1.2456	0.2138	Not Significant
LV Ejection		59	54	1.7127	0.0877	**Not Significant**

Table II: Operative, complication results of both groups (P value by Student's t test).

Parameters	Group I	Group II		P value	Inference
Cross clamp time	42.1	30.6	3.2545	0.0013	Significant
CPB time	58	48.6	3.6628	0.0003	Significant
Postoperative intubation (hrs)	7.5	6.5	0.9584	0.3386	Not Significant
Hospital stay (d)	9.4	9.3	1.1022	0.2712	Not Significant
Size of implanted valve	20.8	22	3.6122	0.0004	Significant
Perioperative death	1	0			–
Myocardial infarction	0	0			–
Pneumonia	2	2	0.0000	1.0000	Not Significant
Ventricular fibrillation	3	1	0.5400	0.5896	Not Significant
Stroke	0	0			
Re exploration	2	1	0.2540	0.7997	Not Significant
ParaValular Leak	0	2	5.5	0.0001	Significant
Infective endocarditis	0	0			
Valve thrombosis	3	0	6.63	0.0001	Significant

the implanted valve size was significantly larger in group II.

The ventilation time and total duration of hospital stay, although they are decreased in group II than in group I, the decrease is not significant. Re exploration was done in 2 patients of group I and one patient in group II for post operative bleeding. One patient in group I succumbed to this complication. There was no significant difference in the other early compli-cation rates.

All the patients were followed up as per established protocol. 2 patients in group II developed paravalvular leakage, while one presented early within 3 weeks of the procedure, the other was diagnosed at six monthly follow up. Both underwent subsequent re operation and had an uneventful recovery. There is no late postoperative leakage (during the follow up period) in both groups. During the follow up period there were no cases with early infective endocarditis. 3 patient in group I presented with valve thrombosis with rapidly increasing gradients and deterioration in NYHA class. They were diagnosed to have thrombotic valve obstruction using trans esophageal echocardiography and fluroscopy (malfunctioning and stuck valves). All patients were managed conservatively with thrombolytic therapy and recovered.

Discussion

Continuous suture technique has been advocated for valve replacement since many decades[1] with the main advantage of having shorter CPB and cross clamp time which would result in minimizing ischemia time and hence a better outcome. Additionally the avoidance of thrombogenic materials like pledgets and braided sutures could also result in lesser incidence of post operative valve thrombosis. The ability to implant a larger valve would also result in better post operative hemodynamics. There is also less distortion of the native annulus while suturing.

In spite of these advantages, interrupted technique continues to be the preferred type by most cardiac surgeons. It is commonly believed that tangling of sutures, excessive traction on the suture will result in traumatic injuries to the annular tissue resulting in higher incidence of post-operative paravalvular leaks.

The semi-continuous suture technique has been proposed as a modification of the continuous technique to make it technically easier by avoiding tangling of the suture loops while seating the valve and allow for better distribution of tension amongst the sutures [2]. It should thereby allow us to preserve the advantages of using mono filament, non pledgetted technique while avoiding its limitations.

In our study we found that semicontinuous suture technique for AVR resulted in a significant advantage due to shorter CPB time, cross clamp time, thereby reducing the myocardial ischemia time. Similar findings were noted by Watanabe et al. [2] found that AVR using modified continuous suture technique markedly reduced operation time, CPB time, and aorta cross clamp time, while avoiding any increase in serious postoperative complication or long term disadvantages.

Ruchat et al. [3] who used this technique for other valve replacements found that the procedure is shortened by less instrumental handling and fewer knots to tie, therefore reducing the cross clamping time. Dalichau H et al. [4] said that due to reduction in the cardiac ischemia time by half with this technique thereby reducing myocardial injury, which may be important to patients with marginal cardiac reserve. Tadashi Kitamura et al. [5] in their

retrospective study also obtained similar results for isolated AVR as in our study.

In our study, we were able to seat an at least one size larger valve by the semicontinuous technique when compared to the conventional interrupted technique (p = 0.001). Studies by Watanabe G. et al. [2], Ricchi A and Ross DN [6] also found similar results. This could be because of seating the valve onto the annulus rather than being wedged into it as is done by interrupted everting mattress sutures. Additionally elimination of the pledget itself may also help in seating a larger valve.

The increased incidence of paravalvular leak with the continuous suture technique for AVR has been cited as the main hindrance preventing its wider application. Nair et al. [7] in a study with a 10-year follow-up after AVR, the incidence of moderate to severe paravalvular leak was 12% in the continuous suture group, while the incidence was 0% in the IS group. However, other studies by Laks et al. [8], Dhasmana et al. [9] and Tadashi Kitamura et al. [5] reported similar incidence of paravalvular leak in both the groups. Hjelms et al. [10] reported that the incidence of paravalvular leak was 8.8% in 80 patients undergoing AVR with the continuous suture technique. Patients with pure aortic insufficiency had the highest incidence of 26%. They suggested that the CS technique was not suitable for patients with pure aortic insufficiency. In our study, we found paravalvular leak in two patients with the semicontinuous suture group (1.8%) both who subsequently underwent reoperation. Both the patients had aortic regurgitation with the size of the native annulus more than 25 mm. The paucity of fibrosis in the annulus may have resulted in less ability of the tissue to handle suture tension. Additionally the downsizing of the annulus to accommodate a 25 size valve could also result in crumpling of the native annulus and resulting defect, tissue trauma could also have contributed for the paravalvular leak in our patients. We believe that the semicontinuous suturing technique should be avoided in this subgroup.

Another major advantage of the continuous suture technique is less thrombogenic material such as pledgets and braided suture material around the prosthesis compared with the interrupted suture technique. Prosthetic valve endocarditis is one of the common postoperative complications after cardiac valve replacement[11]. Because there is no pledget in the aorta to expose the blood to foreign material, our modified continuous suture technique may help reduce the incidence of this severe complication [12]. In our study, 3 patients of group I and no patient in group II developed prosthetic valve thrombosis presenting with markedly increased gradients and deterioration of NYHA class. They were found to have inadequate anti coagulation levels and recovered after conservative management. In cases of semicontinuous suturing, decrease in thrombogenic materials like pledgets, braided sutures could have resulted in better tolerance of inadequate anti coagulation, which is not infrequent in a developing country like ours.

Conclusions

Semicontinuous suturing technique using non pledgetted mono-filament sutures is a viable technique for aortic valve replacement. It is simple, easily reproducible technique with advantages being lesser CPB time, cross clamp time and larger size valve can be implanted and can reduce the incidence of post operative valve thrombosis. Careful selection of patients can avoid complication of paravalvular leaks.

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