Original Research

Comparison of Braided Polyester Suture Versus Stainless Steel Wire for Sternal Closure:Our Experience

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ABSTRACT

Introduction: The ideal sternal closure should ensure stability, minimum postoperative complications, short hospitalization and cost-effective. Poor sternal fixation can result in early and late complications. Stainless steel wires are commonly used in sternum closure. However, braided polyester suture material also provides good sternal fixation and reduces possible complications.

Objective:Comparison of braided polyester suture material versus standard stainless-steel wire for sternal closure in patients who underwent sternotomy for any operative procedure,especially with regard to sternal stability, and postoperative complications.

Patients and Methods:This was a retrospective, comparative study of 200 patients who underwent sternotomy for cardiac and other mediastinal procedures. Patients were divided into 2 groups: Group A, 100 Patients in which sternal closure with large sizebraided polyester suture, and Group B, 100 patients in which sternal closure with stainless-steel wire. **Results**: Group A showed less complications compared to group B in terms of Post operative bleeding, Pain, Sternal instability, and Foreign Body sensation. Re-operation rate and sinus formation were also less in Group A.

Conclusion: We found that Braided Polyester Sutures can be used as a safe alternative to standard Stainless-Steel wire for Sternal Closure.

Keywords: Braided Polyester Suture, Stainless Steel Wire, Sternum Closure.

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INTRODUCTION

Despite the evolution of minimally invasive cardiac surgeries and interventional techniques, median sternotomy is still the most common approach in cardiothoracic surgery. The conventional procedure of sternum closure uses stainless steel wires. However, this approach may increase the risk of induration due to local allergic and inflammatory reactions, chest wall discomfort. mediastinal infection and occasionally death because of use of electrocautery, as there is a risk of ventricular fibrillation during redoes surgery if the wires are near the myocardium.Despite improvements in surgical techniques, anesthesia and antibiotic treatment, early and late postoperative complications related to sternal fixation still represents a significant number of complications after cardiac operations.^[1-3]

Many preoperative risk factors, including elderly patient, obesity, diabetes, smoking, chronic obstructive pulmonary disease, New York Heart Association functional class III/IV, osteoporosis, immunosuppression and previous sternotomy, all increase the risk of sternal dehiscence.^[4,5]

ConventionallyStainless-Steel wire is being used for sternal closure. Some surgeons recommended Braided Polyester Suture material for sternal fixation as an alternative to steel wire.

The purpose of this study was to compare the short and long term outcome of two materials used for closure of median sternotomy incision, using the braided polyester suture and standard stainless steel.

PATIENTS AND METHODS

This is a retrospective comparative study including 200 patients, who underwent cardiac surgeries in cardiothoracic and vascular surgery department of RNT medical college Udaipur, Rajasthan, India, over a period of 3 years from 2020 to 2023. Data included patients baseline data, surgicalprocedure, technique of sternal closure and Various parameters like intraoperative sternal fixation time, bleeding through needle puncture site, early postoperative drainage, pain, numbress, ICU stay and hospital stay. The exclusion criteria were preexisting autoimmune diseases, connective tissue disorders, uncontrolled diabetes mellitus with glycosilated hemoglobin higher than 8, redo surgery, osteoporosis, extremes of age and perioperative death. All patients were divided into 2 groups: Group A 100 Patients in which sternal closure done with large size Braided Polyester Suture, and Group B 100 patients in which sternal closure with Stainless-Steel Wire.

Ethical Consent: Ethical approval for the study was obtained from the ethical committee of RNT medical college Udaipur.

Surgical Technique: After completion of surgical procedure, attainment of good hemostasis and placement of drain tube; sternum closure was done. In group A three or four figure of 8, braided polyester sutures were placed through the manubrium and body of the sternum. Sliding knots were used to ensure tight

sternal coaptation.In group B three or four figure of 8 conventional stainless-steel wires were placed through the manubrium and body of sternum to coapt the sternum. The soft tissue and skin were closed in a routine manner in both groups. The same postoperative care was given to both groups. In the intensive care unit, criteria for extubation were hemodynamic stability, fully conscious status, arterial blood gases met the criteria for extubation, and no significant bleeding from the chest drains. Patients were shifted to postoperative ward from the intensive care unit after stopping inotropes and removal of chest drains. Patients were discharged from hospital in satisfactory condition.

Postoperative Follow Up: All patients who were discharged received follow up for 6 months at the interval of 1 month. The collected data included the duration of pain, wound healing state and occurrence of incisional complications such as superficial and deepinfection, sinus formation with pus discharge, mediastinitis, sternal instability and resuming daily routine work were compared. Sternal instability was sternal fracture with abnormal defined as nonphysiological movement of two halves of sternum.Superficial sternal wound infection (SSWI) was defined as infection involving skin, subcutaneous soft tissue and Pectoralis fascia only without osteomyelitis.Deep sternal wound infection (DSWI) was defined as clinically and laboratory proven osteomyelitis.

Table	1.Summary	of Reseline	Data for	· 200 Median	Sternotomy	Patients
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CHARACTERISTIC	GROUP A (n=100)	GROUP B (n=100)					
Demographic Data							
Age(years)	30 ±10	30 ±10					
Male:Female	59:41	56:44					
BMI(Kg/m ²)	21 ±2	21 ± 2					
Type of Surgery							
Congenital heart disease	30	29					
Valve surgery	50	50					
CABG	17	18					
Anterior mediastinal surgery	3	3					
Intra- operative Data							
Aortic occlusion time(min)	50 ± 10	50±10					
CPB time (min)	70 ±30	70 ±30					
Operative time(min)	220 ±30	220 ±30					

Table 2: Postoperative Data						
CHARACTERISTIC	GROUP A (n=100)	GROUP B (n=100)				
Post-operative Data						
Ventilator Support time (Hrs)	8 ±6	8 ± 6				
Postoperative drainage (ml)	300 ±200	400 ±200				
(In First 24 Hrs)						
Length of ICU stay(days)	3-5	3-5				
Length of hospital stay(days)	10 ±5	10 ±5				
Post-operative Complication						
Reoperation for bleeding	0	3				
Postoperative foreign body sensation	0	2				

Late Postoperative Pain	1	4
Sternal Instability	0	1
Postoperative sinus formation	0	2

RESULTS AND DISCUSSION

Median sternotomy(first described by Julian et al. in 1957)^[6] is the most commonly employed surgical incision for operations on the great vessels, anterior mediastinal tumors, and the heart, and it hasenjoyed worldwide acceptance. Although closure of a sternotomy incision is usually a simple procedure, sternal dehiscence is a serious complication which leads to a high degree of morbidity or mortality after surgery. Risk factors responsible for dehiscence may be - breakage of aseptic surgical technique resulting in wound infection, presence of a foreign body (an excess of bone wax and hemostatic agents), a thin or frail sternum etc.^[7,8] With a reported incidence of 0.2% to 5%, sternal dehiscence may result in sternal malunion, mediastinitis and poor wound healing.^{[9-} ^{11]}The stainless steel wire may break due to inappropriate tension as the fixation process requires experience for the surgeon to find a suitable tension. In group A patients, even junior surgeons were capable to tie and fixation of sternum with ideal tension using braided polyester sutures. The ideal material for sternal closure should be simple. inexpensive, stable and biocompatible. Here, we describe our experience comparing two materials of sternal closure; The braided polyester versus Standard stainless steel wire after cardiothoracic surgeries. both techniques provide equal sternal stability but both techniques are not entirely free of early and late complications. Regarding the postoperative drainage, our study showed that there was significant difference between two groups in first 24 hours, as less bleeding in groupA and this result is concordant with study by Malhotra and his colleagues^[12]as they stated that bleeding was less with polyester sutures. Concerning early and late postoperative pain, our study showed minimum complain in group A, contrary to what AI-Naser et al^[13] found no difference in their study. On the other hand, the study conducted by Malhotra and his colleagues^[12] found that using polyester sutures in closing sternum increased woundpain significantly. In our study, we didn't find significant difference between both methods of closure regarding the incidence of sternal dehiscence and superficial wound infections. We believe that the stability of sternotomy closure lies in the equidistance of steel wire insertion and use of polyester suture material. The technique of wire-twisting and polyester suture knot that secures the uniform distribution of the traction forces throughout the whole body of the sternal bone, in agreement with Casha and his colleagues.^[14]Moreover, in our study there was no significant difference between the two groups regarding the length of ICU stay, mechanical ventilation, ionotropic support and length of hospital stay. This is concordant to what both Malhotra et al.^[5]

and AI-Naser et al^[13] found in their studies.In this study, wound infection was similar between both study groups, this is in agreement with AI-Naser and his colleagues.^[13]However, Malhotra et al^[12] found significantly increased risk of infection with use of polyester for sternal closure.We found that the risk of developing a sinus discharging pus is higher in the steel wire closure group and risk of developing chronic sternal pain was less in the polyester group. That was contrary to what Malhotra et al^[12]as stated that using polyester sutures increases late complications, while Al-Naser et al^[13] reported the closure technique didn't affect the risk of pain.

CONCLUSION

Braided polyester sutures can be used as a safe alternative to standard stainless-steel wire. Moreover, this material has proven lower rate of re-exploration for bleeding, less late complications (sinus formation and pain), and less time required for closure and hemostasis. Another benefit is that braided polyester suture material is compatible with radiological imaging in future.

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