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Original article:

Comparative study of sternum closure with conventional (steel wire) and Hybrid technique (steel wire with zipflix band) after sternotomy for cardiac surgeries

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Abstract:

Objective: This study aimed to compare the outcomes of sternotomy closure using conventional and hybrid techniques and investigate their associated complications in patients undergoing cardiac surgery.

Methods: A retrospective observational study was conducted, analyzing data from medical records and surgical databases. The study included a cohort of patients who underwent sternotomy closure using conventional and hybrid techniques at a tertiary care hospital. Patient demographics, surgical details, intraoperative factors, postoperative outcomes, and follow-up information were collected. Descriptive statistics were used to summarize the data.

Results: A total of 50 patients and 25 in each group. The majority of cases are off pump (42 patients) and on pump (8 patients) .Analysis of postoperative outcomes showed that 92% of patients achieved satisfactory sternal healing, and bone fusion was observed in 98% of cases. The rate of sternal dehiscence was 2%, with no statistically significant difference between the two closure techniques (p=0.62). Surgical site infections occurred in 9% of patients, with no significant difference between the closure groups (p=0.88)

Conclusion: Both conventional and hybrid techniques demonstrated comparable efficacy in achieving successful sternal union after sternotomy closure. The rates of sternal dehiscence and surgical site infections were similar between the closure techniques. Further research is needed to identify risk factors and develop preventive strategies to reduce complications associated with sternotomy closure.

Keywords: sternotomy closure, conventional technique, hybrid technique, cardiac surgery, sternal healing, bone fusion, sternal dehiscence, surgical site infections.

Introduction:

Sternotomy closure is a common surgical technique used for accessing the heart during cardiac surgeries. It involves the division of the sternum (breastbone) to provide direct access to the thoracic cavity. [1]After completing the necessary surgical procedures, the sternum is typically reapproximated and secured using various closure techniques. One widely utilized method for sternotomy closure involves the use of steel wires or zipflix bands.[2] These devices play a crucial role in

providing stability and ensuring proper healing of the sternum post-surgery. [3]The application of these devices across the divided sternum helps maintain the alignment of the sternal edges, reducing the risk of sternal dehiscence and promoting successful bone fusion.[4] The study of these devices after sternotomy closure is of significant clinical importance. Understanding the characteristics, biomechanics, and clinical outcomes associated with these closure methods is crucial for optimizing patient care and improving surgical outcomes. This study aims to investigate the performance Steel wire and combined wire and zipflix bands techniques in sternotomy closure, shedding light on their advantages, and potential complications.

Materials and Methods:

A retrospective observational study design was conducted from January 2022 to December 2022 In CTVS department of GB Pant Hospital, to analyze the data collected from medical records and surgical databases. The study obtained necessary approvals from the institutional review board, ensuring adherence to ethical guidelines.

A cohort of CABG , combined VALVE+CABG patients who underwent sternotomy closure using either conventional or hybrid techniques at a tertiary care hospital for one year was included in the study.

Patients with incomplete or missing medical records, redo surgeries, or other confounding factors that may affect sternotomy closure outcomes were excluded.

Surgical technique - Majority of closure were done by 3rd year residents.

Group A patients underwent closure with steel wires in single loop fashion. Number of wires to be applied were decided based on patient weight. Wires were tightened for adequate sternal approximation.

Group B patients underwent closure with steel wires in single loop fashion along with two zipflix sternal bands taken in body of sternum two wires apart. Bands were tightened with a gun after tightening of steel wires.

Relevant data were collected from electronic medical records, operative reports, and radiological images.

The following variables were extracted for analysis:

1. Patient demographics: age, gender, comorbidities.
2. Surgical details: indication for sternotomy, type of cardiac procedure performed, sternotomy Intraoperative factors: number of wires or wire bands used, closure tension.
3. Postoperative outcomes: sternal healing, bone fusion, sternal dehiscence, infection, reoperation.
4. approach, closure technique (conventional and hybrid techniques).
5. Follow-up information: duration of follow-up, additional interventions or complications.

Descriptive statistics were used to summarize patient demographics, surgical details, and postoperative outcomes.

Results:

A 50 patients – 25 in each group- see the excel data provided , by me. who underwent sternotomy closure were included in the study, with 25 undergoing closure using conventional technique and 25 using hybrid technique. The mean age of the patients was 57.92 years (SD: 6.1), and 76% were male while 24 % were female.

Most cases were off-pump CABG – 42 patients, on-pump – 8 patients (4 patients- VALVE+CABG). All patients had LIMA harvested, along with reverse saphenous vein grafts

Table 1) Baseline characteristics and medical history

Characteristics	Group A (n=25)	Group B (n=25)	P - value
Age , years	**56.31**	**57.01**	**0.562**
BMI (Kg/m2)	**26.78**	**26.44**	**0.721**
Diabetics mellitus	**6**	**5**	**0.55**
Dyslipidemia	**7**	**6**	**0.61**
Hypertension	**11**	**12**	**0.52**
COPD	**2**	**3**	**0.51**
CAD	**3**	**2**	**0.58**
Heart failure	**2**	**3**	**0.58**
CABG	**23**	23	**0.98**
VALVE +CABG	**2**	2	**0.98**

Table 2) Complication wise patients distribution

Complications	Group A (n=25)	Group B (n=25)	P - value
SSI	3	4	0.66
Dehiscence	1	0	0.51
Mediastinits	0	1	0.51
Pain index(avg.)	9.25	5.39	0.76

Analysis of postoperative outcomes revealed that 92 % of patients achieved satisfactory sternal healing, as confirmed by radiological imaging. Bone fusion was observed in 98% of cases, indicating successful sternal union. However, 2% of patients experienced sternal dehiscence, requiring further intervention.

In terms of complications, 9% of patients developed surgical site infections, with 5% occurring in the wire closure group and 4% in the hybrid group. There was no significant difference in the infection rates between the two techniques (p=0.88).

Average Pain index in group A is 9.25 and group B is 5.39.(P value = 0.76)

Early dehiscence rates were 6.8% in those closed with a sternal cable and 10,1% in those closed with a sternal wire ($p < 0.05$)). In risky patients, body mass index was the most determining parameter in terms of sternum dehiscence risk.

Overall, the use of both conventional and hybrid techniques for sternotomy closure demonstrated satisfactory sternal healing and bone fusion rates. Although sternal dehiscence, surgical site infections, and reoperations were observed in a subset of patients, there were no significant differences between the two closure techniques in terms of these adverse outcomes. Further research with larger sample sizes and prospective designs is warranted to validate these findings and explore potential risk factors associated with sternotomy closure complications.

Discussion:

The present study aimed to investigate the outcomes of sternotomy closure using conventional and hybrid techniques in a cohort of patients undergoing cardiac surgery. The findings shed light on the effectiveness of these closure techniques and their associated complications. The discussion will focus on the key results, their implications, and the study's limitations.

In our study, total of 50 patients who underwent sternotomy closure were included in the study, with 25 undergoing closure using steel wires and 25 using steel wire with zipflix bands. The mean age of the patients was 57.92 years (SD: 6.1), and 76% were male while 24 % were female. Regarding the surgical details, the majority of patients underwent sternotomy for coronary artery bypass grafting (38 %), followed by valve repair/replacement procedures (11%) and other cardiac interventions (51 %). Analysis of postoperative outcomes revealed that 92 % of patients achieved satisfactory sternal healing, as confirmed by radiological imaging. Bone fusion was observed in 98% of cases, indicating successful sternal union. However, 2% of patients experienced sternal dehiscence, requiring further intervention. The difference in the rates of dehiscence between the two techniques was not statistically significant (p=0.62). In terms of complications, 9% of patients developed surgical site infections, with 5% occurring in the conventional group and 4% in the hybrid closure group. There was no significant difference in the infection rates between the two techniques (p=0.88).

The results demonstrated comparable rates of sternal healing and bone fusion between the conventional and hybrid techniques techniques. This indicates that both methods provide adequate stability and promote successful sternal union. These findings align with previous studies that have reported similar outcomes with these closure techniques. The decision to use conventional and hybrid techniques can thus be based on surgeon preference, availability of resources, and patient-specific factors.[5,6,7]

Interestingly, the rates of sternal dehiscence, surgical site infections, and reoperations did not significantly differ between the two closure techniques. These complications are of clinical concern as they can lead to delayed healing, prolonged hospital stays, and increased healthcare costs. Although the rates observed in this study were within an acceptable range, efforts should be directed toward identifying risk factors and implementing preventive strategies to further reduce these complications (Reference 3). Factors such as patient comorbidities, surgical technique, and postoperative care protocols may contribute to the occurrence of these adverse outcomes and warrant further investigation.

It is worth noting that the occurrence of sternal dehiscence and surgical site infections can be multifactorial and influenced by various patient-specific and surgical factors. Additional factors that were not explored in this study, such as obesity, diabetes, smoking, and use of prophylactic antibiotics, may have contributed to the observed complications. Future studies with larger sample sizes and multivariate analyses are necessary to elucidate the impact of these factors on sternotomy closure outcomes.[8]

This study has several limitations that should be considered when interpreting the findings. First, its retrospective design introduces inherent biases and limitations in data collection. The reliance on medical records and the potential for missing or incomplete information may have influenced the accuracy and completeness of the data. A prospective study design with standardized data collection protocols would enhance the reliability of the results.

Second, the study was conducted at a single tertiary care hospital, which may limit the generalizability of the findings to other settings and patient populations. The inclusion of multiple centers and a diverse patient population would provide a more comprehensive understanding of sternotomy closure outcomes.Third, the study's sample size may have limited the statistical power to detect small differences in outcomes between the closure techniques. A larger sample size would enable more robust comparisons and subgroup analyses to identify potential predictors of complications.

Despite these limitations, this study contributes to the existing body of knowledge on sternotomy closure techniques. The results indicate that both conventional and hybrid techniques can be effective methods for achieving stable sternotomy closure with satisfactory sternal healing and bone fusion rates. However, efforts should continue to minimize the occurrence of complications such as sternal dehiscence and surgical site infections through further research and the development of evidence-based guidelines for surgical technique, postoperative care, and patient selection.[9,10]

Conclusion:

In conclusion, this study provides valuable insights into the outcomes of sternotomy closure using conventional and hybrid techniques. The findings support the use of both techniques, highlighting their comparable efficacy in achieving successful sternal union. Further research is needed to identify modifiable risk factors and optimize preventive strategies for reducing

complications associated with sternotomy closure. These efforts will ultimately contribute to improving patient outcomes and enhancing the overall safety and success of cardiac surgical procedures.

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