Journal of Population Therapeutics & Clinical Pharmacology

REVIEW ARTICLE
DOI: 10.53555/mvmvp922

COMPARISON OF SUBXIPHOID AND LATERAL INTERCOSTAL DRAINS AFTER CORONARY ARTERY BYPASS GRAFTING

Kifayatullah[1], Waqar Masud Malik[2*], Asif Mehmood Janjua[3], Nasir Khan[4], Muhammad Afsheen Iqbal[5], Sobia Siddique[6]

[1]MBBS, FCPS Cardiac Surgery, Assistant Professor Cardiac Surgery Peshawar Institute of Cardiology, Pakistan
[2*]Senior Registrar Peshwar Institute of Cardiology, Pakistan
[3,4,5]Consultant Cardiac Surgeon AFIC & NIHD, Pakistan
[6]Resident Cardiac Surgeon AFIC & NIHD, Pakistan

***Corresponding author:** Waqar Masud Malik
*Email: waqarmasudmalik@gmail.com

Abstract

Objective

This study aims To compare the outcome of Subxiphoid and Left lateral intercostal drains in terms of pain score, ventilation time, duration of ICU and hospital stay, and the occurrence of atelectasis and pleural effusion in patients after Coronary artery bypass graft CABG.

Place & Duration of Study

Department of Cardiac Surgery, Armed Forces Institute of Cardiology-National Institute of Heart Diseases, Rawalpindi. The duration of the research was from January 2021 to March 2022.

Methodology

A total number of 180 patients in this study scheduled for an elective on-pump CABG were randomized into two groups. Group 1 (G -1 90 patients with sub-xiphoid drain placement) and group 2 (G-2 90 patients with lateral intercostal drain placement). Baseline data were noted, including age, sex, smoking history, diabetes mellitus and hypertension, and preoperative ejection fraction. Pre-operatively, informed consent was taken from all patients included in the study. Each patient was briefed about the surgical procedure, the post-op care plans, and the visual analog scale (VAS) for pain assessment. Post-operatively, data was collected for pain at 24 hours, the number of ventilation hours, ICU-stay hours, Hospital-Stay Days, Chest Drain Output, and development of pleural effusion or atelectasis. These parameters were compared for both groups.

Results

A total of 180 patients undergoing coronary artery bypass grafting were included in the study. The mean age of the participants was 56.4±9.02 years. The mean VAS score of the participants was 5.89±1.66, and it was significantly higher in the lateral intercostal drain group. The frequency of atelectasis was also higher in the lateral intercostal group. There was no statistically significant difference in mechanical ventilation, ICU stay, and hospital stay days.

Conclusion

There is no significant difference between the two methods of drain insertions when it comes to ventilation time, hospital, and ICU stay. However, the pain score and atelectasis are significantly higher in the intercoastal group. More studies need to be conducted to broaden the validation of our results.

Key Words
Coronary artery bypass grafting, Subxiphiod drain, Lateral intercostal drain, Atelectasis, Pleural effusion, Left internal mammary artery, Pleurotomy.

Introduction

The use of arterial grafts and Left Internal Mammary Artery (LIMA or LITA) has been correlated with long-term patency of the grafts and survival benefits. LIMA harvesting requires pleurotomy which may cause pleural effusion. Pleural drainage after harvesting the (LIMA) for Coronary Artery Bypass Grafting (CABG) is mandatory to prevent effusion, tamponade, or pneumothorax and for detecting blood collection. Consequently, one or more plastic drains with negative pressures are put in the mediastinum and pleural cavity[1, 2]. The drains are usually removed on the first or second postoperative day when bleeding has ceased and hemodynamic, respiratory functions are stable, and chest x-rays are clear[3].

There are two preferred ways for tube placement. One is through a subxiphoid, and the other is through the intercostal approach. Pain after the procedure is common due to pleural and intercostal nerve irritation caused by the chest tube. This may lead to the patient experiencing other pulmonary problems due to poor respiratory efforts.[4] Pain caused by chest tubes can reduce lung functions due to less ventilation and lung collapse, especially in high-risk cases with already existing lung diseases.[5] Consequently, additional analgesic agents for pain relief and placement of another tube in the intensive care unit may be required for the residual fluid in the pleural cavity. This may result in a long-duration of hospital stay.

Pain after CABG can also result from sternal or rib retraction, musculoskeletal trauma, harvesting of the LIMA using cauterization, fractured ribs, intercostal nerve injury, and sternal wires.[6] In a cohort study conducted by Kamalipour H et al., it was shown that in the CABG procedure, in the LIMA group, 83 (88%) patients felt pain that persisted for longer than three months in comparison to 71 (75%) patients in the non-LIMA group.[7]

There are different opinions regarding the impact of the site of placing a chest tube on pleural drainage and pain. Guizilini S et al. conducted a study in 2014 that showed that chest pain was felt less in patients with subxiphoid insertion (SI) than with intercostal insertion group II. Similarly, there was a low occurrence of atelectasis and pleural effusions ($P<0.0001$) and decreased ventilation time and hospital stay in the SI group. More patients developed atelectasis and pleural effusion in the Intercostal insertion group compared to the subxiphoid insertion group.[8]

Some surgeons prefer the subxiphoid approach, while others prefer the lateral intercostal approach. There is still much debate regarding the single best pleural drainage approach in terms of decreasing postoperative patient morbidity, pain relief, improved pulmonary function, and decreasing hospital stay. To the best of our knowledge, no such studies comparing the postoperative effects of these two methods of drain insertions have been conducted in our region. In this study, we compared the subxiphoid and left lateral intercostal routes of chest-tube insertion for postoperative pleural drainage, pain, analgesic requirements, ventilation time, ICU and hospital stay, the occurrence of atelectasis and pleural effusion in patients who undergo CABG with the harvesting of the LIMA.

Methods

The study was conducted after the approval of the Institutional Ethical Review Board (IERB) in the Department of Cardiac Surgery, Armed Forces Institute of Cardiology-National Institute of Heart Diseases, Rawalpindi. This was a Randomised Control Trial conducted from January 2021 to March 2022.

The sample size was calculated as 180 (90 in each group) using OpenEpi software sample size calculator for cohort study/randomized controlled trial applying the following parameters; 95% confidence interval, power of the study at 80%, 19% of patients developing atelectasis with subxiphoid drain and 33% with intercostal drain.[8] A P valve of <0.05 was considered to be statistically significant.

All consecutive patients of either gender, aged between 35 to 65 years, admitted for elective CABG on cardiopulmonary bypass were enrolled after informed consent. Patients have left ventricular ejection fraction <30%, history of chronic obstructive lung disease, renal insufficiency (pre-op creatinine level >1.5 mg/dl), patients undergoing combined valve surgery with CABG, off-pump CABG, urgent surgery, bilateral internal thoracic artery harvesting and with bilateral pleural drains, those who suffer postoperative renal shut down (creatinine level > 1.5 mg/dl) and stroke (assessed on CT-scan brain) were excluded from the study.
Baseline data were noted, including age, sex, smoking history, diabetes mellitus and hypertension, and preoperative ejection fraction. Pre-operatively, each patient was briefed about the surgical procedure, the plans for post-op care, and the use of the visual analog scale (VAS) for the pain assessment.[9]

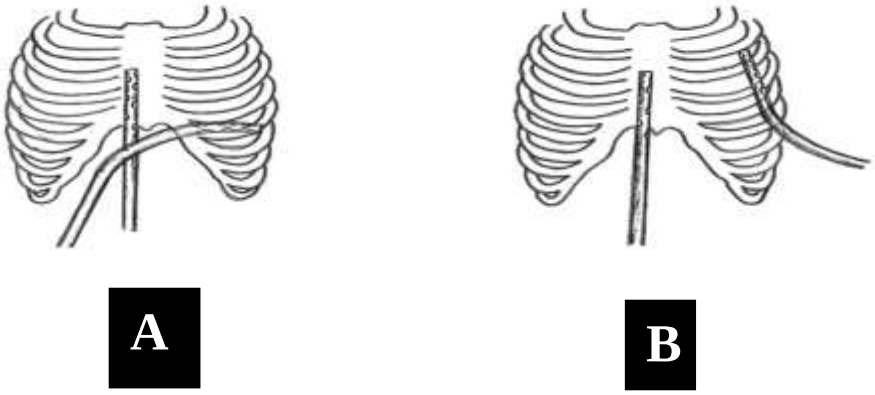

Fig. 1 Illustrations of **A**) subxiphoid and **B**) intercostal routes of chest-tube placement

As per institutional protocol, all the patients got the same standard anesthesia and underwent median sternotomy and harvesting of the LIMA, and on-pump CABG. drains were either inserted through the left subxiphoid area or the 4th or 5th Intercostal Space in the anterior axillary line.

All intubated patients were shifted to the intensive care unit (ICU) on a mechanical ventilator. Duration of postoperative mechanical ventilation was noted in hours. Analgesia was given according to the Institutional protocol. Chest pain was assessed on the first postoperative day using a standard VAS score.[9] VAS score was graded from zero to ten on which zero represented the absence of pain and ten represented the most intense pain.

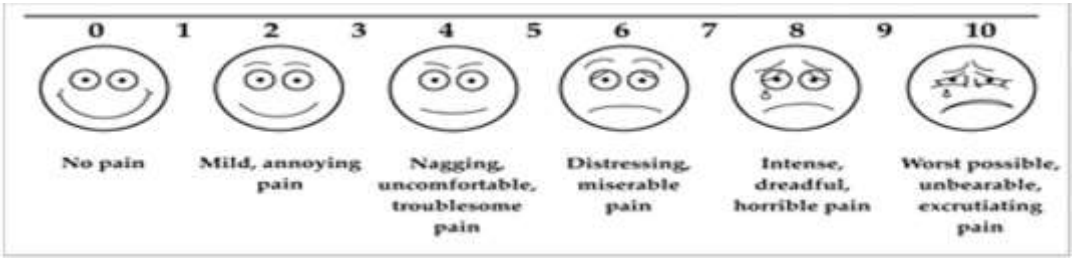

Fig.2. Visual analog score

Pleural effusion and atelectasis were assessed through simple chest X-rays interpreted by an independent blinded intensivist and a radiologist. Pleural effusion was categorized as absent, small, medium, or large and was recorded in performed performances. Chest drains were removed on the second post-op day, subject to the cessation of drainage. On the third post-op day, chest X-ray Radiographs were taken to check for pleural effusion and atelectasis. Duration of mechanical ventilation, length of ICU, and hospital stay was also recorded.

The data was entered and analyzed through Statistical Package for Social Science (SPSS) software version 20 (IBM Corp, Chicago, USA). Continuous variables were described as mean ± standard deviations and/or medians and interquartile ranges (IQR). Categorical variables were reported as frequencies and percentages. The student's t-test was used to compare means, and the Wilcoxon-Mann Whitney U test to compare medians. Comparisons between proportions were made using Pearson's chi-square test or Fisher's exact test. A p-value of ≤ 0.05 was taken as significant.

Results

The mean age of the participants was 56.4±9.02 years and consisted of 83% males (n=150) and 16% females (n=30). The subxiphoid and lateral intercostal groups were comparable regarding baseline characteristics, i.e., age, gender, hypertension, diabetes, smoking status, and ejection fraction. (Table 1)

Table 1: Characteristics of patients undergoing coronary artery bypass grafting (N=180)

Characteristic	**Overall** (N=180)	**Subxiphoid** (n=90)	**Lateral IC** (n=90)
Age (years) mean ± SD	56.4 ± 9.02	56.54 ± 8.87	56.26 ± 9.22
Gender n (%)			
Male	150 (83.33%)	73 (81.11%)	77 (85.56%)
Female	30 (16.67%)	17 (18.89%)	13 (14.44%)
Hypertension n (%)			
Non-hypertensive	75 (41.67%)	41 (45.56%)	34 (37.78%)
Controlled hypertension	102 (56.67%)	48 (53.33%)	54 (60.00%)
Uncontrolled hypertension	03 (1.66%)	01 (01.11%)	02 (02.22%)
Diabetes mellitus n (%)			
Non-diabetics	90 (50.0%)	49 (54.44%)	41 (45.55%)
DM on insulin therapy	23 (12.7%)	09 (10.00%)	14 (15.56%)
DM on oral hypoglycemics	65 (36.1%)	30 (33.33%)	35 (38.89%)
DM on dietary modification	02 (02.2%)	02 (02.22%)	00 (00%)
Smoking status n (%)			
Non-smoker	118 (65.56%)	60 (66.67%)	58 (64.44%)
Ex-smoker	45 (25.00%)	20 (22.22%)	25 (27.78%)
Current smoker	17 (09.44%)	10 (11.11%)	07 (07.78%)
Ejection fraction n (%)			
≤ 50 %	76 (42.22%)	37 (41.11%)	39 (43.33%)
> 50 %	104 (57.78%)	53 (58.89%)	51 (56.67%)

The mean VAS score of the participant with the lateral intercostal drain (6.42 ± 1.63) was significantly higher (p < 0.001) than those with subxiphoid drain (5.36 ± 1.52). There was a significantly higher mean Chest-Drain Output in the Lateral Intercostal Groups (620ml vs 485ml, p-value 0.03). There was no statistical difference between the number of ventilation days, ICU Stay Hours, and Hospital Stay Days. The Pleural Effusion and Atelectasis rates were also not statistically significant in both groups. (Table 2)

Table 2: Outcome of CABG patients with subxiphoid and lateral intercostal drains (N=180)

Outcome measures	**Overall** (N=180)	**Subxiphoid** (n=90)	**Lateral IC** (n=90)	**p-value**
VAS at 24-hour Mean ± SD	5.89 ± 1.66	5.36 ± 1.52	6.42 ± 1.63	< 0.001
Ventilation time median (IQR)	6.0 (9)	6 (9)	6 (8)	0.59

ICU Stay Hours median (IQR)	44 (60)	44 (47)	45 (69)	0.33
Chest-Drain Output (ml) median (IQR)	555 (540)	485 (512)	620 (545)	0.03
Atelectasis n (%) Yes No	16 (8.89%) 164 (91.11%)	5 (5.56%) 85 (94.44%)	11 (12.22%) 79(87.78%)	0.19
Pleural Effusion n (%) Yes No	26 (14.44%) 154 (85.56%)	15 (16.67%) 75 (83.33%)	11 (12.22%) 79 (87.78%)	0.53
Hospital Stay Days median (IQR)	5.0 (1)	5 (1)	5 (1)	0.33

Discussion

A total of 180 individuals who underwent elective coronary artery bypass grafting were included in the study. Post-operatively they had either subxiphoid or lateral intercostal drains implanted. The participants' average age was 56.4±9.02 years, and 83% were men. Regarding baseline features, the subxiphoid and lateral intercostal groups were equivalent. Patients undergoing CABG may experience excruciating pain due to mechanical irritation during chest-tube insertion, which can result in shallow breathing, pulmonary hypoventilation, and unsatisfactory Po2 and Pco2 readings[10]. Regarding ventilation days and ICU stay Hours, we observe that there is not much difference between the two groups.

The same is the case with atelectasis and pleural effusion. Pleural effusion following CABG is caused by several processes, including poor lymphatic drainage, pericardial inflammation, insufficient hemostasis, and post-pericardiotomy syndrome.[11, 12] Although the difference was not statistically significant in our study, the frequency of atelectasis was more for the patients in the lateral intercostal group. Guden et al. found no statistically significant difference in VAS, pleural effusion, and atelectasis in their study [13]. Pleural effusion and atelectasis were postoperative pulmonary sequelae in the subxiphoid and intercostal approaches. Patients in the subxiphoid group had more patients who suffered from these conditions.[13] Brims et al. demonstrated that these patients' ultrasound-guided drainage of pleural effusion is associated with improved oxygenation[11]. A study evaluated that residual pleural effusion was more common in the subxiphoid group, although the results were not statistically significant.[14] Sensor et al. employed a CT scan to find residual pleural effusion after surgery; however, they discovered no connection between the volume of pleural effusion and the location of the pleural drainage insertion site.[15] The frequency of atelectasis has also been higher in patients with lateral intercostal drain insertion. Diminished blood supply and discomfort from pain may contribute to decreased muscle strength at the point of drain insertion resulting in decreased contraction of muscles. The patient's severe discomfort is justified by the drain rubbing against the pleural and intercostal nerves and the stress it places on the parietal pleura during breathing, both reducing the variables and raising the risk of respiratory problems.[16] Additionally, the graft using the left internal thoracic artery may cause ischemia or injury of the phrenic nerve, which physically innervates the diaphragm, one of the primary breathing muscles, impairing the respiratory system's ability to operate normally[17]. These factors tend to restrict chest expansion, modify ventilatory mechanics, and produce a shallow breathing pattern, which may have detrimental effects including tachypnea, dyspnea, and atelectasis. Simon et al. showed that in the group having a drain put in the subxiphoid region, there was a greater prevalence of small and medium pleural effusion, dyspnea, respiratory infection, and atelectasis.[2]

Our study has shown a significant difference in the pain score between the two groups. The mean VAS score of the participants was 5.89±1.66, and it was significantly higher in the lateral intercostal drain group (p-value < 0.001). The group with intercostal insertion has been shown to have greater

pain scores than the subxiphoid group in other studies. Reibman et al. 1996 outlined the procedure for inserting the pleural drain in the subxiphoid area to minimize the discomfort caused by the drain friction against the intercostal space after surgery[18]. Similarly, a study conducted by Hagl in 1999 demonstrated that subxiphoid chest drain insertion results in decreased pain and, consequently, much higher pulmonary function in the early postoperative period compared to intercostal placement[19]. There has not been much difference in the late postoperative period. Pain scores have been similar for intercoastal and subxiphoid drainage in people undergoing unilateral VATS. Bilateral VATS subxiphoid drainage has been associated with significantly higher pain scores in the early post-operative period[20].

After CABG surgery, we found no differences in the impact of the pleural drain insertion site on the length of the hospital stay or the duration of mechanical breathing. While pain and atelectasis were less in the subxiphoid group, chest tube drainage was higher in the lateral intercostal group. To widen the validity of our findings, more research comparing the two sites for the insertion of drainage tubes among CABG surgical candidates is required.

Conclusion

We did not observe any difference in the effect of the pleural drain insertion site after CABG surgery on the duration of hospital stay and mechanical ventilation. VAS score for pain and atelectasis frequency was less in the subxiphoid group while chest tube drainage was more in the lateral intercostal group. A greater number of studies conducted among candidates for CABG surgery to compare the two sites for placement of drainage tubes are needed to broaden the validation of our results.

Study Limitation

Several limitations of our study were

- A relatively small population among patients undergoing CABG with median sternotomy and LIMA harvesting.
- The size and type of chest tubes were not noted.
- A researcher was not blinded to the treatment option.
- Analgesic requirements for pain control were not recorded.

References

1. Vitomskyi V. The impact of mobilization and other factors on pleural effusion in patients undergoing cardiac surgical procedures. Journal of Physical Education and Sport. 2020;20:2167-73.
2. Simon S, Coronel C, Almeida ASd, Marcadenti A. Left lateral intercostal region versus subxiphoid position for pleural drain during elective coronary artery bypass graft surgery: randomized clinical trial. Sao Paulo Med J. 2019;137:66-74.
3. Aygün F, Özülkü M, Günday M. Effects of Cardiopulmonary Bypass on Mediastinal Drainage and the Use of Blood Products in the Intensive Care Unit in 60-to 80-Year-Old Patients Who Have Undergone Coronary Artery Bypass Grafting. Braz J Cardiovasc Surg. 2015;30:597-604.
4. Pinheiro VFdO, Costa JMVd, Cascudo MM, Pinheiro ÊdO, Fernandes MAF, Araujo IBd. Analgesic efficacy of lidocaine and multimodal analgesia for chest tube removal: A randomized trial study. Rev Lat Am Enfermagem. 2015;23:1000-6.
5. Guizilini S, Viceconte M, Esperança GTdM, Bolzan DW, Vidotto M, Moreira RSL, et al. Pleural subxiphoid drain confers better pulmonary function and clinical outcomes in chronic obstructive pulmonary disease after off-pump coronary artery bypass grafting: a randomized controlled trial. Anesth Pain Med. 2014;29:588-94.
6. Gimpel D, Fisher R, Khan Z, McCormack DJ. Primary care management of chest pain after coronary artery bypass surgery. BMJ. 2019;365:1-6.
7. Kamalipour H, Vafaei A, Kazemi AP, Khademi S. Comparing the prevalence of chronic pain after sternotomy in patients undergoing coronary artery bypass grafting using the internal

mammary artery and other open heart surgeries. Anesthesiology and Pain Medicine. 2014;4(3):1-5.
8. Guizilini S, Alves DF, Bolzan DW, Cancio AS, Regenga MM, Moreira RS, et al. Sub-xyphoid pleural drain as a determinant of functional capacity and clinical results after off-pump coronary artery bypass surgery: a randomized clinical trial. Interact Cardiovasc Thorac Surg. 2014;19(3):382-7.
9. Heller GZ, Manuguerra M, Chow R. How to analyze the Visual Analogue Scale: Myths, truths and clinical relevance. SJPAIN. 2016;13(1):67-75.
10. Cohen AJ, Moore P, Jones C, Miner TJ, Carter WR, Zurcher RP, et al. Effect of internal mammary harvest on postoperative pain and pulmonary function. Ann Thorac Surg. 1993;56(5):1107-9.
11. Brims FJ, Davies MG, Elia A, Griffiths MJ. The effects of pleural fluid drainage on respiratory function in mechanically ventilated patients after cardiac surgery. BMJ Open Respir Res. 2015;2(1):e000080.
12. Labidi M, Baillot R, Dionne B, Lacasse Y, Maltais F, Boulet L-P. Pleural effusions following cardiac surgery: prevalence, risk factors, and clinical features. Chest. 2009;136(6):1604-11.
13. Guden M, Korkmaz AA, Onan B, Onan IS, Tarakci SI, Fidan F. Subxiphoid versus intercostal chest tubes: comparison of postoperative pain and pulmonary morbidities after coronary artery bypass grafting. Tex Heart Inst J. 2012;39(4):507-12.
14. Elnasr MA, Arafat AA, Wahab AA, Taha A-HM. Intercostal versus subxiphoid approach for pleural drainage post coronary artery bypass grafting. CTS. 2017;25(1):8-13.
15. Sensoz Y, Gunay R, Tuygun AK, Balci AY, Sahin S, Kayacioglu I, et al. Computed tomography evaluation of different chest tube sites for residual pleural volumes after coronary artery bypass surgery. Ann Saudi Med. 2011;31(4):383-6.
16. Gomes DSdO, Silva EJdA, Silva JS, Barbosa HdCM, Guimarães AR, Cordeiro ALL. Impact of drains positioning on pulmonary function after coronary artery bypass grafting: an observational study. BJAN. 2022;72:83-7.
17. de Castro Rosseto KR, Nunes KZ, Romero WG, Furieri LB, Massaroni L, Fioresi M. Intervenção educativa de enfermagem ao cliente submetido à cirurgia cardíaca. Rev Baiana Enferm. 2017;31(4)::e22441.
18. Riebman J, Olivencia-Yurvati A, Laub G. Improved technique for pleural drain insertion during cardiovascular surgery. J Cardiovasc Surg. 1994;35(6):503-5.
19. Hagl C, Harringer W, Gohrbandt B, Haverich A. Site of pleural drain insertion and early postoperative pulmonary function following coronary artery bypass grafting with internal mammary artery. Chest. 1999;115(3):757-61.
20. Liu Y-W, Chou S-H, Chou A, Kao C-N. Simultaneous comparison of subxiphoid and intercostal wound pain in the same patients following thoracoscopic surgery. J Clin Med. 2022;11(8):2254.