Original Article

Retrospective Study on Anterolateral Mini-Thoracotomy in Emergency Surgical Drainage for Massive Pericardial Effusion Including Sternotomy Case

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Abstract:

Background: The conventional method for managing the surgical drainage of an acute massive pericardial effusion typically involves a median sternotomy. Nevertheless, advancements in surgical optics and tools have enabled the utilization of progressively smaller incisions, such as a left anterolateral thoracotomy, for the same purpose. Aim of the Study: This study aimed to assess the surgical outcomes of left anterolateral mini-thoracotomy compared to median sternotomy for draining acute massive pericardial effusion. Methods: This research took place in the Cardiac Surgery Department at Ibrahim Cardiac and Research Institute, following approval from the local ethics committee, from June 2021 to June 2023. Fourteen patients with acute massive pericardial effusion necessitating emergency surgical drainage were included. The investigation concentrated on evaluating operative and short-term postoperative results to gauge the influence of two surgical drainage methods on patients' quality of life. Result: Both groups exhibited similar age, preoperative comorbidities, and ejection fraction. The sternotomy group required more operation time than the left anterolateral mini-thoracotomy group. Furthermore, the sternotomy group had a prolonged stay in the intensive care unit and hospital compared to the left anterolateral mini-thoracotomy group. Similar rates were observed for blood transfusion and chest tube drainage. However, two cases of superficial wound infection occurred in the sternotomy group. In the anterolateral thoracotomy group, no patients required conversion to full sternotomy, and all patients were alive at the one-month follow-up after hospital discharge. Conclusion: Employing a left anterolateral mini-thoracotomy for draining acute massive pericardial effusion was deemed a secure and reliable alternative to the traditional median sternotomy incision. Despite its limited operating field, requiring proficiency, this approach preserved sternal integrity, offered a more aesthetically pleasing incision, reduced the risk of wound infection, and decreased the need for analgesia. Additionally, it was associated with a faster recovery process and a shorter stay in the intensive care unit (ICU).

Keywords: *cardiac surgery; pericardial effusion; left anterolateral thoracotomy; surgical drainage; postoperative outcomes*

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Introduction:

Pericardial effusion, a condition characterized by the abnormal accumulation of fluid around the heart within the pericardial sac,[1-2] poses a potential and, in some cases, life-threatening threat. Pericardial effusion may appear as transudate (hydropericardium), exudate, pyopericardium or haemopericardium. Large effusions are common with neoplastic, tuberculous, cholesterol, uremic pericarditis, myxedema, and parasitoses.[3-4] Effusions that develop slowly can be remarkably asymptomatic, while rapidly accumulating smaller effusions can present with tamponade. Loculated effusions are more common when scarring has supervened (e.g., postsurgical, posttrauma, purulent pericarditis). Massive chronic pericardial effusions are rare (2–3.5% of all large effusions).[3,5-6]

Cardiac tamponade is the decompensated phase of cardiac compression caused by effusion accumulation and the increased intrapericardial pressure. In “surgical” tamponade intrapericardial pressure is rising rapidly, in the matter of minutes to hours (i.e. haemorrhage), whereas a low-intensity inflammatory process is developing days to weeks before cardiac compression occurs (“medical” tampon ade). Heart sounds are distant. Orthopnoea, cough and dysphagia, occasionally with episodes of unconsciousness can be observed. Insidiously developing tamponade may present with the signs of its complications (renal failure, abdominal plethora, shock liver and mesenteric ischemia).[3,6] In 60% of the patients, the cause of pericardial effusion may be a known medical condition. Tamponade without two or more inflammatory signs (typical pain, pericardial friction rub, fever, diffuse ST segment elevation) is usually associated with a malignant effusion.[3]

cardiac tamponade is an uncommon complication of percutaneous coronary intervention (PCI). A relatively small blood volume within the pericardial space may cause severe hemodynamic instability and death, even with early diagnosis and prompt treatment. Previous reports suggest that cardiac tamponade is most frequently caused by coronary artery perforation during PCI.[6] Acute postoperative cardiac tamponade (defined as up to 7 days post-surgery) is an uncommon entity that requires prompt diagnosis and diligent management to avoid circulatory collapse and cardiorespiratory arrest. Anesthetic management for surgical pericardial drainage of an effusion causing cardiac tamponade in the postoperative period after cardiac surgery is a challenge for the anesthesiologist, considering the unstable hemodynamic situation resulting from abnormal ventricular filling and the subsequent reductions in systolic volume, cardiac output, and systemic blood pressure.[10]

Cardiac tamponade was associated with a very high overall mortality rate, especially for those patients who developed cardiac tamponade in the cardiac catheterization laboratory There are procedures to treat cardiac tamponade, including emergency pericardiocentesis or surgical intervention.[6] Surgical intervention can be done through sternotomy or an anterolateral mini-thoracotomy approach. The latter has gained prominence owing to advancements in surgical techniques, providing a more refined and less invasive alternative.

Historically, median sternotomy (MST) has been the standard approach for excision of these masses. For the past decades, minimally invasive cardiac surgery (MICS) has emerged as an accepted approach for a variety of cardiac procedures such as mitral valve surgery, aortic valve surgery, and surgery for arrhythmia.[7-8] The rise of MICS has mainly been driven by its potential benefits, such as decreased length of intensive care unit (ICU) and hospital stay, decreased surgical trauma with reduced need for blood transfusion, and increased patient cosmetics and satisfaction. The advantages of MICS have mainly been studied in mitral valve surgery, where comparable efficacy was demonstrated without compromising patient safety.[7,9]

As pericardial effusions become larger or massive, the risk of cardiac tamponade increases—a life-threatening condition that needs immediate treatment to save the patient’s life. Quick and effective management is crucial in these situations.The primary objective of this study is to contribute valuable insights by sharing our experiences with pericardial drainage using the anterolateral mini-thoracotomy approach. By doing so, we aim to provide a comprehensive understanding of patient outcomes following this specific surgical intervention. This research serves as a crucial platform for furthering our knowledge and refining the clinical management of pericardial effusion, emphasizing the importance of tailoring interventions to ensure the optimal well-being of affected individuals.

In this study, we conducted a retrospective analysis of 14 pericardiectomy procedures performed to address acute massive pericardial effusion. We compared the outcomes of pericardiectomy performed through left anterolateral thoracotomy versus median sternotomy, both carried out without the use of cardiopulmonary

bypass. Our assessment focused on parameters including morbidity, mortality, and functional outcomes

Methodology:

A retrospective study was undertaken at the Department of Cardiac Surgery, Ibrahim Cardiac Hospital & Research Institute, following approval from the local ethics committee. The study, conducted from June 2021 to June 2023, involved the enrolment of fourteen patients (n=14) with acute massive pericardial effusion necessitating emergency surgical drainage. The retrospective design encompassed a thorough examination of historical medical records and outcomes.

The main goal of this inquiry was to retrospectively evaluate and compare the operative and short-term postoperative results linked to two separate surgical drainage methodologies utilized within this timeframe. These methods were applied to manage acute massive pericardial effusion in the included patients. Furthermore, the study sought to assess the potential impact of these surgical interventions on the overall quality of life experienced by the patients throughout their recovery.

Throughout the study duration, comprehensive data pertaining to the surgical procedures, immediate postoperative outcomes, and subsequent patient recovery were systematically gathered and analysed. This thorough retrospective methodology facilitated comprehensive scrutiny of the efficacy and influence of the selected surgical drainage techniques on both the immediate health outcomes and the overall well-being of the participants in the study.

Every patient in our cohort underwent preoperative evaluation, encompassing a thorough history-taking and routine investigations conducted upon referral to the cardiac surgery department in anticipation of surgical drainage. A comprehensive set of routine investigations for general anesthesia, including X-ray, ECG, and echocardiography, were conducted to evaluate the extent of pericardial effusion.

Table-I

patient Inclusion and Exclusion criteria

Inclusion criteria:
1. Patients with age equal to or >18 years.
2. Patients had body weight greater than 50 Kg.
Exclusion criteria:
1. Patients who had bleeding diathesis.
2. Patients with kidney or liver dysfunction.
3. Patients with chest wall deformity.
4. Patients with severe fixed pulmonary hypertension.
5. Obese patients.

Table-II

Patient Intraoperative and Postoperative assessment

Intraoperative assessment:
1. Calculation of the total operative time.
2. Identification and documentation of the type of incision employed.
3. Measurement of blood loss during the procedure.
4. Quantification of blood units required.
Postoperative assessment:
1. Mechanical ventilation time
2. Chest tube drainage
3. Blood transfusion
4. Monitoring for bleeding
5. Occurrence of re-exploration
6. Evaluation of wound infection and/or seroma
7. Mortality
8. Duration of Intensive Care Unit (ICU) stay
9. Length of hospital stay
10. Total analgesic requirements
11. Identification and management of postoperative complications
12. Pre-discharge and one-month post-discharge echocardiography.
13. Assessment of cosmetic outcomes, patient perception, and pain levels, including overall satisfaction

Results:

The entirety of our patient cohort, comprising 14 individuals, was systematically categorized into two distinct groups to facilitate a comprehensive comparative analysis. Group A was constituted of patients who underwent the surgical drainage of pericardial effusion through a left anterolateral mini-thoracotomy, while Group B underwent the same procedure employing the median sternotomy approach. Delving into the demographics of these groups, the age distribution among patients in Group A ranged from 45 to 71 years, reflecting the diverse age spectrum within this cohort. In contrast, patients in Group B exhibited an age range of 48 to 68 years, adding further granularity to the comparative assessment. Turning our attention to gender distribution, Group A

comprised 4 male individuals, constituting 57.14% of the group, and 3 female individuals, making up the remaining 42.85%. In Group B, the gender distribution manifested differently, with 3 male individuals accounting for 42.85% and 4 female individuals constituting 57.14% of the group.

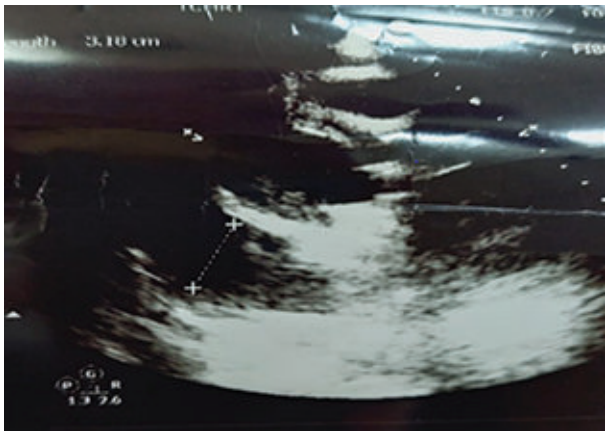

Figure 1: *Preoperative Echocardiography show Massive Pericardial Effusion.*

In both groups, 2 (28.57%) patients had diabetes mellitus (DM). In Group A, 1 (14.28%) patient had a history of stroke, while in Group B, 2 (28.57%) had experienced a stroke. Smoking habits were observed in 1 (14.28%) patient in Group A and 2 (28.57%) patients in Group B.

The causes of pericardial effusion in Group A were post-transcatheter pulmonary valve replacement (TPM)-related right ventricle perforation, tuberculosis, and post-mechanical valve replacement (MVR) massive pericardial effusion due to high international normalized ratio (INR), accounting for 5 (71.42%), 1 (14.28%), and 1 (14.28%) case, respectively. In Group B, the causes were post-TPM-related right ventricle perforation and tuberculosis, with 4 (57.14%) and 3 (42.85%) cases, respectively

In Group A, the surgical technique involved an anterolateral mini-thoracotomy of 6-12 cm in length under general anesthesia. Pericardiectomy was performed on the left side, creating a large pleuropericardial window. Repair of right ventricular (RV) perforation was undertaken when necessary. The chest was subsequently closed, and a drain was placed for drainage.

In Group B, the surgical approach comprised a standard median sternotomy of 19-26cm in length under general anesthesia. Pericardiectomy was performed parallel to the sternotomy, and, if required, RV perforation repair was conducted. Two chest drains were placed retrosternally and retrocardiac, and the sternum was closed using sternal wires, with wound closure in layers.

Table-III
Comparision of Demographic data and clinical characteristics in two groups

Variable	Group A Left anterolateral mini thoracotomy (n=7)	Group B Standard mini sternotomy (n=7)
Age (years)	45-71	48-68
Male	4(57.14%)	3(42.85%)
Female	3(42.85%)	4(57.14%)
DM	2(28.57%)	2(28.57%)
Smoker	1(14.28%)	2(28.57%)
Stroke	1(14.28%)	NA
Issues:post-TPM-related	5(71.42%)	
RV perforation	1(14.28%)	4(57.14%)
Tuberculosis	1(14.28%)	3(42.85%)
Post-MVR massive pericardial effusion due to high INR		NA

Within Group A, the recorded patient blood loss varied between 500 and 800ml, while in Group B, the range extended from 600 to 950ml. Blood transfusion requirements were noted as follows: in Group A, 6 patients (85.71%) necessitated 1 unit of blood transfusion, and 1 patient (14.28%) required 2 units during the procedure. In contrast, Group B exhibited 5 patients (71.42%) requiring 1 unit of blood transfusion, and 2 patients (28.57%) requiring 2 units during the same procedural phase. The total operating time within Group A spanned from 30 to 45 minutes, presenting a relatively concise timeframe. Conversely, in Group B, the operating time extended from 55 to 75 minutes, reflecting a comparatively longer duration for the procedural completion. This detailed breakdown of key procedural metrics contributes to a thorough understanding of the variations and nuances between the two groups.

When comparing the outcomes of the two groups, Group A, which underwent the left anterolateral mini-thoracotomy, exhibited favorable results. The ventilation duration for this group ranged from 130 to 185 minutes, with an intensive care unit (ICU) stay spanning 24 to 28 hours. Removal of chest drains took place on the 2nd to 3rd postoperative day, and the subsequent hospital stay extended from 3 to 4 days. Patients in Group A reported a pain score within

the range of 3-4, and notably, no instances of wound infection were observed. Importantly, all patients (100%) expressed satisfaction with the cosmetic outcomes.

Table-IV

Comparision of operative data in two groups

Variable	Group A Left anterolateral mini thoracotomy (n=7)	Group B Standard mini sternotomy (n=7)
Skin incision (cm)	6-12	19-26
Times of surgery(minutes)	30-45	55-75
Blood loss	500-800 ml	600-950ml
Blood transfusion		
1 unit	6(85.71%)	5(71.42%)
2 unit	1(14.28%)	2(28.57%)

In contrast, Group B, where the standard mini-sternotomy was performed, exhibited some variations in outcomes. The ventilation duration for this group ranged from 180 to 240 minutes, with a lengthier ICU stay ranging between 38 and 52 hours. Chest drain removal occurred on the 3rd to 5th postoperative day, and the subsequent hospital stay was prolonged, ranging from 6 to 8 days. Patients in Group B reported a higher pain score in the range of 5-6. Notably, two patients (28.57%) experienced wound infection, and satisfaction with cosmesis was divided, with 3 patients (42.85%) expressing satisfaction and 4 patients (57.14%) not satisfied. All patients in both groups were subject to continuous follow-up for a duration of 1 year.

Table-V

Comparision of postoperative data in two groups

Variable	Group A Left anterolateral mini thoracotomy (n=7)	Group B Standard mini sternotomy (n=7)
Ventilation time (minute)	130-185	180-240
ICU stay (hours)	24-28	38-52
Post operative hospital stay(day)	3-4	6-8
Pain score	3-4	5-6
Wound infection	NA	2(28.57%)
Patient satisfaction with cosmesis n(%)		
Yes	7(100%)	3(42.85%)
No	NA	4(57.14%)

Discussion:

The study encompassed 14 patients, stratified into two groups for comparative analysis. Group A underwent left anterolateral mini-thoracotomy, while Group B opted for median sternotomy. In Group A, aged between 45 and 71 years, there were 4 (57.14%) males and 3 (42.85%) females. Conversely, Group B, aged from 48 to 68 years, comprised 3 (42.85%) males and 4 (57.14%) females. Both groups displayed similar occurrences of diabetes mellitus, noted in 2 patients (28.57%), and a history of stroke, observed in 1 patient (14.28%) in Group A and 2 patients (28.57%) in Group B. Smoking habits were reported by 1 patient (14.28%) in Group A and 2 patients (28.57%) in Group B.

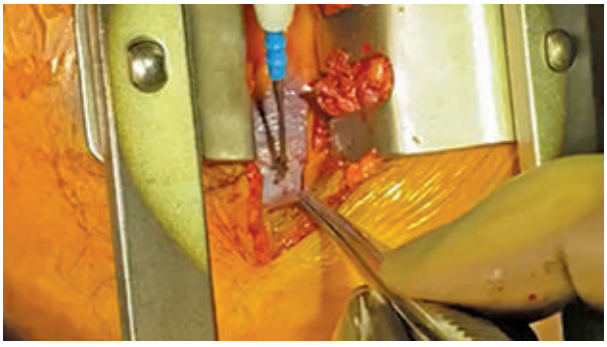

Figure 2: *Show operative field through left anterolateral thoracotomy.*

The etiology of pericardial effusion varied between the groups, with Group A presenting instances such as post-TPM-related right ventricle (RV) perforation, tuberculosis, and post-mitral valve replacement (MVR) massive pericardial effusion attributed to elevated International Normalized Ratio (INR). In contrast, Group B's causes included post-TPM-related RV perforation and tuberculosis. The surgical approaches differed, as Group A underwent anterolateral mini-thoracotomy, while Group B underwent sternotomy.

Group A exhibited favorable outcomes characterized by reduced blood loss, a shorter operative duration, and fewer complications. Importantly, all patients in Group A expressed satisfaction with the cosmetic results. Conversely, Group B experienced lengthier ventilation time, prolonged stays in the intensive care unit (ICU) and hospital, higher pain scores, and incidences of wound infections.

Anterolateral mini-thoracotomy presents a feasible and secure option in cardiac surgery, aligning with the principles of minimally invasive techniques to mitigate trauma and enhance cosmetic outcomes. Its dual

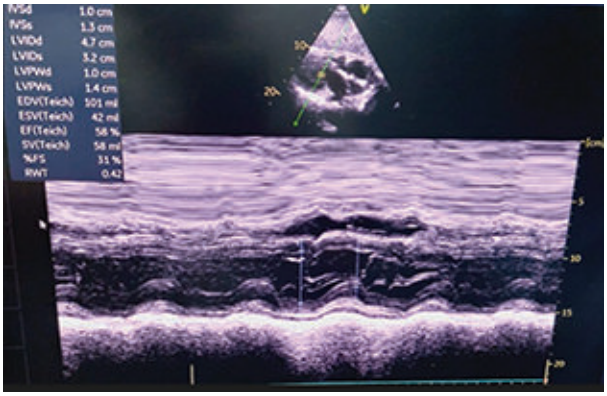

Figure 3: *Postoperative Echocardiography show minimum Pericardial Effusion.*

capability allows for the simultaneous resolution of right ventricular (RV) issues during the drainage of pericardial effusion, underscoring its versatility in the comprehensive management of cardiac pathologies. The establishment of a pleuropericardial window minimizes the risk of pericardial fluid reaccumulation, effectively addressing this critical aspect. The attractiveness of anterolateral mini-thoracotomy is further heightened by its capacity to execute such interventions through a minimally invasive approach.

Figure 4: *Show left anteolateral thoracotomy scar.*

Furthermore, the safety profile of anterolateral mini-thoracotomy becomes particularly evident in the postoperative period. Deemed the safest approach one month after cardiac surgery, it hints at a potential reduction in both mortality and morbidity compared to the traditionally employed sternotomy.[7,9,11-12]

In conclusion, the diverse advantages of anterolateral mini-thoracotomy, including its less invasive nature, concurrent RV repair, and pleuropericardial window creation, position it as a promising and safe alternative in cardiac surgery. These benefits emphasize the importance of considering this approach in specific clinical scenarios, recognizing its potential to enhance patient outcomes and postoperative recovery.

The retrospective design introduces potential limitations from reliance on existing medical records, while the small sample size (14 patients) may limit generalizability and the ability to detect subtle differences. Future studies should consider adopting a prospective design with larger, diverse populations for increased accuracy and statistical power. The study's one-year follow-up duration may constrain the assessment of long-term outcomes, so extending follow-up periods in future investigations can provide more comprehensive insights into intervention effectiveness and safety over an extended timeframe. Collaborative efforts or multicentre approaches could enhance sample size and research robustness.

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Conclusion:

Performing urgent surgical drainage of massive pericardial effusion through anterolateral mini-thoracotomy offers a method that is both minimally invasive and effective in managing cardiac tamponade. This approach brings advantages such as reduced surgical trauma, accelerated recovery, and enhanced cosmetic results, making it a fitting option for critically ill patients requiring prompt intervention. Continuous research and progress in this field are essential for continually refining the technique and optimizing outcomes for patients in need.

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