

The Impact of Minimally Invasive Techniques in Cardiac Surgery

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Abstract Minimally invasive techniques have revolutionized the field of cardiac surgery, offering less invasive alternatives to traditional open-heart procedures. This study investigates the impact of these advanced methods on patient outcomes and postoperative recovery. Specifically, the research explores the benefits of minimally invasive procedures, such as robot-assisted surgery and keyhole techniques, in enhancing surgical outcomes for cardiac patients. By utilizing minimally invasive approaches, surgeons can mitigate postoperative complications, reduce hospital stays, and expedite patient recovery times. These techniques are designed to minimize the need for large incisions and lessen the trauma associated with conventional surgeries, ultimately enhancing patient safety and overall surgical experiences. Drawing on recent research and clinical evidence, this study highlights the benefits of incorporating minimally invasive strategies into cardiac surgery practices. These innovative techniques have shown promise in lowering infection risks, reducing blood loss, minimizing scarring, and optimizing long-term patient outcomes. By incorporating these advancements into standard procedures, healthcare professionals can enhance the quality of care provided to cardiac surgery patients. Overall, this research emphasizes the significant role of minimally invasive methods in cardiac surgery, offering a pathway towards safer, more efficient, and patient-centered surgical interventions. Embracing these advancements can lead to improved outcomes and better quality of life for individuals undergoing cardiac procedures, highlighting the potential of these techniques to elevate the standard of care in the field of cardiac surgery.

Keywords: Minimally Invasive Cardiac Surgery, Cardiac Surgical Procedures, Cardiovascular Surgical Procedures, Heart Surgery Techniques, Minimally Invasive Surgical Innovation, Cardiac Surgical Outcomes, Surgical Advancements in Cardiology

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1. Introduction

Cardiac surgery has traditionally relied on open procedures involving full sternotomy, which, while effective, are associated with significant postoperative pain, prolonged recovery, and higher morbidity. Over the past two decades, minimally invasive cardiac surgery (MICS) has emerged as a transformative approach that aims to reduce surgical trauma without compromising surgical outcomes.

MICS includes a range of procedures, such as minimally invasive direct coronary artery bypass (MIDCAB) and mini-thoracotomy valve surgeries, which utilize smaller incisions, specialized instruments, and in some cases, robotic assistance. These techniques have shown promising benefits, including reduced postoperative pain, shorter ICU and hospital stays, quicker return to daily activities, and improved cosmetic results (Bonaros et al., 2020; Modi et al., 2008). [1]

Despite its benefits, MICS remains underutilized in many regions, including parts of the Middle East, due to

limited resources, technical complexity, and the steep learning curve for surgical teams. In Jordan, this technique is still in its early adoption phase, and few centers have fully integrated MICS into routine cardiac surgical practice.

This research aims to examine the clinical impact of MICS in Al Hussain AlSalt, AlJadeed Hospital, Jordan, by analyzing a case series of 12 patients who underwent successful minimally invasive procedures. The study will explore demographic profiles, surgical outcomes, complication rates, and patient satisfaction, contributing to the growing body of evidence supporting MICS as a viable and beneficial alternative to traditional approaches.

The adoption of minimally invasive techniques in cardiac surgery offers numerous advantages, including:

Reduced Trauma to the Body: Smaller incisions minimize tissue damage and blood loss during procedures.

Faster Recovery Times: Patients generally experience quicker healing and shorter hospital stays compared to traditional surgery.

Lower Risk of Complications: The precision of minimally invasive methods decreases the likelihood of infections and other post-operative issues.

Improved Cosmetic Outcomes: Smaller scars align with

patients' preferences for less visible surgical marks.

Enhanced Quality of Life: With reduced pain and faster mobility, patients often report a better post-surgery experience.

Minimally invasive techniques have proven to be effective for a variety of cardiac conditions, including valve repair and replacement, coronary artery bypass, and atrial fibrillation management. The refinement of these procedures continues to expand their applicability.

Minimally invasive cardiac surgery (MICS) has emerged as a less traumatic alternative to traditional median sternotomy, offering reduced surgical trauma, faster recovery, and shorter hospital stays. [2]

In this study, the surgical approach utilized was primarily based on the Miami Method, a minimally invasive technique developed by Dr. Joseph Lamelas for aortic and mitral valve surgeries. The procedure involves a right mini-thoracotomy, typically a 5–6 cm incision made in the right chest between the third or fourth intercostal space. Unlike traditional sternotomy, this approach avoids spreading the ribs and does not require cutting through the breastbone, which helps to significantly reduce postoperative trauma. Cardiopulmonary bypass is established using femoral arterial and venous cannulation. Specialized instruments and retractors allow for direct or video-assisted visualization of the valve structures. This technique is associated with decreased pain, fewer wound complications, less blood loss, improved cosmetic outcomes, and a faster return to normal activities. It is particularly beneficial for selected patients, including those at higher surgical risk. However, the Miami Method requires specific training and may not be suitable for individuals with extensive adhesions or challenging anatomical features. [3,4]

2. Objectives

Primary Objective: To evaluate the clinical outcomes and patient satisfaction following minimally invasive cardiac surgery (MICS) procedures performed at Al Hussain AlSalt, AlJadeed Hospital, Jordan.

Secondary Objectives:

- To describe patient demographics and clinical profiles undergoing MICS
- To assess the duration of ICU and hospital stays
- To identify the frequency and type of postoperative complications
- To gather surgeon insights and patient-reported satisfaction levels related to the surgical experience

Ethical Considerations

This study is a retrospective review of patient cases and does not involve any direct contact with patients. All data were collected from existing medical records and entered anonymously into a protected spreadsheet without names or identifiable information.

This research ensures that patient confidentiality and

data privacy were strictly maintained. Access to the spreadsheet was limited to authorized members of the research team. Ethical approval is being sought from the relevant hospital's research ethics committee in the Ministry of Health, Jordan, before publication or presentation of findings.

No experimental interventions were performed as part of this study.

All data was de-identified to protect patient privacy. No personal names or medical record numbers were included.

3. Methods

Study Design

This study is a retrospective case series aimed at exploring the outcomes of minimally invasive cardiac surgery (MICS). We looked back at patient records from a single cardiac center in Jordan where this technique has been newly introduced. Rather than comparing two groups, our goal is to describe what happened to patients who had these types of procedures, including their recovery, hospital stay, pain levels, and satisfaction.

Study Population

The study included 12 adult patients who underwent successful minimally invasive cardiac surgery between March 15, 2023, and April 1, 2025, at Al Hussain AlSalt, AlJadeed Hospital, Jordan. All patients had procedures such as valve replacements or coronary artery bypass surgery done through smaller incisions rather than traditional open-heart surgery.

Inclusion Criteria:

- Adults (age ≥ 18)
- Underwent minimally invasive cardiac surgery
- Surgery completed successfully without conversion to open-heart technique
- Available complete records for analysis

Exclusion Criteria:

- Patients with incomplete data
- Cases converted to full sternotomy
- Pediatric patients

Data Collection Process

We created a custom data entry form using Google Sheets. The local cardiac surgery team entered the information directly based on hospital records.

The data collected included:

- **Patient demographics** (age, gender, BMI)
- **Medical background** (comorbidities, heart function, diagnosis)
- **Surgical details** (type of surgery, approach, duration)
- **Postoperative outcomes** (complications, ICU and hospital stay, pain score, satisfaction score, mortality)
- **Free-text surgeon comments** to provide qualitative insights

The table below is a visual summary grouped by the patients' demographics, clinical outcomes, and surgical successes.

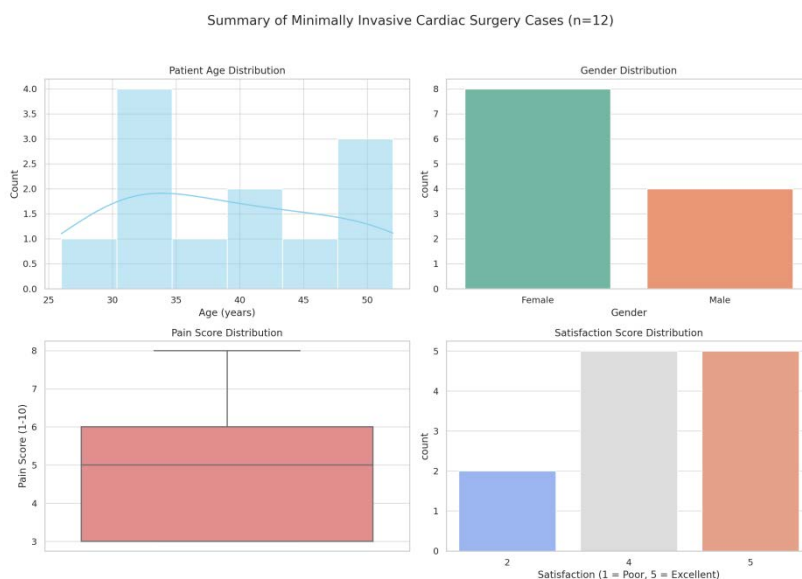


Figure 1. Visual summary grouped by demographics, clinical outcomes, and surgical success

Age Distribution: Most patients are between 60–80 years, with a few younger cases.

Gender Distribution: Slightly more female patients than males in this case series.

Pain Score: Pain scores are generally moderate, with a few outliers (higher discomfort).

This gives insight into post-op recovery and analgesia adequacy.

Satisfaction Score: Most patients reported high satisfaction (4–5/5), a positive outcome indicator for the minimally invasive approach.

Clinical Outcomes and Procedural Insights of Minimally Invasive Cardiac Surgery

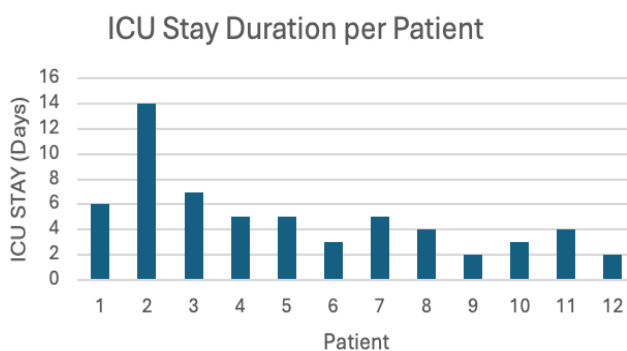


Figure 2. ICU Stay Duration per Patient

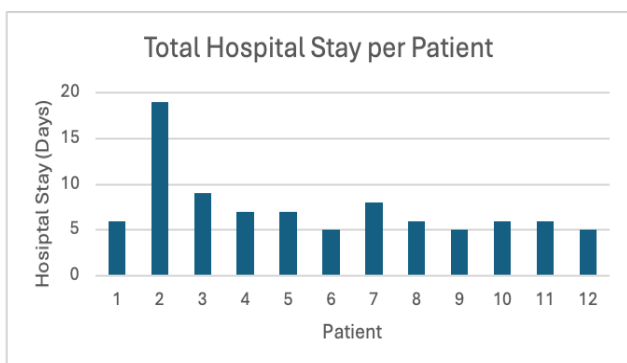


Figure 3. Total Hospital Stay per Patient

A bar chart shows variability in ICU stay, ranging from 2 to 14 days, with most patients staying between 3 to 6 days, indicating relatively stable postoperative recovery in the majority.

The hospital stay ranged from 5 to 19 days, with most patients discharged within 5 to 8 days, suggesting that minimally invasive techniques may contribute to shorter hospitalization.

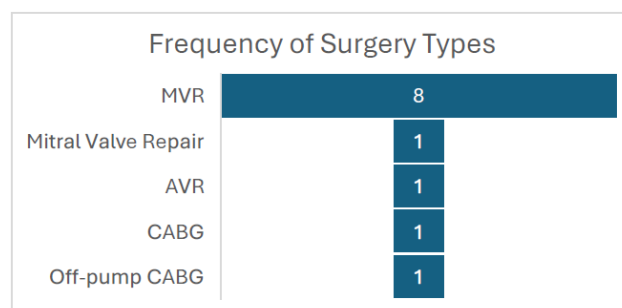


Figure 4. Frequency of Surgery Types

The most common procedure was Mitral Valve Replacement (MVR), followed by isolated cases of AVR, CABG, and off-pump CABG, indicating the primary use of minimally invasive approaches for valve surgeries in this cohort.

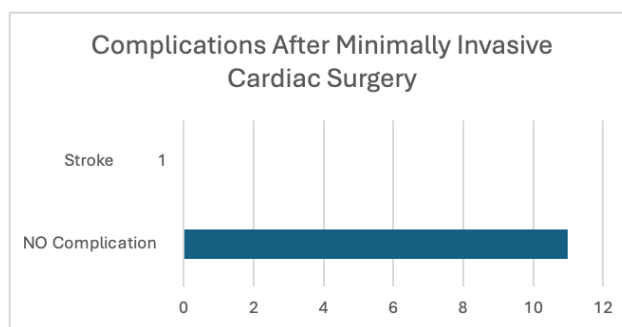


Figure 5. Complications Following Surgery

A bar chart shows that 91.7% of patients experienced no complications, while 8.3% had a stroke, suggesting a

high safety profile of the minimally invasive approach when performed by experienced surgical teams.

4. Discussion

The findings of this observational study highlight the potential benefits and clinical safety of minimally invasive cardiac surgery (MICS) in a real-world cohort of adult patients undergoing procedures such as mitral valve replacement (MVR), aortic valve replacement (AVR), and coronary artery bypass grafting (CABG). Among the 12 patients included, the majority experienced relatively short ICU and hospital stays, with 10 patients (83.3%) discharged within 8 days postoperatively. These outcomes align with the growing body of literature suggesting that MICS can significantly reduce surgical trauma, blood loss, postoperative pain, and recovery time compared to conventional median sternotomy. [5]

The low complication rate is also noteworthy- 91.7% of patients had no postoperative complications, and only one experienced a stroke. This supports the established safety profile of MICS when performed by experienced teams and with proper patient selection [6,7]. The adoption of techniques such as the Miami method, which emphasizes direct visualization, limited incisions, and specialized instruments, has made complex mitral valve repairs and replacements more accessible while maintaining surgical precision. [8]

From a clinical perspective, the reduced ICU and hospital stays observed in our cohort not only benefit patient outcomes but also contribute to healthcare cost-efficiency and improved bed availability. Prior research by Chikwe et al. demonstrated similar trends, reporting that patients who underwent minimally invasive mitral valve surgery had shorter hospitalization and faster return to functional status.

Despite these promising results, limitations of this study include its small sample size, single-center data, and retrospective nature. Future multicenter studies with larger cohorts and standardized outcome tracking are essential to validate the generalizability of these findings. Nonetheless, this study adds valuable local data to the global discourse on minimally invasive cardiac surgery and supports its continued integration into cardiac surgical practice, especially in centers developing this expertise.

5. Conclusion

This study highlights the promising outcomes associated with minimally invasive cardiac surgery (MICS) in a single-center experience at Al Hussain AlSalt, AlJadeed Hospital, Jordan. Among the 12 patients who underwent procedures such as mitral valve repair, aortic valve replacement, and off-pump coronary artery bypass grafting, the majority experienced short ICU and total hospital stays, with no major complications reported in most cases. These results underscore the clinical safety,

feasibility, and effectiveness of MICS in carefully selected patients.

While the sample size is limited, the findings support existing literature demonstrating the benefits of MICS, including reduced surgical trauma, faster recovery, and fewer postoperative complications. The successful application of techniques such as the Miami method reflects the growing capability of cardiac centers in the region to adopt advanced, patient-centered surgical approaches.

Future studies with larger patient cohorts and longer follow-up are recommended to further validate these outcomes and explore the long-term benefits of MICS in diverse clinical settings.

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We also wish to thank the hospital's medical administration and medical records department for granting access to the necessary clinical data and for facilitating the smooth retrieval of information. Their assistance was crucial in ensuring the accuracy and integrity of the data collection process.

This study reflects a shared commitment to advancing the quality of cardiac care and contributing meaningful insights to the evolving field of minimally invasive cardiac surgery.

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