

RESEARCH

Minimal invasive cardiac surgery for aortic valve replacement through an upper mini-sternotomy: multicenter experience

Yasser Mubarak^{1,2,3*}¹Faculty of Medicine, Minia University, Minya, Egypt²Madinah Cardiac Center, King Fahad Hospital, Al-Madinah al-Munawwarah, Saudi Arabia³King Salman Heart Center, King Fahad Medical City, Riyadh, Saudi Arabia***Correspondence:**Yasser Mubarak,
yassermubarak73@gmail.com**Received:** 24 March 2023; **Accepted:** 10 April 2023; **Published:** 27 April 2023**Background:** Aortic valve replacement (AVR) by minimally invasive cardiac surgery (MICS) performed through an upper mini-sternotomy has reduced pain after surgery, the risk of bleeding, and the length of hospital stay.**Patients and methods:** From January 2019 until December 2022, 230 patients underwent AVR through a partial upper sternotomy (J or inverted-L). The study assessed our early experience with AVR *via* mini-sternotomy, including cannulation, the progression of the learning curve and patient selection, and finally morbidity and mortality.**Results:** Early mortality was 1% (2 patients), and morbidities were 4% (4 patients). The average age was 58 ± 9.7 . The mean Euro-SCORE was $4.7\% \pm 3.2$ and the ejection fraction (EF) was $40\% \pm 4.3$. The cannulation was performed peripherally in the femoral artery and vein by the direct or percutaneous approach; however, three cases required central cannulation. The average aortic cross clamping time (ACC) for MICS-AVR patients was 83 ± 17 min, and the cardiopulmonary bypass (CPB) time was 114 ± 34 min. The mean duration of mechanical ventilation (MV) was 4.3 ± 2.5 h, the average stay in an intensive care unit (ICU) was 1.4 ± 1.2 days, and the mean hospital stay was 4.3 ± 1.3 days. 30-day mortality was 2 patients (1%). The incidence of blood loss and reopenings for bleeding decreased.**Conclusion:** An upper mini-sternotomy can be used safely to replace an aortic valve, and the minimally invasive approach was not associated with increased morbidity or mortality.**Keywords:** mini-sternotomy, minimal invasive cardiac surgery, partial upper sternotomy, aortic valve replacement

Introduction

Partial upper sternotomies are described for a minimally invasive approach to valvular and ascending aortic surgery (1). Nowadays, MICS-AVR is growing to be performed by many surgeons (2). MICS-AVR did not increase morbidity or mortality; however, they may be reduced without compromising the excellent outcome. It reduced

postoperative bleeding, the need for blood transfusions, the length of stay in the hospital, and sternal dehiscence (3).

Upper mini-sternotomy improves surgical outcome and reduces morbidity in AVR (4). Other authors enumerated disadvantages of the minimally invasive approach, like longer CPB and ACC times and an increased incidence of stroke due to retrograde perfusion through femoral cannulation (5).

Methods

In MICS-AVR, all surgical steps were similar to a standard full sternotomy except those steps. A roll is placed behind the right shoulder to elevate that side 30° – 45° . External

Abbreviations: ACC, aortic cross clamp; AI, aortic insufficiency; ARE, aortic root enlargement; CPB, cardio pulmonary bypass; EF, ejection fraction; MICS-AVR, minimal invasive cardiac surgery aortic valve replacement; ICU, intensive care unit; TOE, trans esophageal echography; MV, mechanical ventilation; RITA, right internal thoracic artery.



FIGURE 1 | Partial upper sternotomy intraoperative.

defibrillator pads are placed because we cannot use internal pads due to a small incision.

The sternum was incised down to the 4th space with preservation of the right internal thoracic artery (RITA) (**Figure 1**). A smaller sternal retractor is used. We began with central aortic and right atrial cannulation, then moved on to femoral cannulation via open cut-down or Seldinger technique. Transesophageal echocardiography (TOE) was used to evaluate cannulation, de-airing, and valve function after replacement.

Pacing wires are inserted during the arrest. Only four stainless steel wires are used to approximate the sternal halves.

Results

The study began in January 2019 and will conclude in December 2022, with 230 patients undergoing isolated AVR *via* a mini sternotomy. Postoperative results for early (3 months) and midterm (1 year) were followed up. Early mortality was 1% (2 patients) due to stroke postoperatively and prolonged mechanical ventilation.

The stroke was related to old age and a history of previous strokes. Also, there were 4% (4 patients) with different morbidities: (i) heart failure due to severe aortic insufficiency (AI); (ii) late mild ischemic stroke resolved without deficit; (iii) trivial paravalvular leak without hemolysis treated with follow-up; and (iv) injury of the right internal thoracic artery and ligation (with clip). The average age was 58 ± 9.7 years.

The average Euro-Score was $4.7\% \pm 3.2$, with an EF of $40\% \pm 4.3$. The mean ACC time for patients with MICS-AVR was 83 ± 17 min and the mean CPB time was 114 ± 34 min. The mean time of MV was 4.3 ± 2.5 h, the average time in the ICU was 1.3 ± 1.2 days, and the average stay in the hospital was 4.2 ± 1.3 days.

There was no case of bleeding and wound infection. No conversion to sternotomy was performed.

Discussion

The main drawback of the mini-sternotomy approach is the difficulty of de-airing (6). There was no problem during de-airing by CO₂ insufflation, Trendelenburg position, aortic root, and TOE.

Mini-sternotomy AVR is a safe procedure with the same efficacy as a full sternotomy (4). As the number of patients increases, so does the learning curve and the efficacy of the technique.

In MICS-AVR, there is no risk of complete sternal dehiscence and an early return to work (7). As in our cases, there was no sternal rocking or infection.

MICS-assisted AVR has the same mortality and postoperative stroke as standard sternotomies (1). Also, in our cases, a minimal approach or access did not increase mortality.

A J-shaped mini-sternotomy or partial upper sternotomy is an approach that concerns decreasing surgical trauma, enhancing convalescence, and improving the cosmesis of the incision (8). Other investigators have not been able to show any advantage to MICS-AVR approaches except a smaller incision (3). Our research confirmed that this was not just a cosmetic approach, but that it was also safe and effective. It also improved the outcome.

Conclusion

MICS-AVR is a safe and effective procedure. It has the advantage of a small cosmetic incision, patient satisfaction, and an early return to normal activity without increasing morbidities or mortalities.

Limitations

This study is not a comparative cohort study, and there is no statistical analysis.

Author contributions

The author confirms being the sole contributor of this work and has approved it for publication.

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