



Risk factors and in-hospital outcomes of conversion to sternotomy during minimally invasive cardiac surgery

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Introduction

- Minimally invasive cardiac surgery (MICS) through a right minithoracotomy is increasingly performed due to its safety, reproducibility, and advantages over sternotomy—including reduced blood product use, lower infection rates, shorter hospital stays, faster recovery, and lower costs.¹⁻⁴
- Despite careful patient selection, conversion to median sternotomy is required in 1–3% of cases and is associated with significantly increased morbidity and mortality.³⁻⁵
- While common causes for conversion include bleeding, pulmonary adhesions, vascular complications, and poor exposure, the role of preoperative anatomical factors—such as reduced anteroposterior (AP) diameter—remains poorly described.³⁻⁵
- This study aims to identify preoperative risk factors associated with conversion to median sternotomy to refine patient selection, improve surgical planning, and enhance the safety and efficacy of MICS.

Methods

- We retrospectively reviewed 254 adult patients who underwent MICS via right minithoracotomy at our institution between 2015 and 2024.
- Procedures included mitral and tricuspid valve repair or replacement, atrial septal defect repair, patent foramen ovale closure, myxoma resection, and combined procedures.
- Preoperative characteristics, intraoperative data, in-hospital outcomes, and 30-day mortality were collected.
- Intrathoracic anteroposterior (AP) diameter was measured on computed tomography (CT) at the level of mitral valve, from the posterior sternum wall to the anterior vertebral body.

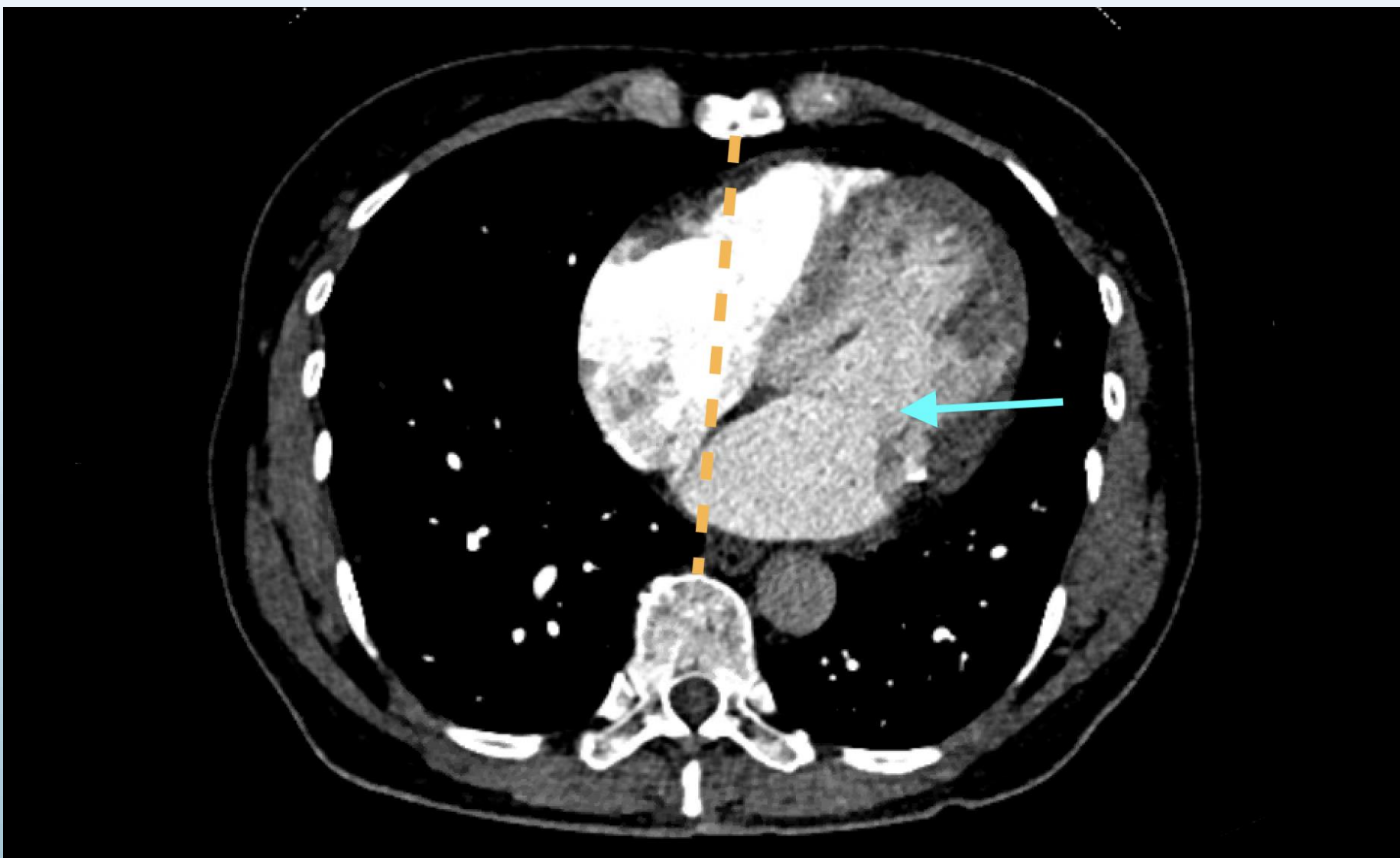


Fig. 1. Intrathoracic AP diameter measured at the level of the mitral valve.

- Two-tailed Mann-Whitney, and two-sided Fisher's exact and chi-squared tests were used for continuous and categorical data, respectively (p<0.05, SPSS v28.0).

Results

- The rate of conversion to sternotomy was **1.6%** (n=4).
- Median age was 55 years (IQR 40-68).
- Median BMI was 23 kg/m² (IQR 21-26).

Table 1: Reasons for conversion to sternotomy.

Procedure	Reason	(N = 4)
MVr; TVR	Persistent MR following attempted repair	2 (50)
MVr	Difficult exposure of mitral valve anatomy	1 (25)
ASDr	Difficult cannulation	1 (25)
MVr, mitral valve repair; TVR, tricuspid valve replacement; ASDr, atrial septal defect repair		

Preoperative Risk Factors

- All patients in the converted group were **female** (100% vs. 32.3%, p=0.019).
- Patients in the converted group had a significantly **smaller AP diameter (100 mm** [IQR 93–105]) compared to the non-converted group (124 mm [IQR 109–143], p=0.020).
- Non-converted group had a higher prevalence of **severe mitral regurgitation** compared to the converted group (82% vs. 25%, p=0.001).

Perioperative Outcomes and Mortality

- Postoperative **stroke** and **infection** rates (25% vs. 1%, p=0.047 for both) were significantly higher in the converted group compared to the non-converted group.
- There was **no 30-day mortality** in conversion group. Non-conversion group had a 30-day mortality rate of 0.4% (n=1).

Table 2: Postoperative outcomes.

Parameters	Non-converted (N = 250)	Converted (N = 4)	P value
Hospital LOS (day)	6 (5-8)	6 (6-7)	0.195
Post-operative complications			
Re-op for bleeding	4 (2)	0 (0)	1.000
Stroke	2 (1)	1 (25)	0.047
Renal failure	15 (6)	1 (25)	0.230
Infection	2 (1)	1 (25)	0.047
Lymphocele	3 (1)	0 (0)	1.000
Pre-discharge imaging			
MR			0.330
None/trace	199 (80)	3 (75)	
Mild	27 (11)	0 (0)	
Moderate	17 (7)	1 (25)	
Severe	0 (0)	0 (0)	
TR			0.957
None/trace	86 (34)	1 (25)	
Mild	97 (39)	2 (50)	
Moderate	54 (22)	1 (25)	
Severe	5 (2)	0 (0)	
Lymphocele at follow up	3 (1)	0 (0)	1.000
LOS, length of stay; MR, mitral regurgitation; TR, tricuspid regurgitation			

Discussion & Conclusions

- Our low conversion rate (1.6%) reflects careful preoperative selection and aligns with prior literature on MICS for atrioventricular valve surgery (1–3%)^{3,5}.
- Following 2019, our institutional practice shifted to exclude patients with narrow intrathoracic cavities (AP diameter ≤10 cm), severe pectus excavatum, or extensive pleural adhesions—contributing to reduced conversion rates.
- An AP diameter ≤10 cm was significantly associated with conversion, likely due to reduced instrument maneuverability and suboptimal visualization during MICS.
- All converted patients were female, supporting the influence of sex-based anatomical differences such as smaller thoracic cavities on MICS complexity.
- Though infrequent, conversion was associated with higher risk of in-hospital stroke and infection. However, there was no 30-day mortality.
- Intrathoracic AP diameter is a simple and reproducible metric obtained from preoperative CT imaging that can inform patient selection and anticipate technical challenges in MICS.
- Our study reinforces that MICS is a safe approach in appropriately selected patients. As cardiac surgery evolves toward personalized and precision-guided approaches, our findings emphasize that incorporating patient-specific anatomical factors, such as AP diameter, into preoperative planning enhances the safety and efficacy of MICS.

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