

Development of Single-Incision Minimally Invasive Programs in Congenital Heart Surgery

Building a Dedicated Program for Improved Efficiency and Expanded Complexity

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BACKGROUND

- The paradigm in congenital cardiac surgery has shifted toward minimizing procedural trauma beyond the incision alone
- Right vertical minithoracotomy offers a single-incision approach with direct surgical view and central cannulation — avoiding peripheral cannulation risks
- Despite proven safety, most eligible patients still undergo median sternotomy; systematic program development remains underreported
- A structured, dedicated MICS program is essential to move beyond sporadic adoption toward institutional standard of care

OBJECTIVES

- Characterize the learning curve and procedural efficiency gains of a dedicated single-incision MICS program
- Evaluate the expansion of case complexity over time
- Assess the integration and impact of accelerated recovery pathways within the MICS framework

METHODS

DESIGN

Narrative review synthesizing contemporary clinical series and programmatic analyses

SURGICAL APPROACH

- Single right vertical minithoracotomy
- Central aortic and bicaval cannulation (no peripheral cannulation)
- Standard cardiopulmonary bypass with cardioplegic arrest

SCOPE OF REVIEW

- Implementation strategies for dedicated MICS programs
- Learning curve analysis across program maturation
- Outcome benchmarking vs. alternative sternal-sparing and multi-port techniques
- Integration of accelerated return-to-ward recovery protocols

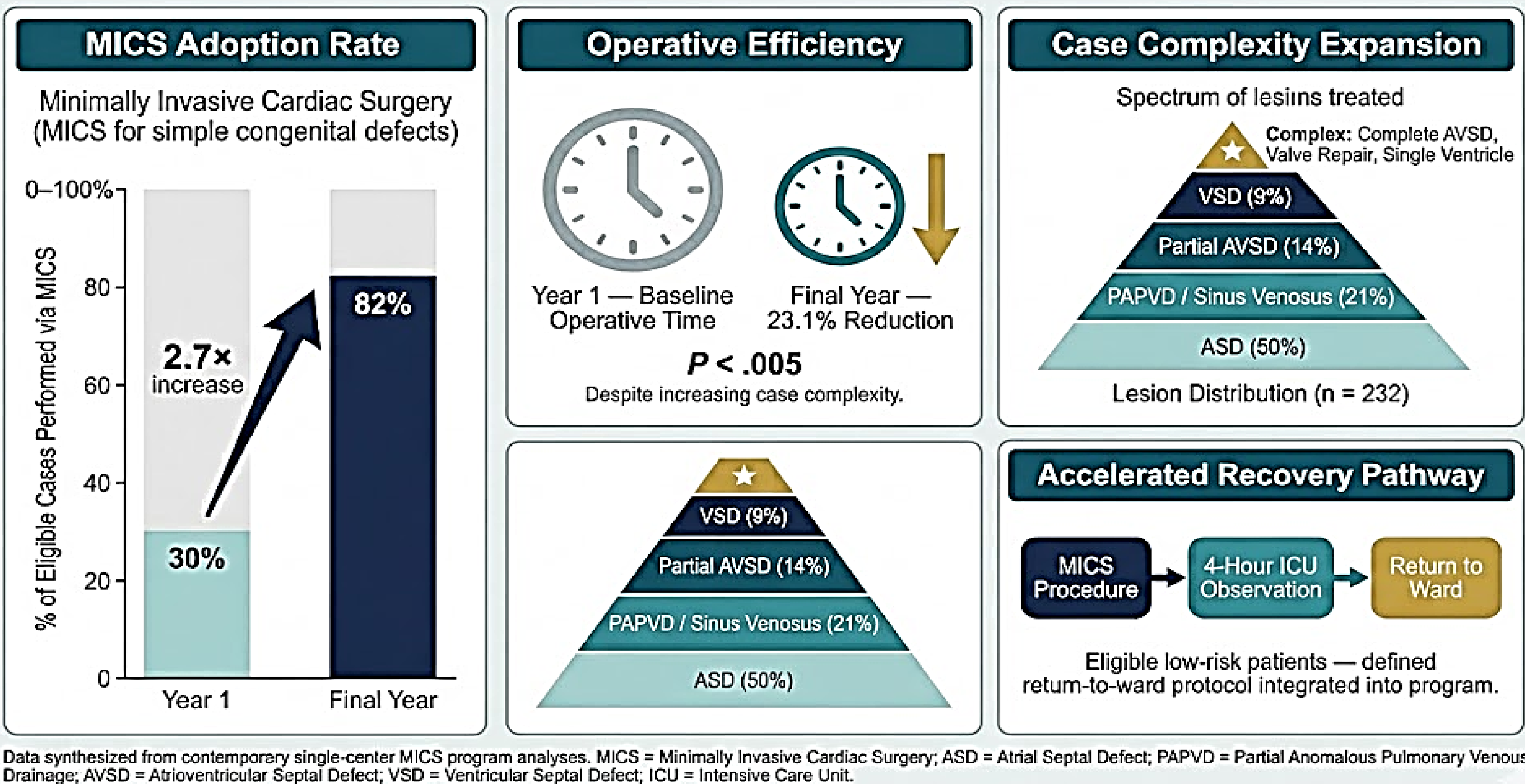
PATIENT SPECTRUM

- Pediatric and adult congenital populations
- Simple septal defects → complex repairs (AVSD, valve repair, single ventricle)

RESULTS

SINGLE-INCISION MINITHORACOTOMY vs. ALTERNATIVE APPROACHES

Feature	Single-Incision Minithoracotomy	Multi-Port / Robotic	Sternotomy
Surgical View	Direct	Camera-dependent	Full
Cannulation	Central	Peripheral (femoral)	Central
Incision Count	1	4–3	1
Peripheral Vascular Risk	Avoided	Present	Avoided
Cosmetic Outcome	Excellent	Good	Visible midline scar
Equipment Complexity	Standard	High (robot, ports)	Standard
Applicability to Pediatrics	Broad	Limited by vessel size	Universal



CONCLUSIONS

- Dedicated MICS programs achieve >80% adoption for eligible simple defects and >20% operative time reduction as the learning curve matures
- The single-incision right minithoracotomy with central cannulation provides direct visualization without peripheral vascular risk — a critical advantage in pediatric patients
- Systematic expansion to complex lesions (complete AVSD, valve repair, single ventricle) is achievable within a structured program
- Integration of accelerated recovery pathways with defined return-to-ward protocols enhances the value proposition of MICS
- Standardized, multi-institutional training frameworks and refined criteria for fast-track postoperative pathways are the essential next steps

FUTURE DIRECTIONS

- Multi-center prospective registries to validate efficiency and safety benchmarks
- Standardized training curricula and simulation-based learning curve metrics
- Refined patient selection criteria for accelerated postoperative pathways
- Long-term cosmetic and functional outcome assessment across age groups

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