Median Sternotomy vs. Minimally Invasive Pulmonary Valve Replacement Following Tetralogy of Fallot Repair

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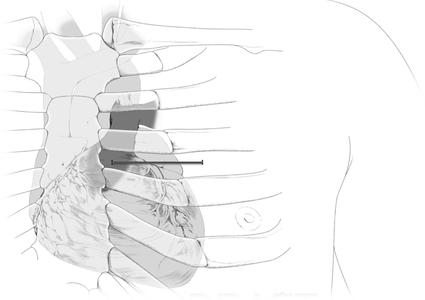
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Introduction

- **Minimally invasive approaches have transformed adult cardiac surgery** with improved postoperative pain, shorter lengths of stay, decreased surgical site infections, and improved cosmetics relative to traditional median sternotomy[1,2]
- **Congenital cardiac surgery has been slow to adopt these approaches** because of anatomic constraints, lack of FDA approved solutions, need for extensive surgical correction, historical concerns regarding outcomes[3]
- **Adult congenital cardiac patients now out number pediatric patients**[4]
- **Few minimally invasive approaches exist even for adult congenital patients**
- **We started performing surgeries on the RVOT, including PVR s/p primary ToF repair, through a 5cm left anterior mini-incision (LAMI) in 2018**[5]

Hypothesis

Outcomes for PVR following ToF through a 5cm LAMI and 9cm redo median sternotomy (MS) are comparable



Methods

- Single Institution, Retrospective Review
- IRB Pro00101549
- Patients with history of ToF repair undergoing PVR via redo MS or LAMI
- March 2016 through March 2020
- Patient reported pain per nursing averaged over 24 hours (0700-0700)
- Opioids were calculated as morphine equivalents (ME) over 24 hours (0700-0700)

Results

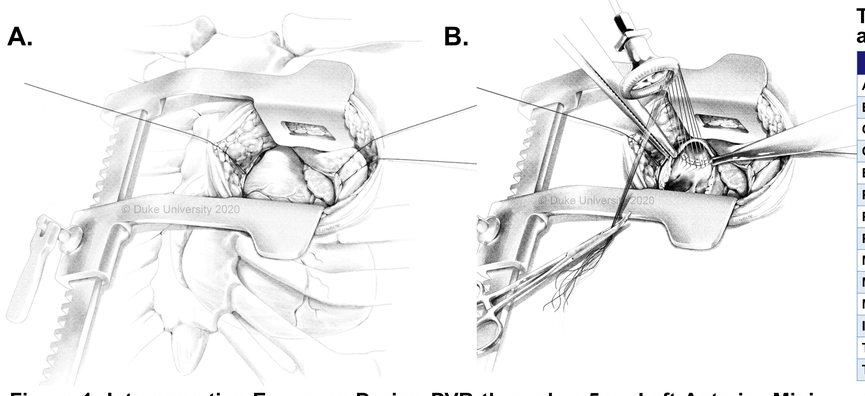


Figure 1. Intraoperative Exposure During PVR through a 5cm Left Anterior Mini-Incision (LAMI). A. Exposure of RVOT with paradoxical clockwise rotation following prior median sternotomy. **B.** Parachuting PVR. Knots are secured on RVOT aspect of the annulus using a CorKnot securement device (LSI Solutions, Victor, NY, USA).

Table 1. Outcomes for PVR following ToF Repair via Redo Median Sternotomy and 5cm Left Anterior Mini-Incision (LAMI)

	Redo MS (n = 12)	LAMI (n = 12)	p-value
Age (years)	14.5 (11.5 – 45)	16 (13 – 23.3)	0.62
BMI (kg/m²)	23.7 (20.0 – 26.6)	20.9 (18.9 – 29.8)	0.64
CPB Time (minutes)	119 (71 – 137)	145 (132 – 164)	0.08
Operative Time (minutes)	291 (230 – 318)	304 (290 – 355)	0.26
Blood Products (Units)	0 (0 – 1.8)	0 (0 – 1)	1
Pt. Reported Pain POD 1	3.25 (2.1 – 5.1)	4 (3.3 – 5.0)	0.60
Pt. Reported Pain POD 3	1 (0 – 2.2)	2.8 (0 – 3.8)	0.29
Pt. Reported Pain at Discharge	0.3 (0 – 1.4)	0.8 (0 – 4.1)	0.54
Morphine Equiv. (ME) POD 1	17.5 (9.4 – 46.9)	51.8 (31.3 – 67.5)	0.06
ME POD 3	0 (0 – 20.5)	15 (0 – 35)	0.35
ME at Discharge	0 (0 – 0)	0 (0 – 9.4)	0.40
ICU Length of Stay (days)	1.5 (1 – 2)	2 (1 – 3)	0.26
Total Length of Stay (days)	5 (3.8 – 5)	4.5 (3.8 – 7.3)	0.77
Time to Follow Up (days)	1083 (789 – 1330)	77 (27 – 421)	< 0.05

Data is listed as the median followed by the interquartile range (IQR) in parenthesis. CPB, cardiopulmonary bypass; LAMI, left anterior median incision; ME, morphine equivalents; MS, median sternotomy; Pt, patient.

Conclusions

- Two patients converted from LAMI to pMS and MS intraoperatively
  - One with BMI 35 and 3 prior MS due to dense adhesions
  - One with mesocardia and difficulty lateralizing the pulmonary valve
- Trend toward longer CPB times in LAMI group
  - Expected given early initiation of CPB to facilitate decompress anatomy and facilitate dissection as well as exposure
- **No difference in postoperative pain or required morphine equivalents**
- **No difference in ICU or total length of stay**
- Patients undergoing PVR via **LAMI avoided sternal precautions**
- **Outcomes for PVR following ToF repair through a 5cm LAMI are comparable to those performed through a redo MS**

References

1. Dieberg G, Smart NA, King N. Minimally invasive cardiac surgery: A systematic review and meta-analysis. *Int J Cardiol.* Nov 15 2016;223:554-560.
2. Walther T, Falk V, Metz S, et al. Pain and quality of life after minimally invasive versus conventional cardiac surgery. *Ann Thorac Surg.* Jun 1999;67(6):1643-1647.
3. Alsarraj MK, Nellis JR, Vekstein AM, Andersen ND, Turek JW. Borrowing from Adult Cardiac Surgeons-Bringing Congenital Heart Surgery Up to Speed in the Minimally Invasive Era. *Innovations (Phila).* Mar/Apr 2020;15(2):101-105.
4. Marelli AJ, Ionescu-Ittu R, Mackie AS, Guo L, Dendukuri N, Kaouache M. Lifetime prevalence of congenital heart disease in the general population from 2000 to 2010. *Circulation.* Aug 26 2014;130(9):749-756.
5. Nellis JR, Vekstein AM, Meza JM, Andersen ND, Haney JC, Turek JW. Left Anterior Mini-Incision for Pulmonary Valve Replacement Following Tetralogy of Fallot Repair. *Innovations (Phila).* Mar/Apr 2020;15(2):106-110.

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