Background
Cardiac catheterization is integral to congenital heart disease management and general anesthesia is required for pediatric patients undergoing catheterization.

Cardiac patients have increased anesthesia risk and often require multiple catheterization procedures with radiation exposure. 1 Ionizing radiation from catheterization has been associated with chromosomal damage in children. 2 Magnetic resonance imaging guided right heart catheterization (MRI-RHC) offers decreased radiation exposure as well as diagnostic and imaging benefits over traditional fluoroscopy but with increased anesthetic complexity and risk. 3, 4

We describe our early experience with anesthetic technique and challenges in pediatric MRI-RHC.

Methods
Following Institutional Review Board approval, we reviewed anesthetic records of all patients consented for MRI-RHC since program initiation in 2014. Demographics, anesthetic techniques and complications were recorded.

Results
➢ Twenty patients were consented for MRI-RHC
➢ Table 1 lists patient characteristics and anesthetic technique
➢ 18 patients completed the procedure without complication.
➢ Mean age was 12.6 years (4-21 years); 56% of patients were male
➢ All patients had general anesthesia
➢ Two MRI-RHC procedures were aborted prior to entering MRI suite due to:
  1. patient hemodynamic instability
  2. abandoned pacing lead identified during fluoroscopy screening; both patients completed cardiac catheterization under fluoroscopy
➢ Two patients required inhaled nitric oxide for provocative testing during MRI-RHC, generating the challenge of MRI suite nitric oxide delivery.
➢ There were no anesthesia or MRI-RHC associated complications.

Discussion
We provide the first report of anesthetic technique for pediatric MRI-RHC.

MR guided catheterization has multiple advantages over traditional fluoroscopy. MR allows prodigious soft tissue visualization and depicts blood and soft tissue in any plane, allowing complex anatomy to be defined in real time. Measurements of volume, cardiac function, perfusion and flow assessment are also obtained during cardiac MRI. Phase contrast MR provides measurements of Qp:Qs during conditions when the Fick Principle is inaccurate. 5 Additionally, MRI offers the important benefit of decreased radiation exposure to both the patient and medical staff.

MR guided RHC requires a suite designed for combined catheterization and MRI procedures. MR procedures are currently limited to right sided heart structures. The MRI environment and general anesthesia present multiple hazards including monitoring challenges and equipment compatibility. 6

To address combined risks of anesthesia in pediatric cardiac patients, MRI environment and cardiac catheterization, we utilized a deliberate approach to protocol development including cardiac anesthesia team, cardiac imaging staff, MR technicians and nursing, cardiac interventionalists and catheterization laboratory nursing and technicians. Figure 1 shows the flow process and safety checks developed and tested using pre-patient in-situ simulations. Similarly, Figure 2 shows our emergency evacuation process.

Conclusion:
MRI-RHC has several advantages over traditional fluoroscopy assisted cardiac catheterization and may have increasing utilization. Despite logistical challenges, complexity and risk, anesthetic care for MRI-RHC can be performed safely in children.

References