Fetal Cardiac Intervention

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OBJECTIVES:

- What is fetal cardiac intervention?
- What are the different types of therapy?
- What conditions are considered for intervention?
- What are the goals, impacts, and outcomes?
WHAT IS FETAL CARDIAC INTERVENTION?

• Pharmacologic or surgical manipulation aimed at the fetus in an effort to improve in utero fetal cardiac status.

• Done during pregnancy, so inherently carries benefits & risks to fetus and also risks to the mother without potential direct benefit.

• Ethical considerations:
  • Surgical risks to mother and fetus
  • Risks to fetus without intervention
  • Medication side effects for mother
  • Couplet pregnancy risks of preterm labor, premature rupture of membranes, infection for both mother and fetus(es)

• Generally considered only for singleton pregnancies and in case of mother without significant co-morbidities
RATIONAL FOR FETAL CARDIAC INTERVENTION

• Improve fetal and neonatal survival
• Improve the course/progression of the evolving disease
• Mitigate and potentially resolve the issue
• Improve or halt end organ damage or progression of damage
TYPES OF FETAL CARDIAC INTERVENTION?

• PHARMACOLOGIC
  • Maternal antiarrhythmics for fetal SVT
  • Oxygen therapy for Shone complex
  • Maternal indocin for Ebstein ‘s anomaly

• INTERVENTIONAL
  • Surgical debulking of teratoma
  • Steroids or pacemaker implantation for fetal heart block
  • Valvuloplasty
  • Atrial septal intervention
FETAL CENTER VOLUMES

- 2012 - 1st TCH Fetal Center Surgical Cardiac Intervention
- To date: 49 referrals, 47 evaluated cases
- 28 cases were offered intervention (60%)
- 20 FCI completed (71%)
- 2019 - 7 referrals, 3 offered, 2 underwent procedure, 1 live birth
WHAT FETAL CONDITIONS ARE CONSIDERED FOR FETAL CARDIAC INTERVENTION?

• Condition 1:

Aortic Stenosis with evolving Hypoplastic Left Heart Syndrome (HLHS):
  • Percutaneous approach
  • A tiny balloon deployed through a needle and is inflated inside the aortic valve to open up the leaflets, which is then removed.
  • This allows blood to flow more easily through the left side of the fetal heart and potentially improve growth & function of left-sided structures to prevent/limit progression to HLHS.
PERCUTANEOUS FETAL VALVULOPLASTY
WHAT FETAL CONDITIONS ARE CONSIDERED FOR FETAL CARDIAC INTERVENTION?

- Condition 2: HLHS with restrictive or intact atrial septum:
  - Fetuses who already have HLHS in-utero with no potential for growth of the left-sided structure depend on an opening in the atrial septum to keep blood circulating throughout their body.
  - The goal of the procedure is to create an atrial septal opening and/or via balloon stretch or by place a stent in utero to decompress the left atrium and provide for mixing.
Why Intervene & What Are the Gains?

- Mortality 50-75% in patients with HLHS and intact/highly restrictive atrial septum
- Goal is NOT biventricular circulation, but to improve blood flow across the atrial septum both prenatally and postnatally and lessen chronic pulmonary bed changes
Hypoplastic Left Heart with intact atrial septum
METHODS FOR ATRIAL SEPTOSTOMY

1. **Needle/balloon technique:** A needle is guided into the fetal heart to initiate a septal opening and then a balloon or stent is guided through the needle and is used to create/maintain an atrial septal opening to keep blood flowing through the fetal heart.

   • Considerations:
     • Difficulty due to tenting of atrium septum during procedure > baby moves
     • Accurate deployment of stent and persistent position over time.

2. **Thulium laser:** TCH has recently innovated this technique with use of a thulium laser to gentle and accurately create an opening in the septum allowing for more reliable stent placement.
THE OPERATING ROOM

- Maternal epidural anesthesia with anxiolytics
- Fetal “combo” Q 30 mins or so during case to paralyze, sedate, manage fetal pain
BALLOON BASED TECHNIQUE....
INNOVATIVE CASE

25 yo F G3P1 at 29.5 wks GA with fetal HLHS with intact atrial septum, presented after decline at OSH d/t severity of lesion and concern with technical limitations due to thick septum and very small LA.

- Evaluations and input by Fetal Cardiology, Fetal Intervention Maternal Fetal Medicine, Interventional Cardiology, CV surgery, Neonatology, Ethics, & Social Services.

- Submitted and approved by Fetal Innovation Committee
Thulium laser septostomy with stent placement
Atrial Stent

Pre-laser flow

Post laser + stent flow

Color flow across atria
CASE OUTCOME

• Delivery: 40.1 wks, SVD, female neonate, Apgars 8, 9
• Neonate underwent Norwood procedure in immediate neonatal period and remained admitted and later underwent a Glenn procedure.
• D/c from TCH last week (~ 6 months post delivery)
• 3rd surgery anticipated age 3-5 yrs age

(Note: Overall survival to age 5 - 50-70%)
WHAT FETAL CONDITIONS ARE CONSIDERED FOR FETAL CARDIAC INTERVENTION?

- Shone’s Complex: Maternal Hyperoxgenation Therapy
  - For fetuses with borderline left heart
  - Texas Children’s Fetal Center is the first in the country to offer a new research protocol in which mothers receive daily oxygen therapy throughout their third trimester.
  - By delivering extra oxygen to the mother through face mask or cannula, we hope to:
    - increase the amount of oxygen in her blood
    - Increase the amount of oxygen going to the placenta and fetus
    - and ultimately increase the amount of oxygen flowing into the fetal lungs and into the left side of the baby’s heart.
  - By improving oxygen flow to the left side of the heart, growth should improve as well
WHAT FETAL CONDITIONS ARE CONSIDERED FOR FETAL CARDIAC INTERVENTION?

- Fetal SVT > urgent referral
  - First line therapy – Digoxin
  - Second line therapy – Digoxin & Sotalol
  - Consideration for fetal intervention for pacing if fails to convert with above and signs of fetal cardiac decompensation
- Maternal Fetal Management:
  - Initially inpatient mgmt. to initiate medications, closely observe mother & fetus
  - Transition to outpatient mgmt. with fetal ECHOs weekly, weekly US, and often twice weekly visits to monitor maternal side effects, EKG, FHR, and maternal drug levels for toxicity.
IN SUMMARY, WHAT ARE THE TAKEAWAYS?

• Innovative care area
• Goals > mitigation
• Consideration of two patients and related risks, benefits, ethics, risk/reward
• Who should perform these? Rare procedures, technically complex
CONCLUSIONS FROM COLLECTIVE EXPERIENCE

• Fetal cardiac intervention can be successfully performed with a dedicated, experienced team

• Fetal aortic valvuloplasty can increase chance of biventricular repair in HLHS

• Fetal atrial septal dilation/stenting may improve outcomes in HLHS with intact atrial septum

• Maternal hyperoxygenation may help left-sided growth in left heart hypoplasia
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https://women.texaschildrens.org/program/texas-childrens-fetal-center

https://women.texaschildrens.org/program/texas-childrens-fetal-center/volumes-outcomes

https://women.texaschildrens.org/program/fetal-cardiology
COMMENTS/QUESTIONS?