Fetal Rhythm and Blues

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Objectives

• To review methods used to assess fetal cardiac rhythm
• To understand and identify abnormal fetal cardiac rhythms
• To learn typical therapy for common fetal arrhythmias
Rhythm...who cares?

Total: 239
Normal: 141 (59%)
Cardiac Rhythm

• Observe rhythm throughout examination
  ♦ Wide variation in rate is normal
  ♦ Short bradycardic or tachycardic rates are normal
  ♦ Occasional ectopic beats

• Measure heart rate - Doppler or M-mode
  ♦ Normal mean HR 140 ± 20 bpm at 20 wks
  ♦ Normal mean HR 130 ± 20 bpm at term

• Tachycardia - > 180 bpm

• Bradycardia - < 100 bpm

• Frequent irregular beats > 1 in 10 beats
Rhythm Method

• M-Mode – line through back wall of atrium and ventricular free wall

• Pulse Doppler
  ◆ Pulse Doppler sector between mitral valve and aorta
  ◆ Pulse Doppler sector between superior vena cava and aorta

• Tissue Doppler

• Feto-Magnetocardiography (fMCG)
M-Mode Rhythm Assessment

• Pros
  ♦ Familiar
  ♦ Simple to perform
  ♦ Adequate for majority of cases

• Cons
  ♦ Poor echo windows common
  ♦ Difficult to get correct angle
  ♦ Timing may be difficult to determine
  ♦ Can be difficult with poor function
Normal Sinus Rhythm
Pulse Doppler Rhythm Assessment

• Inflow–Outflow View
  ♦ Place cursor between mitral valve and aortic valve with larger sample volume

• SVC-Ascending Aorta View
  ♦ Place cursor between SVC and aorta in long axis three vessel view
SVC- Ascending Aorta
SVC-AA Normal Doppler
Common Arrhythmias

- **Tachycardia (> 180 beats per minute)**
  - Thyroid disease, maternal medications, structural heart disease, extracardiac disease
- **Bradycardia (< 100 beats per minute)**
  - Maternal autoimmune diseases, medications, structural heart disease, hydrops
- **Irregular Rhythms**
  - Caffeine intake, medications, structural heart disease
Tachycardias

1. Sinus tachycardia - < 200 bpm
2. Ectopic atrial tachycardia - 180-220 bpm
3. Supraventricular tachycardia - 200-280 bpm
4. Ventricular tachycardia – 180-240 bpm
5. Atrial flutter - 220–400 bpm
Sinus Tachycardia
Supraventricular Tachycardia
Supraventricular Tachycardia

Simpson J, Ultrasound in Obstet Gynecol 2006:27;599
Supraventricular Tachycardia
Ventricular Tachycardia

V = 220
A = 150

Simpson J, Ultrasound in Obstet Gynecol 2006:27;599
Atrial Flutter
Atrial Flutter
Atrial flutter inflow outflow
Atrial Flutter
Bradycardia

- Blocked premature atrial contractions
- Sinus bradycardia
- Complete heart block
- Atrial flutter with high grade AV block
- Prolonged QT syndrome (bradycardia or 2:1 block)
Blocked premature atrial contractions
Blocked premature atrial contractions
Complete Heart Block
Complete Heart Block
Irregular Rhythms

- Sinus rhythm
- Premature atrial contractions
- Premature ventricular contractions
- Chaotic atrial tachycardia
Premature Atrial Contractions
Blocked Premature Atrial Contraction

Simpson J, Ultrasound in Obstet Gynecol 2006:27;599
Premature Ventricular Contractions
Treatment of Common Arrhythmias

- Premature atrial contractions – no treatment needed
- Intermittent tachycardia – observation with close follow-up
- Sustained tachycardia
  - SVT, Atrial Flutter – Digoxin, Flecanide, Sotalol
  - Ectopic Atrial Tachycardia – Digoxin, Amiodarone
  - Worse prognosis with hydrops
  - Deliver if fetus is mature or as last resort
- Bradycardia
  - >60 bpm - observation
  - <60 bpm - Terbutaline, delivery
New Techniques

• Multipoint Pulse Tissue Doppler Imaging
• Fetal Magnetocardiography (fMCG)
Multipoint Pulse Doppler TDI
Fetal Magnetocardiography (fMCG)

- Maternal ECG signal is 10-100x stronger than fetus
- As cardiac tissue depolarizes, currents are generated and a magnetic field is generated
- Strength is about one millionth the strength of the earth's magnetic field
- Maternal signal 50 pT, fetus 0.5-10 pT
SQUID

• Superconducting Quantum Interference Device
• Supercooled and shielded
• Filter for background noise
• Identify maternal signal and then attenuated
• Result is a signal analogous to a surface ECG
Figure 1. SARA, consisting of 151 gradiometers arranged to comfortably fit the gravid abdomen.
Figure 2. (A) Raw tracing demonstrating both fetal and maternal tracings. Maternal signals are marked with blue arrows. Fetal signals are marked with red arrows. (B) Fetal signal after attenuation of maternal signal using orthogonal projection.
Figure 3. (A) FMCG of twin “A” in atrial flutter with signal averaged ECG. (B) FMCG of twin “B” in sinus. Recordings were obtained simultaneously.
Case 1
** PEDIATRIC ECG ANALYSIS **

NORMAL SINUS RHYTHM WITH FREQUENT NONCONDUCTED ATRIAL BEATS.

TYPE I OR TYPE 2 SECOND DEGREE ATRIOVENTRICULAR BLOCK

OCCASIONAL PREMATURE ATRIAL BEATS

NONSPECIFIC T WAVE ABNORMALITY

NONCONDUCTED ECGS AVAILABLE
Case 2
**Pediatric ECG Analysis**

- **Vent rate**: 39 BPM
- **PR interval**: 6 ms
- **QRS duration**: 66 ms
- **QT/QTc**: 666/536 ms
- **F.R.T axes**: 50 55 67

**Diagnosis**

- **Sinus Rhythm with Complete Heart Block and Junctional Bradycardia**
- **Borderline Left Axis Deviation for Age**
- **Left Ventricular Hypertrophy**
- **Non-specific ST Abnormality**
- **Prolonged QT, May be Secondary to QRS Abnormality**

**Technical Information**

- **Room**: NCCC
- **Loc**: 477
- **Technician**: Kellie Rybicki
- **Test Ind**: UNK

**EID**: 1093

**Equipment Details**

- **25mm/s** 10mm/mV 150Hz 8.0.1 12SL 241 HD CID: 107

**Date and Time**

- **13-12-08 OCT 2016**

**Order Information**

- **Order No**: 1265673390
- **Account**: 20263468755
Case 3
Case 4
**PEDIATRIC ECG ANALYSIS**

**14-JUN-2011 08:33:36**

**Location:** NCCA, Loc: 477

**Patient Information:**
- **Age:** <1 days
- **Gender:** Male
- **Race:** Caucasian
- **Heart Rate:** 206 BPM
- **PR Interval:** 120 ms
- **QRS Duration:** 56 ms
- **QT/QTc:** 218/403 ms
- **P-R-T Axes:** 210 191

**Diagnosis:**
- **Atrial Flutter with 2 to 1 Block**
- **Right Axis Deviation**
- **Right Ventricular Hypertrophy**

**ECG Tracings:**
- Leads I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6

**Remarks:**
- **Expedite:**
- **Referral by:** 970697 Savage
- **Confirmed by:** JMI OEHRI MD

**Comments:**
- No previous ECGs available.
Case 6
Summary

• Fetal rhythm disturbances are common and mostly benign
• Rhythms can be identified through multiple echo modalities
• A complete fetal echocardiogram should be done to rule out structural heart disease
• Treatment should be undertaken by an experienced team including high risk OB and pediatric cardiology