Fetal Arrhythmia

Recommendations of Practice

Background

- An irregular heart rate is noted at some point in 1 – 2% of all pregnancies
- 90% of these are of no clinical significance
- A sustained bradyarrhythmia or tachyarrhythmia can lead to congestive heart failure, hydrops, fetal demise, and the possibility of neurologic morbidity.

Objective

- To guide the accurate diagnosis, investigation and management of women presenting with a fetal arrhythmia.

Definition

- A normal fetal heart rate is usually in the range between 110 and 160 bpm.
- Fetal arrhythmias can be divided into three categories:
    - Irregular/Ectopic beats
        - 85% of all arrhythmias
        - Usually secondary to atrial extrasystoles
        - More common in 3rd trimester
        - 1 – 3 % will develop a sustained tachyarrhythmia.
    - Tachyarrhythmias
        - HR > 180 bpm
        - Unlikely to compromise the fetal circulation until > 200 bpm
        - 5 – 8% of all arrhythmias
        - 5% also have structural congenital heart disease (CHD)
        - Two most common types of tachyarrhythmias:

            1.SVT:
            - HR 180 - 300 BPM (60 – 90%)
            - Usually re-entrant tachycardia secondary to an accessory pathway

            2.Atrial Flutter:
            - HR 220 – 500 BPM (10 – 30%)
            - Slower ventricular rate secondary to variable AV block (2:1 or 3:1 conduction).
    - Bradyarrhythmias
        - HR < 110 BPM
        - 5 – 8% of all arrhythmias
        - Types of bradyarrhythmias:

1. *Ectopic related*
   Most commonly blocked atrial premature beats. This is usually benign. The rhythm may be slow and irregular or slow and regular if there is atrial bigeminy.
2. *Complete heart block*
   a. Structural heart disease: 50% is associated with CHD and is due to abnormal structure and/or course of the conduction system. Atrial isomerism and congenitally corrected transposition of the great arteries are most common associated anomalies
   b. Anti-Ro/Anti-La Antibodies (anti SSA/ anti SSB antibodies)
   - 1:15,000 – 20,000 live births.
   - 2% of antibody positive women will develop some degree of atrial- ventricular block (AVB). Risk increases to 15-20% if previous offspring affected by heart block and/or cutaneous lupus
3. *Long QT syndrome and other channelopathies*
   These may be familial. In cases where long QT syndrome is suspected, ECG on both parents is useful. In cases where a combination of sinus bradycardia or 2:1 AVB and ventricular tachycardia are noted, consider diagnosis of long QT (very rare but can be life threatening).

Differential Diagnosis

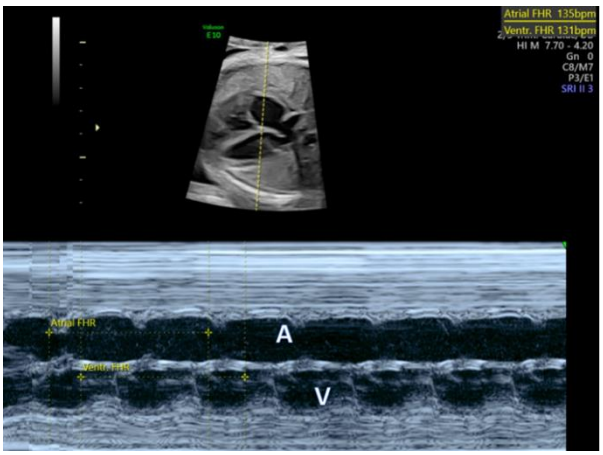
- Infection – maternal or fetal
- Hypoxia
- Fetal anaemia
- Maternal drugs
- Maternal Graves' thyrotoxicosis.

Important History

- Maternal drugs
- Connective tissue disorder or rheumatological disorder including SLE
- Maternal thyroid status
- (Family) history of congenital heart disease.

Ultrasound

- M-Mode Doppler
  - Detects atrial and ventricular wall motion.



Assessment of rhythm with M-mode
SVT 1:1 conduction

- Pulsed Wave Doppler
    - Determines the P-R interval
    - Best sites to obtain the P-R interval from are:
        - Left ventricular inflow-outflow
        - IVC-descending aorta
        - SVC-ascending aorta
        - Pulmonary artery-Pulmonary vein.

- Structural heart views
    - Obtain or check all basic cardiac views (no need to repeat if they have been demonstrated to be normal at the time of anatomy scan)
        - Four chamber view
        - Outflow tracts
        - Three vessel view and three vessel trachea view
        - Aortic and ductal arches
- Assess for signs of heart failure, including cardiomegaly, pericardial effusion, tricuspid regurgitation.
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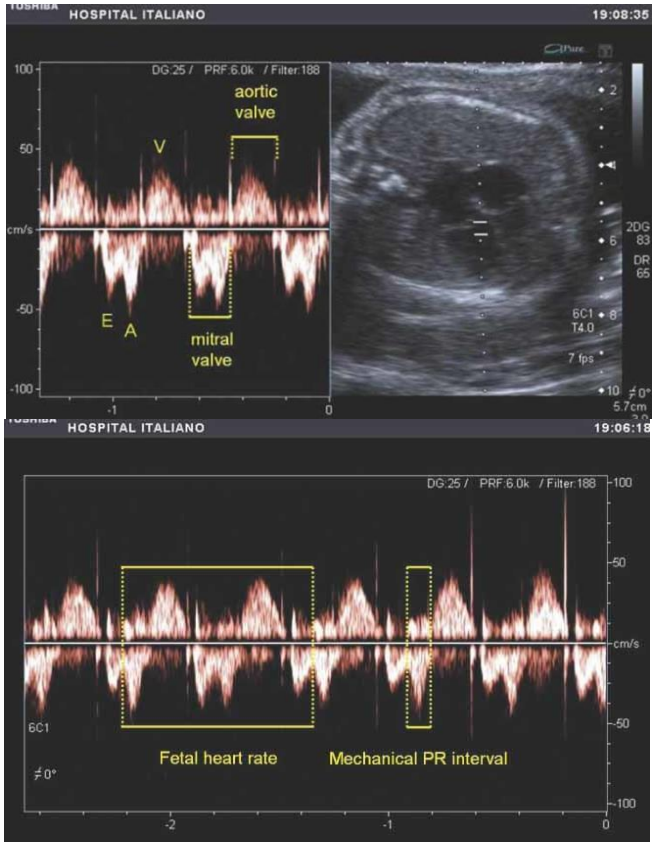


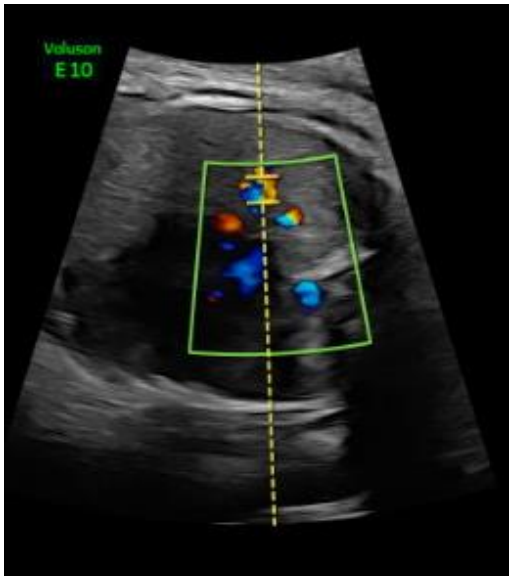
Measurement of PR interval
(Wojakowski UOG 2009; 34: 538–542)

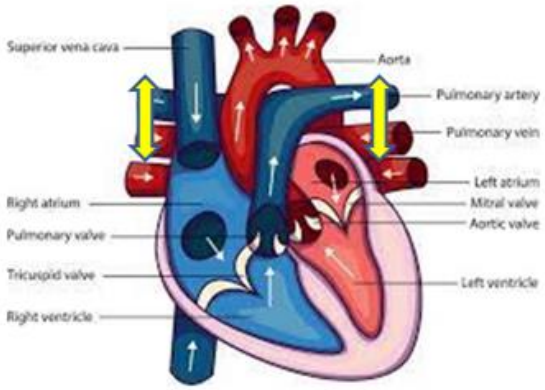
Investigation

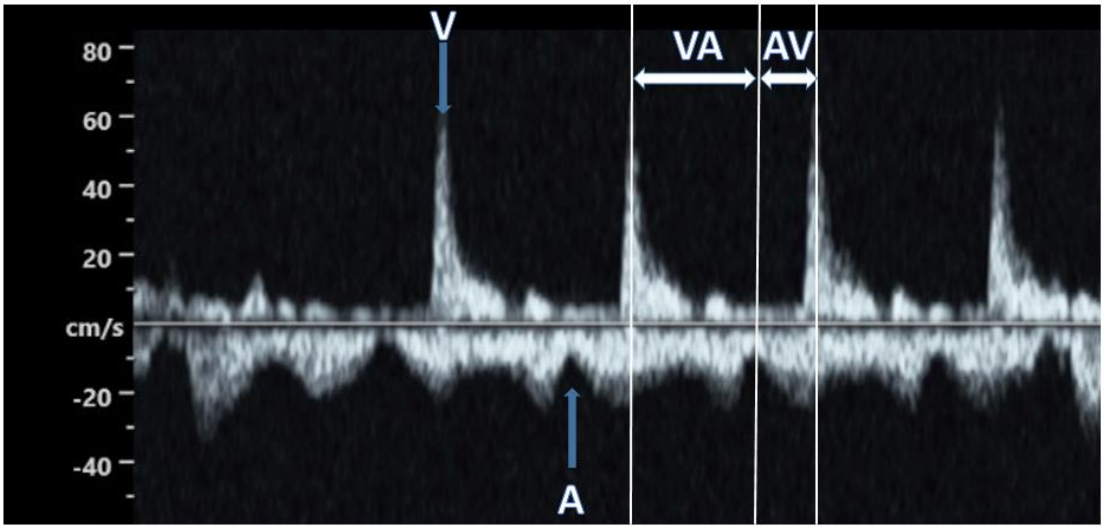
- Maternal vitals
- Maternal thyroid function tests +/- thyroid antibodies (TRAb)
- Ultrasound
    - MCA peak systolic velocity
    - M-mode or pulsed wave for waveform assessment (examples below).
    -

Prognosis

- Irregular/Ectopic Beats
    - Excellent prognosis if does not progress to sustained tachycardia.
- Tachyarrhythmia
    - 90% survival for SVT and Flutter with transplacental medical treatment
    - Most infants have medications stopped in 1st year of life
    - 30% will have recurrent SVT
    - >75% of arrhythmias can be converted to sinus rhythm with antenatal treatment
    - Presence of hydrops does not affect cardiac conversion significantly if appropriate medications chosen (75% conversion to sinus rhythm)
    - Factors associated with worse prognosis
        - Hydrops
        - Associated abnormalities esp. structural heart disease
        - Metabolic derangements
        - Inappropriate medication choice.







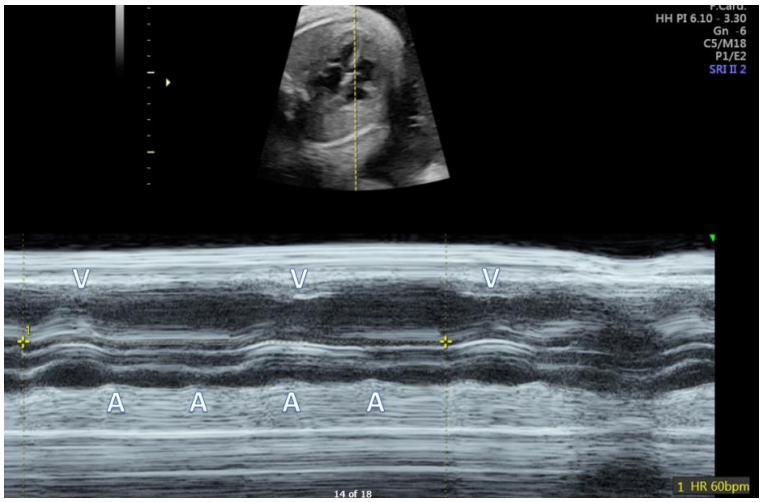
Assessment of rhythm with pulsed wave Doppler: Long VA tachycardia: VA > AV interval

(Note: In cases where VA < AV interval: this is suggestive of re-entry tachycardia)

- Bradyarrhythmia
  - High morbidity and mortality
    - Hydrops is most important prognostic factor – in the context of complete heart block and in the absence of an option to deliver and pace the heart rate it is almost always fatal and consideration to a palliative care pathway should be given
    - Presence of structural heart disease next most important prognostic factor – greater than 80% mortality in presence of atrioventricular block
    - Ectopic related bradycardia usually has a good prognosis, and can be managed expectantly with low risk tachycardia.
    - In presence of Anti Ro/ Anti La antibodies congenital heart block usually manifests between 18 and 28 weeks gestation. The antibodies can sometimes cause endocardial fibroelastosis or more serious valvular disease or dilated cardiomyopathy. Second degree heart block or complete heart block result in fetal bradycardia. Progression to complete block can happen quite rapidly and

unpredictably. Once complete heart block has developed, this is irreversible. In this situation the fetal heart rate can drop to below 50 BPM, which can cause hydrops. Other factors worsening prognosis:

- HR < 55 BPM
- Negative antibodies.



Complete heart block M-Mode: total A-V dissociation

Management/Treatment

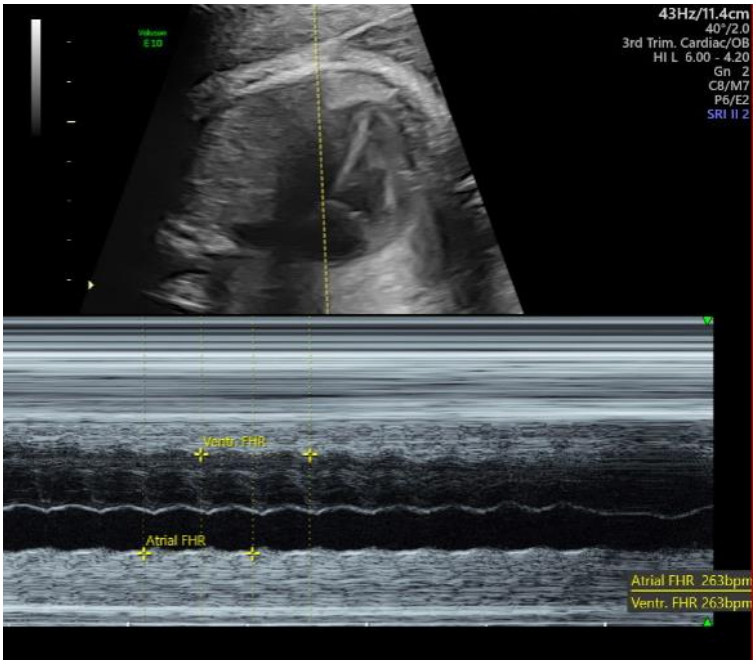
NO CONTROLLED TRIALS OF TREATMENT (Fast Trial underway)

- General options for treatment are:
  1. Observe
  2. Deliver then treat
  3. Transplacental fetal therapy (maternal ECG, electrolytes and drug levels as part of process)
  4. Direct fetal therapy.

- No treatment if:
  - Intermittent (arrhythmia present < 50% of time) and no signs of fetal compromise
  - No cardiac or valvular dysfunction
  - Advanced gestation (> 37 weeks).

- Irregular/Ectopic Beats
  - Confirm standard views of cardiac anatomy have previously been obtained to rule out structural heart disease (echo not needed if all standard views were obtained and appear normal)
  - Weekly auscultation via handheld Doppler to rule out conversion to tachyarrhythmia, at least until resolution (at least 3 consecutive weeks where no ectopic beats are heard). This can be done via LMC with referral back in cases of conversion to a tachyarrhythmia. LMC can do auscultation for a minimum of 5 minutes, and refer back urgently to the local fetal medicine unit if there is a sustained tachycardia > 180 bpm.
  - Recommend mother to limit caffeine intake
  - If the arrhythmia persists until near term, hospital delivery is advised, with paediatrician review, and if clinically indicated an ECG of the neonate is advised.

- Tachyarrhythmia *(see drug chart below)*
  1. *Supraventricular tachycardia*
     - Non-Hydropic Infant
       - Transplacental Flecainide therapy 1st line.
       - Either sotalol or digoxin are equivalent 2nd line agents.
     - Hydropic Infant
       - Flecainide 1st line
       - Sotalol or Amiodarone 2nd line
       - Direct fetal therapy with intramuscular (fetal) digoxin: Can be considered for the hydropic fetus
         - Reduces time to onset of sinus rhythm, from 145 +/- 114 hrs to 5.5 +/- 4 hrs.
  2. *Atrial flutter*
     - Non-Hydropic Infant
       - Transplacental Sotalol therapy 1st line.
       - Second line digoxin in combination with Flecainide
     - Hydropic Infant
       - Atrial flutter: Sotalol 1st line (NOT flecainide as it does not slow AV conduction time).
       - Digoxin or Amiodarone 2nd line
       - Direct fetal therapy with digoxin: Can be considered for the hydropic fetus.



Atrial flutter may show 2:1 conduction

- Bradyarrhythmia (see drug chart below)
  - Ectopic related bradycardia:
    - manage expectantly as low risk of sustained tachycardia. Most important not to deliver the baby for this indication.
  - Heart block due to maternal Ro/La antibodies:
    - Treatment with steroids: Fluorinated steroids, such as dexamethasone, cross the placenta and have the potential to mitigate inflammation in

autoimmune congenital heart block-affected children, but there are conflicting reports regarding the drug's efficacy for either treatment or prophylaxis. Jaeggi *et al*. concluded that CHB-affected fetuses treated with both dexamethasone and β-agonists had improved survival at one year and reduced morbidity. However, several research groups could not confirm this finding, and concluded that in isolated cases of autoimmune CHB, prenatal corticosteroid treatment showed no significant difference for in utero progression, survival to birth, pacemaker implantations, or long-term dilated cardiomyopathy. The option of treatment and associated uncertainty of benefit and risk should be discussed, and management determined with patient individually.

- Monitor for AV valve regurgitation (MVR specifically) and umbilical artery blood flow for positive end-diastolic flow (note: umbilical artery pulsatility index reading will be outside the normal range).
- Indications for intervention or delivery include evidence of deterioration in cardiac function or early signs of hydrops in the context of a fetal heart rate < 55 bpm.
- Intervention with medication: Sympathomimetic agents such as Salbutamol or Terbutaline can be considered.
- Fetuses with complete heart block will need once weekly scans for fetal wellbeing and assessment for signs of hydrops. Consider increasing the monitoring frequency to twice weekly if FHR < 60 bpm.

Future pregnancies

- In pregnancies with antibodies and a previously affected fetus it is recommended to start hydroxychloroquine 400 mg once daily (or 200 mg once daily if maternal weight < 50 kg) from <10 weeks gestation onwards until delivery. In this high risk situation weekly measurement of PR interval from 16 weeks onwards should be considered. Maintenance dosing of 200 to 400 mg once daily should be considered after several weeks.
- In women with positive antibodies without a history of a previously affected fetus assessment at 16, 20 and 24 weeks is recommended. Fetal heart rate should be documented on every routine obstetric visit.

Drug chart

Medication	Mechanism of Action	Maternal Dosage & Monitoring	Utility	Precautions
Digoxin	Slows AV nodal conduction via increased vagal tone	Check baseline ECG, electrolyte & creatinine (target K+ >4.0; Mg2+ >0.8) Start 0.25 mg TDS for 2 days then check level and maintain at 0.25mg daily or BD depending on level Monitor ECG, electrolyte and level every 3 days. Target 6-hours post-dose level 1.5 to 2.0 nmol/L (toxicity if >2.6 nmol/L)	Not effective in hydropic infants. Option for second line treatment of SVT, or for atrial flutter in absence of hydrops if combined with Flecainide	Not recommended in WPW. ½ dose if used with amiodarone ECG may show "digitalis effect" which is different to toxicity (PVC, tachyarrhythmia, AV block)
Direct fetal treatment with Digoxin	Slows AV nodal conduction via increased vagal tone	i.m. digoxin 88 mcg/kg, every 12-24 hours (max 3 doses), given in fetal buttock.	May be effective if transplacental treatment is delayed due to hydrops	
Sotalol	K^+ channel blocker and Beta blocker (non-cardioselective). Slows AV nodal and accessory pathway conduction	Check baseline ECG, electrolyte & creatinine (target K+ >4.0; Mg2+ >0.8) Without hydrops: start 80 mg BD. Dose can be titrated according to response and toxicity with a stepwise increase of 80 mg every 3 days until maximum 480 mg per day in 3 divided doses. With hydrops: Loading dose 240 mg, then 80 mg BD. Dose can be titrated according to response and toxicity with a stepwise increase of 80 mg every 3 days until maximum 480 mg per day in 3 divided doses. Monitor ECG and electrolyte every 3 days. Check ECG for wide QRS, new AV or bundle branch block and QTc >480 ms	Preferred treatment for atrial flutter (with or without hydrops); combines well with digoxin. Option for second line treatment of SVT	Sotalol is proarrhythmic. Severe QT prolongation possible. Avoid other meds with same effect and monitor maternal ECG Caution if maternal asthma To wean dose over 1 to 2 weeks (do not stop abruptly)

Flecainide	Na^+ channel blocker. May increase AV nodal conduction. Very effective at blocking accessory pathway conduction Must be used with conduction slowing agent (e.g. Digoxin) in Atrial Flutter without hydrops	Check baseline ECG Start 100 mg TDS Aim for trough (pre-dose) level of 300 to 600 ug/L Monitor ECG and level every 3 days. Check ECG for wide QRS, new AV or bundle branch block and QTc >480 ms	Preferred treatment for SVT (with or without hydrops) (NOT for atrial flutter with hydrops).	Do not use with maternal structural heart disease (if unsure, arrange maternal echo prior to dose) Need AV blocking agent when used with AF. Do not refrigerate
Amiodarone	K^+ channel blocker. Slows conduction velocity and prolongs refractory period in all cardiac tissues	Check baseline ECG, electrolyte, liver and thyroid function (target K+ >4.0; Mg2+ >0.8) PO 600 mg TDS for 2 to 7 days, reducing to 400 mg BD for 7 days, then to 200 to 400 mg/day Monitor ECG every 3 days. Check ECG for wide QRS, new AV or bundle branch block and QTc >480 ms	Promising in management of hydropic fetus without AF	Rare hypotensive collapse with IV use. Decrease digoxin dose by 50% (if concurrent use) before starting amiodarone QT prolongation possible. Avoid other meds with same effect. Long half life
Dexamethasone	Reduce immune response, as cause is thought to be inflammatory carditis.	Check baseline fasting glucose and HbA1c (if high risk for GDM) 4 or 8 mg/day for 2 weeks, followed by 4 mg/day, when possible, maintained for duration of pregnancy, tapering at times (2 mg/d) in the third trimester.	Incomplete heart block with positive anti Ro/La Stop if progression to complete heart block (unless steroids which are given to improve fetal lung maturity appear to improve cardiac function)	Poor tolerance from maternal side effects (weight gain, neuropsychiatric, hyperglycaemia, hypertension) Fetal concerns include oligohydramnios, fetal growth restriction and neonatal adrenal insufficiency
Salbutamol	Beta- symphato mimetic	Check baseline ECG, electrolyte and thyroid function (target K+ >4.0). Caution if QTc >480 ms Start PO 2 to 4mg TDS/QID	For heart block with signs of fetal cardiovascular compromise	Poor tolerance from maternal side effects (tremor, palpitation, sweating) Monitor for hypokalaemia and arrhythmia. Can cause QT prolongation
Terbutaline	Beta- symphato-mimetic	Check baseline ECG, electrolyte and thyroid function (target K+ >4.0). Caution if QTc >480 ms Start PO 2.5 to 5mg TDS	For heart block with signs of fetal cardiovascular compromise	Poor tolerance from maternal side effects (tremor, palpitation, sweating) Monitor for hypokalaemia and arrhythmia. Can cause QT prolongation

This Recommendation of Practice was updated in March 2023 by Dr. Monique Stein with input from members of Wāhi Rua NZMFM Network, and from Congenital Cardiac Services, Starship Children's Hospital, and Obstetric physician Dr. Ian Kando, Auckland City Hospital.

The most up to date version of this Recommendation of Practice can be found on Healthpoint Wāhi Rua: New Zealand Maternal Fetal Medicine Network (NZMFM) webpages: https://www.healthpoint.co.nz/public/wahi-rua-new-zealand-maternal-fetal-medicine/

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