Paediatric ECG Interpretation

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(thanks to http://lifeinthefastlane.com/ecg-library/paediatric-ecg-interpretation/)
3 yo boy complaining of abdominal pain and chest pain
Child ECG vs Adult ECG
What’s different?

• Newborn has ECG picture reminiscent of right ventricular hypertrophy in the adult:
  – marked rightward axis,
  – dominant R wave in V1
  – T-wave inversions in V1-3.
Child ECG vs Adult ECG
What’s different?

Conduction intervals (PR interval, QRS duration) are shorter than adults due to the smaller cardiac size.
May be normal findings in children

1. Heart rate >100 beats/min
2. Rightward QRS axis > +90°
3. T wave inversions in V1-3 (“juvenile T-wave pattern”)
4. Dominant R wave in V1
5. RSR’ pattern in V1
6. Marked sinus arrhythmia
7. Short PR interval (< 120ms) and QRS duration (<80ms)
8. Slightly peaked P waves (< 3mm in height is normal if ≤ 6 months)
9. Slightly long QTc (≤ 490ms in infants ≤ 6 months)
10. Q waves in the inferior and left precordial leads.
1. Heart rate >100 beats/min

- Newborn: 110 – 150 bpm
- 2 years: 85 – 125 bpm
- 4 years: 75 – 115 bpm
- 6 years+: 60 – 100 bpm
2. Rightward QRS axis > +90°
<table>
<thead>
<tr>
<th>Lead</th>
<th>1</th>
<th>aVF</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°−+90</td>
<td><img src="image1" alt="Graph" /></td>
<td><img src="image2" alt="Graph" /></td>
</tr>
<tr>
<td>0°−−90°</td>
<td><img src="image3" alt="Graph" /></td>
<td><img src="image4" alt="Graph" /></td>
</tr>
<tr>
<td>+90°−180°</td>
<td><img src="image5" alt="Graph" /></td>
<td><img src="image6" alt="Graph" /></td>
</tr>
<tr>
<td>−90°−180°</td>
<td><img src="image7" alt="Graph" /></td>
<td><img src="image8" alt="Graph" /></td>
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</tbody>
</table>

- Normal
- Left
- Right
- Extreme Right
3. T wave inversions in V1-3 (“juvenile T-wave pattern”)

- **The precordial T-wave**: 
- For the first week of life, T waves are upright

- After the first week, the T waves become inverted in V1-3
  - the “juvenile T-wave pattern”
  - usually remains until ~ age 8
  - can persist into adolescence and early adulthood
    - persistent juvenile T waves

**Tall, peaked T waves** are seen in:
- Hyperkalaemia
- LVH (volume overload)
- Benign early repolarisation

**Flat T waves** are seen in:
- Normal newborns
- Hypothyroidism
- Hypokalaemia
- Digitalis
- Pericarditis
- Myocarditis
- Myocardial ischaemia

**Large, deeply inverted T waves** are seen with:
- Raised intracranial pressure (e.g. intracranial haemorrhage, traumatic brain injury)
3 yo boy complaining of abdominal pain and chest pain
ST

Normal:
- Limb lead ST depression or elevation of up to 1mm (up to 2mm in the left precordial leads).
- J-point depression: the J point (junction between the QRS and ST segment) is depressed without sustained ST depression, i.e. upsloping ST depression.
- Early repolarisation in adolescents: the ST segment is elevated and concave in leads with an upright T wave. Others are **pathological**:  
  - A downward slope of the ST followed by a biphasic inverted T.

Pathological
- Pericarditis.
- Myocardial ischaemia or infarction.
- Severe ventricular hypertrophy (ventricular strain pattern).
- Digitalis effect.
• A sustained horizontal ST segment depression 0.08 sec or longer.
• A = upsloping ST depression / J-point depression (normal variant)
• B = downsloping ST depression (usually abnormal)
• C = horizontal ST depression (usually abnormal)
3 yo boy complaining of abdominal pain and chest pain
3. Dominant R wave in V1
4. RSR’ pattern in V1
5. Marked sinus arrhythmia
Short PR interval (<120ms) and QRS duration (<80ms)

- **Prolonged PR interval**
  - *normal*
  - myocarditis
  - congenital heart disease (Ebsteins, ECD, ASD)
  - Digitalis toxicity
  - Hyperkalaemia

- **Short PR interval**
  - *normal*
  - Pre-excitation (eg Wolff-Parkinson-White)
  - Glycogen storage disease

- **Variable PR interval**
  - Wandering atrial pacemaker
  - Wenckebach (Mobitz type 1) second degree heart block
QRS

Prolonged QRS is characteristic of ventricular conduction disturbances:

- Bundle branch blocks
- Pre-excitation conditions (eg WPW)
- Intraventricular block
- Ventricular arrhythmias

| Table 3–3. QRS Duration: Average (and Upper Limits of Normal) for Age |
|---|---|---|---|---|---|---|---|
| 0–1 mo | 1–6 mo | 6 mo–1 yr | 1–3 yr | 3–8 yr | 8–12 yr | 12–16 yr | Adult |
| Seconds | 0.05 (0.07) | 0.05 (0.07) | 0.05 (0.07) | 0.06 (0.07) | 0.07 (0.08) | 0.07 (0.09) | 0.07 (0.10) | 0.08 (0.10) |
3 yo boy complaining of abdominal pain and chest pain
8. Slightly peaked P waves (< 3mm in height is normal if ≤ 6 months)

• Normal P-wave amplitude is < 3mm (tall P waves = right atrial enlargement).

• Normal P wave duration is < 0.09 seconds in children and < 0.07 seconds in infants (wide P waves = left atrial enlargement).

• A combination of tall and wide P waves occurs in combined atrial hypertrophy.
3 yo boy complaining of abdominal pain and chest pain
9. Slightly long QTc (≤ 490ms in infants ≤ 6 months)
10. Q waves in the inferior and left precordial leads.

- QT interval varies with heart rate.
- *Bazett’s formula* is used to correct the QT for HR:
  \[ \text{QTc} = \frac{\text{QT measured}}{\sqrt{\text{R–R interval}}} \]

**Normal QTc**

- Infants less than 6 months = < 0.49 seconds.
- Older than 6 months = < 0.44 seconds
**QTc is prolonged in:**
- Hypocalcaemia
- Myocarditis
- Long QT syndromes eg Romano-Ward
- Head injury
- Drugs

**QTc is short in:**
- Hypercalcaemia
- Digitalis effect
- Congenital short QT syndrome
Normal Q waves:
- Narrow (average 0.02 seconds and less than 0.03 seconds).
- Usually less than 5mm deep in left precordial leads and aVF.
- May be as deep as 8mm in lead III in children younger than 3 years.

Q waves are abnormal if they:
- Appear in the right precordial leads ie V1 (eg severe RVH).
- Are absent in the left precordial leads (e.g. LBBB).
- Are abnormally deep (ventricular hypertrophy of the volume overload type).
- Are abnormally deep and wide (myocardial infarction or fibrosis).
A U Wave is an extra positive deflection at the end of a T wave. Most common causes:
  - Hypokalaemia
  - Normal finding at slower heart rates (e.g. sinus bradycardia).
3 yo boy complaining of abdominal pain and chest pain
• The same patient with the paper at double speed (50 mm/s).
• There are no visible P waves — this is an AV nodal re-entry tachycardia.
6 yo girl with syncope
If you search “askew” in Google search, the page will tilt slightly clockwise.

wtf-fun-facts.tumblr