The "Interpretation" of the Cardiologist's ECG Interpretation

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The physician receiving ECG results may question what these mean in some instances, what is significant and finally, what to do with the results. This is a brief review of the terminology and implications of ECG interpretations to assist providers in their decision making.

Intraventricular Conduction Delay

This is also known as conduction delay, IVCD, or incomplete right bundle branch block (iRBBB).

It is mostly a variant of normal, especially in athletes. The difficulty for cardiologists reading an electrocardiogram with conduction delay without seeing the patient is that it is tempting to label it as normal since the vast majority of the patients with this, in fact, have a normal heart. But since there is a small proportion of patients who do have an abnormality, a decision on whether or not the patient should be evaluated further depends on the reasons for the electrocardiogram.

Cause for concern: This may be a manifestation of RV enlargement in situations such as an atrial septal defect or anomalous pulmonary venous return. Sometimes medications can cause conduction delay, this is felt to be benign. If a murmur is present or there are potential cardiac symptoms or the QRS duration is >120msec cardiology evaluation is warranted.

Sinus Arrhythmia

This is invariably normal and physiologic. Unfortunately, when it is very pronounced, it can be a cause for concern in the patient or parents who interpret the irregular rhythm as abnormal or possibly (in medical families) as a sign of atrial fibrillation. Frequently these situations result in sinus tachycardia because of the fear reaction. Holter monitors interpreted by non-pediatric cardiologists may label this as recurrent SVT.

Left Axis Deviation (LAD)

This refers to the mean QRS vector being less than 0 degrees. Cause for concern is that it can be associated with an AV canal defect or inlet VSD. Other causes include left-sided heart disease, single ventricles, and cardiomyopathies.

It is frequently a normal variant in asymptomatic older children. However, the reason for performing the ECG in part should dictate whether cardiology evaluation is warranted. In infants or children with murmurs or a family history of cardiomyopathy, cardiology evaluation is warranted. If the mean QRS vector is greater than -10 degrees (example -30 degrees), cardiology evaluation is warranted as is the case if there is LAD along with other findings (T wave inversion, atrial enlargement, conduction delay, etc.)

Right Axis Deviation (RAD)

Most of these are normal in the range of 90-100 degrees. Cardiology evaluation is recommended for >120 degrees.

First-Degree AV Block

This refers to PR prolongation >200msec; however, it is a rate-dependent definition, thus shorter intervals at low heart rates also qualify.

The majority of cases are normal variants.

Pathological causes for this relate to the underlying reason for the first-degree AV block. With an atrial septal defect, the atrial enlargement can prolong the time for conduction from the sinus node to the AV node. These individuals will have a murmur and may also have IVCD (see above). A patient with a history of possible SVT may have first degree AV block because of the presence of "dual AV node physiology," which is the presence of two pathways to the AV node that predispose to AV node reentry SVT, the most common type of SVT with onset in the adolescent and teen years. Finally, there are occasional cases of AV node dysfunction that may show first-degree AV block.

Consider cardiology evaluation in symptomatic patients or those with a heart murmur or PR > 400ms.

Second Degree AV Block, Wenckebach Type (MobitzType 1)

This is a gradual prolongation of the PR interval followed by a dropped QRS complex after a P wave. It is commonly seen in normal children during deep sleep on Holters or inpatients being monitored on telemetry. The reason for this being considered benign during sleep is that the high vagal tone during deep sleep is felt to be a physiologic cause. It is not considered normal when individuals are awake. The

exception to the rule is highly-trained athletes who have increased vagal tone manifesting at rest. If in doubt, contact a cardiologist to discuss the need for referral.

Sinus Pauses During Sleep

Pauses of less than 2 seconds are often seen in normal individuals during sleep, but generally there will just be one to three of these, not dozens. More frequent pauses or pauses >2.5 seconds should be evaluated.

Variants of Normal Rhythm

These are not of concern and include:
Sinus bradycardia (rates >30)
Sinus arrhythmia
Low right atrial rhythm or ectopic atrial rhythm (NOT atrial ectopic **tachycardia**)
Wandering atrial pacemaker
Junctional rhythm
Rare PACs and rare PVCs

Left Ventricular Hypertrophy

Up to 40% of highly trained athletes with a **normal heart** may show voltage criteria for LVH (SV1+RV6 >35mm), the same is also true for many African-American people.

Patients with hypertrophic cardiomyopathy will also show LVH but in these cases there are frequently other accompanying abnormalities such as T wave inversion, ST depression, QRS axis deviation, complete bundle branch block, atrial enlargement.

Therefore the indication for cardiology evaluation is either symptoms, a murmur, family history of cardiomyopathy (“enlarged heart”), sudden death or the presence of LVH PLUS other ECG abnormalities. Please make sure all first degree relatives of a patient diagnosed with hypertrophic cardiomyopathy are evaluated.

Bundle Branch Block

True complete (not incomplete) bundle branch block, BBB, either right or left warrants cardiology evaluation.

Early Repolarization

This is often seen in teen athletes and is usually normal. It consists of J point elevation, ST elevation and some terminal QRS slurring in the inferior and/or lateral leads. This is different than ST elevation in many leads and one should be suspicious in a patient with a history of pericarditis (chronic pain, difficulty lying supine, nausea or decreased appetite, and audible cardiac rub).

Q Waves

Small narrow Q waves (less than 40ms or one small box) in one or two leads may be normal but otherwise wider or deeper Q waves warrant further evaluation

Prolonged QTc

The most common cause for a prolonged QTc seen by cardiologists on a daily basis are drug overdoses and ingestions. Other benign causes are low K, Ca, Mg, use of tricyclic antidepressants and erythromycin. It would be prudent to repeat an ECG on these patients when the ingestion or electrolyte imbalance is completely resolved.

The best assessment of the QTc is using the Bazett formula, not Hodges. Unfortunately, the presets for ECG machines in the majority of pediatrician's offices is the Hodges formula. All children's hospitals and our group use Bazett. Please consider having your ECG tech contact our office medical assistants for advice on changing the preset formula.

Bazett QTc= QT(in msec)/ square root of RR (in msec)

Normal: Male up to 0.425, females up to 0.444. Consider the QTC prolonged and worthy of further investigation if 0.460 or greater. Note that ECG machine QTc values are often incorrect and it can take an experienced reader to correctly identify a prolonged QTc. This is the reason that the **indication for the ECG** is so important: History of seizures, syncope, family history of sudden death or Long QT syndrome will prompt the reader to manually measure a QTc. Please make sure all first degree relatives of a person with Long QT syndrome are evaluated.

African-American Athletes

In African-American athletes a common normal variant ECG finding is the combination of left ventricular hypertrophy plus J point elevation (early repolarization) with a convex pattern and T wave inversion in leads V1-V4.

Two or More "Borderline" ECG Findings

Consider cardiology referral.

Helpful references

Pediatric Cardiology Center of Oregon, www.pccoforegon.com, phone 503-280-3418, fax 503-284-7885.

Simplified Pediatric Electrocardiogram Interpretation. William N. Evans et al., https://fhs.mcmaster.ca/pediatrics/documents/simplifiedEKGinterpretation-clinicalpediatrics2010.pdf. This is a very easy to use and simple guide to reading Pediatric ECGs.

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