ECG Quiz 54

CASSA
CARDIAC ARRHYTHMIA SOCIETY OF SOUTHERN AFRICA
A SPECIAL INTEREST GROUP OF SA HEART ASSOCIATION

ANSWER

OVERVIEW OF THE ECG

This is an electrocardiogram (ECG) of a 3-year-old girl – so an important consideration before classifying the rhythm is to remember the normal QRS duration for a child of this age. The normal paediatric values by age are displayed in Table I.[1] The normal QRS duration in a 3-year-old is between 0.04s and 0.08s. The QRS duration in this ECG is 0.07s (70ms) and the ventricular rate is 144bpm. This is therefore a narrow complex, regular tachycardia. A QRS axis of +90 degrees is normal for this age group (0 to +110 degrees). A dominant R in V1 can be a normal finding in this age group. The narrow QRS complexes make the diagnosis of monomorphic ventricular tachycardia (VT) highly unlikely.

MORE DETAILED ANALYSIS OF THE ECG

The first step in the analysis of this narrow complex, regular tachycardia is to identify underlying P waves. There are 2 different morphology P waves (Figure 1). There are 12 x P waves visible that are dissociated with the QRS complexes (note the variable PR intervals). These P waves have an axis of +60 degrees and are compatible with a sinus node origin. The P wave in lead II is 4.5mm (>2.5mm), meeting criteria for right atrial enlargement. There are 3 x P waves that are associated with the preceding QRS complex (RP intervals are identical = 120ms). The P waves are very narrow (80ms) with a P wave axis around -75 degrees, which suggests retrograde P waves (P waves are narrow because of simultaneous right atrial and left atrial activation that occurs with retrograde conduction). The number of QRS complexes (n=24) outnumber the number of P waves (n=15) with atrioventricular (AV) dissociation – this excludes a rhythm that is driven by the atria (focal and multi-focal atrial tachycardia can therefore be excluded). While atrioventricular nodal re-entrant tachycardia (AVNRT) with VA block has been described, this is very rare. While VT can cause AV dissociation, it should not cause narrow QRS complexes.

The correct answer is (3): Junctional ectopic tachycardia (JET).

DISCUSSION

JET is an arrhythmia caused by enhanced automaticity in the AV junction. This arrhythmia is rare in adults and occurs more commonly in children. Paediatric JET most often occurs after surgical repair of congenital heart defects and is usually self-limiting, but may be fatal. Non-postoperative paediatric JET is

TABLE I: Paediatric ECG: normal values by age (adapted from reference 1).

Age	HR (bpm)	QRS axis (degrees)	PR interval (sec)	QRS interval (sec)	R in V1 (mm)	S in V1 (mm)	R in V6 (mm)	S in V6 (mm)
1st week	90 - 160	60 - 180	0.08 - 0.15	0.03 - 0.08	5 - 26	0 - 23	0 - 12	0 - 10
1 - 3 weeks	100 - 180	45 - 160	0.08 - 0.15	0.03 - 0.08	3 - 21	0 -16	2 - 16	0 - 10
1 - 2 months	120 - 180	30 - 135	0.08 - 0.15	0.03 - 0.08	3 - 18	0 - 15	5 - 21	0 - 10
3 - 5 months	105 - 185	0 - 135	0.08 - 0.15	0.03 - 0.08	3 - 20	0 - 15	6 - 22	0 - 10
6 - 11 months	110 - 170	0 - 135	0.07 - 0.16	0.03 - 0.08	2 - 20	0.5 - 20	6 - 23	0 - 7
1 - 2 years	90 - 165	0 - 110	0.08 - 0.16	0.03 - 0.08	2 - 18	0.5 - 21	6 - 23	0 - 7
3 - 4 years	70 - 140	0 - 110	0.09 - 0.17	0.04 - 0.08	1 - 18	0.5 - 21	4 - 24	0 - 5
5 - 7 years	65 - 140	0 - 110	0.09 - 0.17	0.04 - 0.08	0.5 - 14	0.5 - 24	4 - 26	0 - 4
8 - 11 years	60 - 130	-15 - 110	0.09 - 0.17	0.04 - 0.09	0 - 14	0.5 - 25	4 - 25	0 - 4
12 - 15 years	65 - 130	-15 - 110	0.09 - 0.18	0.04 - 0.09	0 - 14	0.5 - 21	4 - 25	0 - 4
>16 years	50 - 120	-15 - 110	0.12 - 0.20	0.05 - 0.10	0 - 14	0.5 - 23	4 - 21	0 - 4

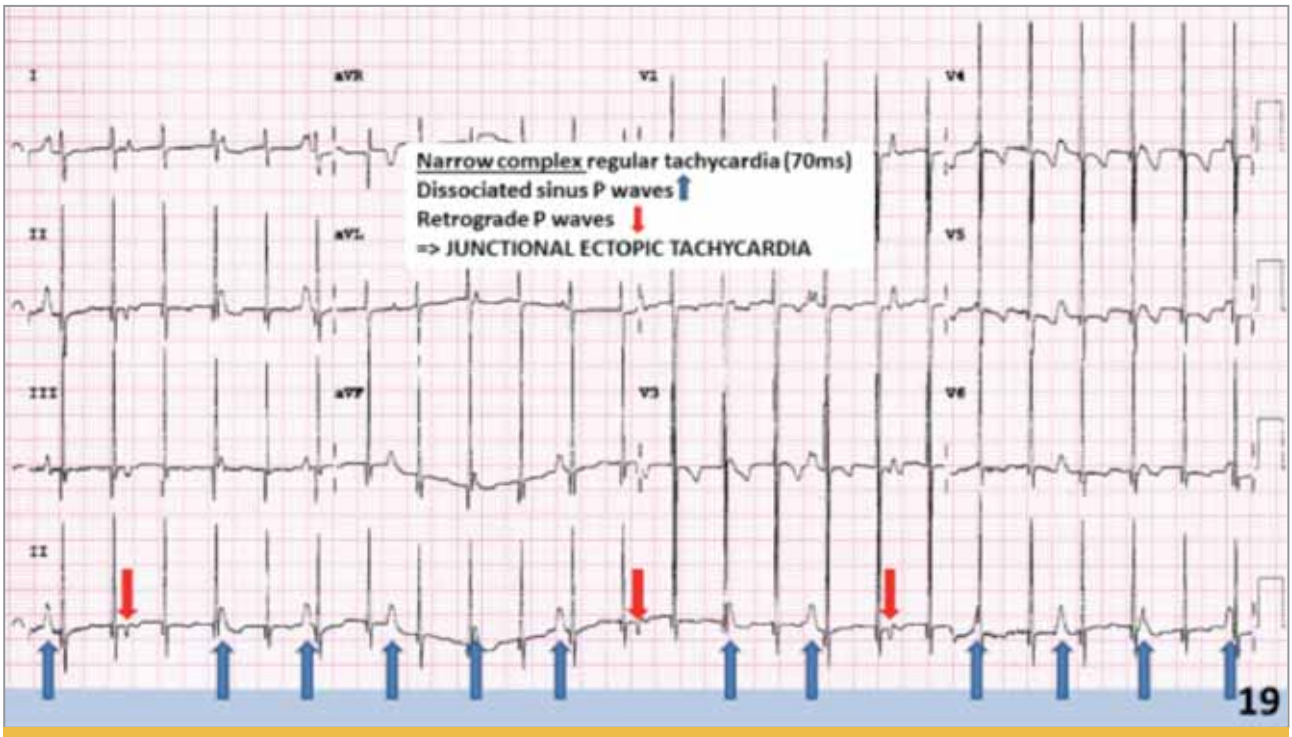

FIGURE 1: Junctional Ectopic Tachycardia. Red arrows = retrograde P waves. Blue arrows = dissociated sinus P waves (see text for details).

uncommon, often incessant and is associated with increased morbidity and mortality. Tachycardia-induced cardiomyopathy is a well-known complication of incessant JET (this patient had a left ventricular ejection fraction [LVEF] of 33% on presentation). Treatment usually involves antiarrhythmic drug therapy (mostly intravenous or oral Amiodarone with or without beta-blockade). Catheter ablation of the automatic junctional focus can be considered in drug refractory cases, but the risk of AV block is high.

A recent report has described the use of Ivabradine in the treatment of JET.[2] Ivabradine, a blocker of the HCN channel which conducts the If current, is well known to decrease sinus rate by blocking HCN channels in the sinus node. The AV node is also known to express HCN channels and in a small series, Ivabradine was able to convert JET to sinus rhythm in 4/5 paediatric patients and suppress the JET in the other patient. The authors proposed using Ivabradine as a second-line agent if Amiodarone fails.

The correct answer is (5): All of the above.

The ECG of a JET commonly manifests with VA block (VA dissociation) as in this case. A JET can also mimic a typical slow/fast AVNRT or an AVRT with a short RP interval with 1:1 retrograde conduction (VA association). Figure 2 shows another example of a JET with short RP interval of 120ms. VA block is again seen in this example after QRS complexes 1, 15, 21 and 24. A JET can also present as a 1:1 long RP tachycardia.

This child was treated with oral beta-blockers and Amiodarone. Her JET and heart failure resolved fully on this therapy with improvement in her LVEF after 4 months of therapy.

CONCLUSION

Normal ECG values differ by age and paediatric ranges should be remembered when interpreting a child's ECG. For example, a monomorphic VT in a 3-year-old child can have a QRS dura-

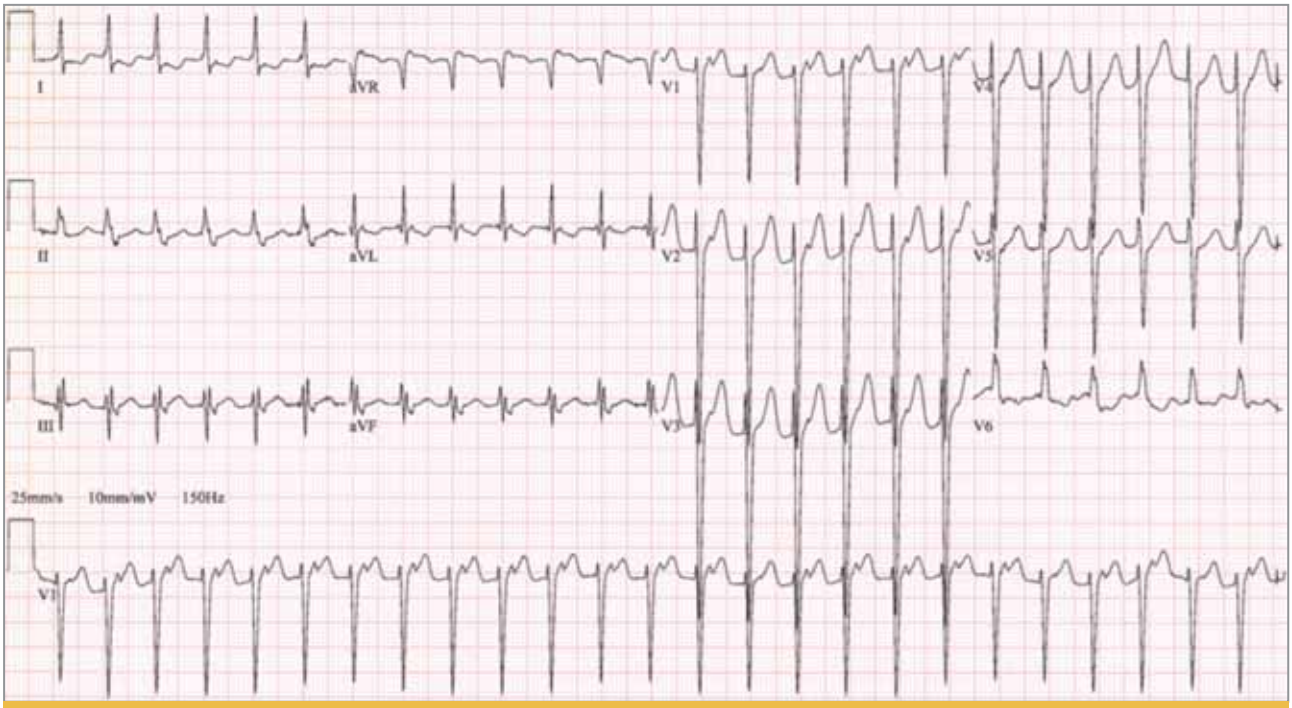

FIGURE 2: Junctional ectopic tachycardia. Short RP tachycardia with retrograde P waves visible after the QRS complexes (RP interval 120ms). Note the VA block (dissociation) after QRS complexes 1, 15, 21 and 24 – best seen in V1.

tion of 90ms - 100ms and can be falsely interpreted as narrow complex tachycardia.

JET is uncommon in adults but can occur in infants and children.

JET can present as a narrow complex, regular tachycardia with signs of VA dissociation, but can mimic a short or long RP re-entrant tachycardia.

Conflict of interest: none declared.

REFERENCES

1. Sharieff GQ, Rao SO. The paediatric ECG. Emerg Med Clin North Am 2006;24(1):195-208.
2. Dieks JK, Klehs S, Müller MJ, Paul T, Krause U. Adjunctive Ivabradine in combination with Amiodarone: A novel therapy for paediatric congenital junctional ectopic tachycardia. Heart Rhythm 2016;13(6):1297-302.

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