Pulsus trigeminy and electrolyte derangements: a forgotten primary care presentation

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A four-year-old boy with a 5-day history of coryzal symptoms presented to his general practitioner (GP). His mother reported that following a swim, he developed sore throat, running nose, dry cough, fever of 38.5°C, drowsiness and photophobia. The child had reduced oral intake limited to mostly sips of water and reduced urine output. He had a history of upper respiratory tract infections. The child's vaccinations were up to date and he was allergic to Amoxicillin. Family, social and medication history were unremarkable.

Table 1 displays the vital signs and urine dipstick results. Given the concerning physical findings, pulsus trigeminy and urine dipstick results, a prompt referral to the emergency department (ED) was made. The child's electrocardiogram (ECG) and its description are shown in Figure 1. The urine dipstick results could be due to dehydration and starvation. At the ED, the patient was slightly hypokalaemic (3.4 mmol/L) (normal range 3.5–5.0 mmol/L).

Following ED assessment, the paediatric cardiologist considered the child's condition stable and he was managed conservatively and discharged with oral potassium supplements. The parents were advised to give him bananas and fluids until his oral intake recovered. The child's fever was managed with antipyretics. He returned the next day for follow up with a paediatric cardiologist and a subsequent ECG reading. At follow up, S3 was not detected, ECG showed normal sinus rhythm and normal serum potassium. The paediatric cardiologist recommended subsequent patient follow up by the GP.

Discussion

The likely diagnosis was a dehydration-induced electrolyte imbalance provoking an arrhythmia. The dehydration was likely a consequence of poor feeding due to an upper respiratory tract infection. However, specific infections like encephalitis, meningitis, otitis media, mastoiditis, septic arthritis and osteomyelitis were considered and should be ruled out. Other important but less likely cardiac considerations were cardiomyopathy, myocarditis and acute rheumatic fever.

Additionally, important causes such as structural heart disease need to be excluded. The child did not display structural heart disease risk factors seen in Table 2. S3 is difficult to auscultate in a tachycardic child, so an innocent murmur accentuated by systemic illness was another possibility.[1] An innocent murmur can be diagnosed based on clinical findings and history seen in Table 2. Urine dipsticks, ECG, chest x-ray, full blood count, blood culture, C-reactive protein, electrolytes and urea may support the diagnosis of an innocent murmur caused by systemic illnesses.

Specific to this case, a relatively non-invasive ECG was performed to provide more information to supplement the arrhythmia and S3 findings. The child's new onset irregular heartbeat and overall worrying clinical impression warranted urgent clinical assessment and management by the GP. The ECG assisted the GP in this situation by risk stratifying the situation's clinical urgency.[2,3] The ECG also strengthened the ED referral and provided the receiving medical team with useful information.[3] Although the ultimate management was unlikely to be changed, the ECG findings provided safety netting for the acutely unwell child with an undifferentiated diagnosis at that point in time.

The prevalence of paediatric arrhythmias ranges from 1% to 2%, while premature ventricular contraction, of which pulsus trigeminy is a subtype, ranges from 0.3% to 0.7%.[4] Therefore, in a general paediatric population, an ECG is unlikely to detect significant arrhythmias. This is even more so for pulsus trigemini, which is rare and likely to be missed. Common causes of paediatric arrhythmias are electrolyte imbalances, metabolic disturbances, thyroid disease, infection, congenital heart defect and anxiety.[5] Specific to this case, hypokalemia can cause ventricular trigeminy.[6,7] The patient did not display classical hypokalemia ECG changes, probably due to the marginal hypokalemia. Hypokalaemia can be caused by reduced ingestion and absorption, increased losses and intracellular shifts of potassium.[8] Diarrhoea and vomiting with insufficient potassium intake are common causes of paediatric hypokalaemia.[8] Management is often potassium supplementation with clinical urgency determining oral or intravenous route.

Table 1. Summary of child's vital signs plus relevant positive and negative findings on presentation at the general practitioner's clinic

Vital signs	
Heart rate (Beats/min)	133
Respiratory rate (Breaths/min)	24
Blood pressure (mm/Hg)	100/60
Mental state	Glasgow Coma Scale of 15
Temperature (°C)	37.4
Relevant positive physical signs	
Child was lethargic but easily rousable and responsive	
Erythematous stage 3 enlarged tonsils with no discharge	
Third heart sound (S3)	
Relevant negative physical signs	
Clear lungs with bilateral air entry	
No murmurs	
Negative Kernig's sign	
Negative Brudzinski's sign	
No photophobia	
No meningococcal rash	

Figure 1. An ECG showing sinus rhythm with ventricular trigeminy, normal axis, borderline prolonged QT intervals, incomplete RBBB and T wave inversion in V1 and V2. The trigeminy was regular in all leads and was caused by a premature ventricular contraction. This contraction caused the S3 and appeared as two normal QRS followed by a premature ventricular contraction. The premature ventricular contraction is larger and wider than the QRS, and the ectopic focus has its origin in the ventricular wall rather than the bundle branches

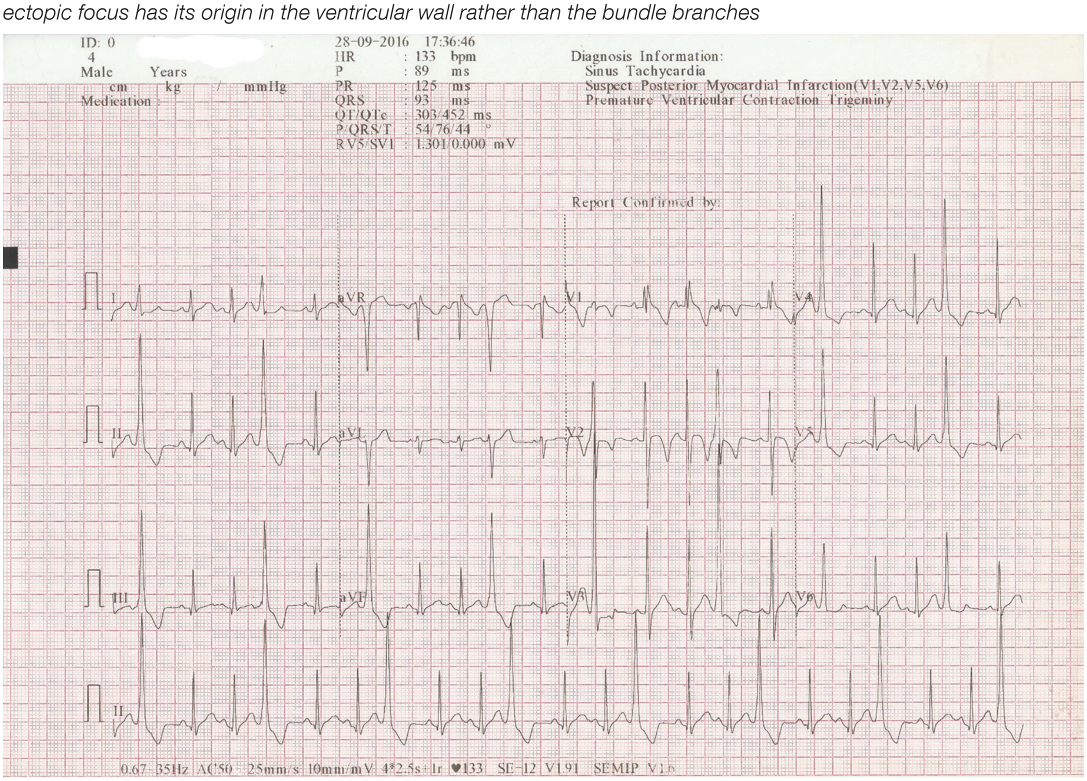

Table 2. Table of clinical findings suggestive of an innocent murmur

	Clinical findings suggestive of innocent murmur
1)	Normal physical examination findings except for murmur
2)	Child is asymptomatic after systems review
3)	History negative for structural heart disease risk factors
	3a. Family history of sudden cardiac death, hypertrophic cardiomyopathy, congenital heart disease, sudden infant death syndrome
	3b. Child's history of aneuploidy, connective tissue disorder, inborn error of metabolism, other major congenital defects, syndrome with dysmorphic features, frequent respiratory infections, Kawasaki disease and rheumatic fever
	3c. Prenatal and perinatal history such as *in utero* exposure to alcohol, toxins, potentially teratogenic medications, intrauterine infection, maternal diabetes mellitus and preterm delivery
4)	Characteristic auscultatory features of specific innocent heart murmurs
	4a. Sensitive (changes with child's position or with respiration)
	4b. Short duration (not holosystolic)
	4c. Single (no associated clicks or gallops)
	4d. Small (murmur limited to a small area and non-radiating)
	4e. Soft (low amplitude)
	4f. Sweet (not harsh sounding)
	4g. Systolic (occurs during and is limited to systole)

Table 3. Table of severe organ specific complications of paediatric dehydration

Severe complications of paediatric dehydration	
Brain	Seizures Intracerebral haemorrhage Altered mental state Coma
Kidneys	Electrolyte imbalances Acute kidney injury Acid-base imbalances especially metabolic acidosis
Liver	Ischaemic hepatitis
Heart	Arrhythmia Hypotension
Hypovolemic Shock	
Death	

Apart from hypokalaemia, managing the child's fluid balance was also important as dehydration is a contributing problem. Paediatric dehydration is sometimes overlooked due to its lower prevalence in developed countries.[9] However, children are still vulnerable to dehydration due to higher surface area to weight ratio, higher basal fluid requirement and immature renal tubular reabsorption mechanisms.[10] Moreover, the complications are severe if improperly managed, as seen in Table 3.[11,12]

The gold standard for determining dehydration is bodyweight percentage change, so measuring bodyweight is important when assessing paediatric fluid balance.[13] Other useful adjuncts for measuring dehydration are abnormal capillary refill, skin turgor and mucous membranes.[14]

In summary, given the acuity and complexity of a new-onset arrhythmia and a S3 in the context of a dehydrated child, an expedited ED referral was performed to ensure safety.[5] The GP can assist by performing simple investigations and a thorough history and examination of cardiac, respiratory and gastrointestinal systems.[1] In rural and remote settings, a telemedicine conference with a paediatrician would be advised.[15]

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COMPETING INTERESTS
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