ATRIAL FIBRILLATION

FELLOWS CASE OF THE MONTH

Cold-Induced, Swallow-Related Atrial Fibrillation in an Adolescent

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ABSTRACT. *Paroxysmal atrial fibrillation is uncommon in the pediatric population. This is a case report of an adolescent male presenting with episodes of palpitation and chest pain that were identified as atrial fibrillation. Careful history taking revealed that immediately before this and a previous episode the patient had drunk an ice-cold beverage.*

KEYWORDS. *Atrial fibrillation, electrocardiogram, electrophysiology study, pharmacologic cardioversion, pediatric cardiology.*

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Case report

A 17-year-old, healthy African American male presented to the pediatric emergency department with sudden onset of substernal chest pain during lunch, described as pressure accompanied by mild dyspnea and the sensation that his heart rate had suddenly decreased. His past medical/surgical history and review of systems were negative. He denied alcohol and illicit drug use, and had no family history of arrhythmia, pacemaker/defibrillator placement, congenital heart disease, cardiomyopathy, or sudden cardiac death.

The patient was afebrile, with a heart rate of 67 bpm and blood pressure of 129/89 mmHg. His weight was 79 kg (85th percentile for age and gender), with a height of 173.4 cm (38th percentile), body mass index 26.2 kg/m² (90th percentile), and body surface area 1.93 m². He was noted to have an irregularly irregular rhythm with an otherwise normal physical examination. A 12-lead electrocardiogram (ECG) revealed atrial fibrillation (Figure 1). Upon further questioning, the patient stated that he had previously experienced a similar episode; both had occurred during consumption of an exceptionally cold beverage.

His tests demonstrated normal serum electrolytes and serum cardiac troponin I, a negative drug screen, and a normal echocardiogram. Qualitatively, there was no left atrial dilation. The patient was admitted to the pediatric intensive care unit and after risks and benefits of pharmacologic treatment were discussed, pharmacologic cardioversion with ibutilide was performed. He was pretreated with magnesium sulfate, and an ibutilide infusion of 1 mg intravenously over 10 minutes was initiated. The patient's atrial fibrillation terminated 5 min into the infusion with a return to normal sinus rhythm (Figure 2). The ibutilide infusion was stopped, and the patient's maximum corrected QT interval (QTc) measurement peaked at 447 ms.

A repeat ECG at 6- and 12-hour post cardioversion demonstrated normal sinus rhythm (50 and 46 bpm, respectively) with no significant ectopy, arrhythmia, or ventricular pre-excitation. After overnight observation, the patient was discharged home with a 14-day heart rate monitor (ZIO® XT Patch, iRhythm Technologies, Inc., San Francisco, CA, USA), which demonstrated a regular rhythm and rare (<1/day) premature atrial complexes. He was referred for an exercise stress treadmill test, which demonstrated no evidence of ectopy or ST segment changes during either exercise or recovery. Owing to this documented episode of atrial fibrillation and the additional presumed episode by history, an intracardiac electrophysiology (EP) study was performed to assess for the presence of an accessory atrioventricular connection as an indirect cause of his paroxysmal atrial

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Figure 1: Twelve-lead electrocardiogram demonstrating atrial fibrillation with ventricular rate of 67 bpm.

Figure 2: Inpatient telemetry recording from the intensive care unit displaying heart rhythm (top row), respiratory cycle (middle), and pulse oximetry (bottom). An irregularly irregular ventricular rhythm is demonstrated at the beginning (left) of this strip, consistent with atrial fibrillation. Pharmacologic cardioversion is recorded at 5 min after the start of ibutilide infusion (1 mg IV over 10 min), with return of normal rhythm. Ashman phenomenon (denoted by the asterisks), characterized by aberrant ventricular conduction, is noted just before cardioversion.

fibrillation. The EP study was negative, revealing no concealed accessory atrioventricular pathway, inducible atrioventricular nodal re-entry tachycardia (AVNRT), or atrial fibrillation, despite aggressive attempts to induce arrhythmia.

Following the EP study, no activity restrictions were placed. However, the patient was advised to avoid rapid consumption of cold food and beverages. He has been followed for 6 months without recurrence of his arrhythmia.

Discussion

Atrial fibrillation is the most common arrhythmia encountered in adults. However, it is rare in children and adolescents, where the exact incidence has yet to be established.^{1,2} In children, atrial fibrillation is known to occur in the setting of inflammation of the myocardium, cardiomyopathy, rheumatologic disease, and electrolyte imbalances.² Likewise, atrial fibrillation has been described in children with congenital heart disease, left ventricular non-compaction, and genetic mutations.²⁻⁷

Trauma and Taser shocks have also been reported to cause this arrhythmia in the pediatric population.⁸

A search of the literature revealed no known cases of cold-induced, swallow-related atrial fibrillation in the pediatric population. A previous case report described a 43-year-old woman who presented with atrial fibrillation after eating frozen yogurt.⁹ She was found to have ventricular pre-excitation on ECG and underwent radiofrequency ablation of a right-sided accessory atrioventricular connection associated with Wolff–Parkinson–White syndrome, which had most likely led to a tachycardia-induced tachycardia syndrome. Likewise, a father and son (ages 79 and 42 years, respectively) were both documented to have atrial fibrillation following the consumption of an ice-cold frozen dessert.¹⁰ Historically, the initial report of atrial fibrillation triggered by drinking an ice-cold beverage was described in a 55-year-old patient.¹¹ In this patient, most episodes spontaneously converted to normal sinus rhythm after several hours. However, six episodes required direct current or pharmacologic (flecainide) cardioversion. This patient was advised to avoid consumption of cold liquids, discharged on no antiarrhythmic medications, and remained asymptomatic.

The mechanism of cold-induced atrial fibrillation is most likely vagally mediated, as it has been proposed that an abnormal interface of the vagus nerve at the dorsal nucleus may be responsible, perhaps involving signaling between the sensory limb (from the esophagus) and motor limb (to the right atrial myocardium).¹² The correlation with strong vagal tone is supported by the resting sinus bradycardia of the patient described in this case.

Pediatric patients with atrial fibrillation may exhibit additional underlying forms of supraventricular arrhythmia, including atrioventricular re-entry tachycardia and AVNRT.¹³ Abnormal atrial foci have been described in the pulmonary veins, crista terminalis, and left atrium.¹⁴ Consequently, an EP study has been recommended for all children presenting with paroxysmal atrial fibrillation.^{13,14}

Though it was not indicated by the history in the case described herein, children and adolescents presenting with atrial fibrillation may require further laboratory studies for diagnostic evaluation. History and physical examination may call for investigation of hyperthyroidism. Obesity and systemic hypertension should be followed longitudinally, as each have been linked to increased risk of atrial fibrillation.¹ Underlying channelopathy or nuclear protein defect should also be considered, especially when family history suggests the involvement of multiple relatives.^{7,6} Family history or abnormal exercise test may suggest catecholaminergic polymorphic ventricular tachycardia. Serum C-reactive protein can be used to rule out underlying inflammatory processes in new patients presenting with atrial

fibrillation, though this has not been studied in pediatric patients with atrial fibrillation.¹⁵

Conclusion

This is a case report of cold-induced paroxysmal atrial fibrillation in a pediatric patient. This diagnosis can be made only after performing meticulous history. Paroxysmal atrial fibrillation in a child or adolescent warrants EP study to exclude an underlying concealed accessory atrioventricular pathway and AVNRT.

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