Cardiology in the Young

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Sudden cardiac arrest in the field in an 18-year-old male athlete with Noonan syndrome: case presentation and 5-year follow-up

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Brief Report

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Abstract

We present a case of sudden cardiac arrest in the field with complete neurological recovery in an 18-year-old athlete with phenotypic Noonan syndrome. Evaluation revealed interventricular septal thickness of 18 mm without left ventricular outflow tract obstruction and no other identifiable structural, electrophysiologic, or genetic abnormality except isolated heterozygous variant for desmoplakin DSP variant p.Lys2103Glu, with unknown clinical significance.

Cardiac arrest in young athletes is a devastating event with poor overall survival rates. The incidence of sudden cardiac arrest in athletes varies between 1:3000 and 1:917000.[1] In the majority of cases, a documentable cause of arrest and death can be identified. These identifiable causes vary by the population studied.[2] In a large registry athletes in the United States of America, the most common causes included intrinsic anomalies such as hypertrophic cardiomyopathy (36%), coronary artery anomalies (17%), myocarditis (6%), genetic channelopathies (4%), with additional causes due to blunt trauma (22%), commotio cordis (3%), and heat stroke (2%).[3]

Noonan syndrome is a common autosomal dominant genetic disorder with variable expression occurring in approximately 1:1000–2500 live-born infants. It is associated with well-described cardiac anomalies including pulmonary valve stenosis (57%), secundum atrial septal defects (32%), and hypertrophic cardiomyopathy (16%),[4] as well as multiple other cardiac abnormalities.[4,5] Most deaths related to cardiac events in Noonan syndrome are related to heart failure due to progression of known structural disease.[4,6,7] Patients with minimal cardiac abnormalities typically have a good prognosis.[8]

We present a case of neurologically intact survival after sudden cardiac arrest in the field in a young athlete with Noonan syndrome with 5 year follow-up and discuss the possible reasons for cardiac arrest in this case.

Case description

Cardiac arrest in the field

Our patient was an 18-year-old male, participating in intense lifeguarding training in a 19.5°C freshwater chlorinated pool. Following intervals of jumping in and out of the pool and swimming intensely to simulate rescue of a drowning victim, he climbed out of the pool, stating that he did not feel well, then collapsed to his knees, and fell to the ground. Emergency response arrived within approximately 3 minutes. The patient was unresponsive, pulseless, and apneic. Automatic defibrillator delivered electric shock twice for unknown rhythm with return of spontaneous circulation. On arrival to the emergency department, Glasgow Coma Scale was 13/15, with blood pressure of 153/64 mmHg, pulse 101/minute, respiratory rate 20/minute, and temperature 36.2°C. Exam showed a young male with mild dysmorphic features including hypertelorism, deep philtrum, low set ears, wide set neck with webbing, and mild pectus excavatum.

Past medical history

The patient had a history of dysmorphic features diagnosed at an early age as Noonan syndrome. He was followed regularly by a paediatric specialist and cleared for physical activity without restrictions. A right axis deviation and incomplete right bundle branch block were seen on EKG at age 2. A cardiac MRI 3 years prior to the event showed right atrial enlargement with borderline thickened left ventricle, but was otherwise normal.

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He had two healthy siblings and healthy parents with no family history of sudden or unexplained death, and no history of Wolff–Parkinson–White syndrome or other known congenital rhythm abnormalities.

Approximately 2 weeks prior to admission, he completed outpatient treatment for a clinically diagnosed pneumonia with doxycycline followed by ciprofloxacin. Perhaps more significantly, he had an isolated syncopal episode at school approximately 2 months prior to admission, which occurred while walking down the stairs and was preceded by dizziness. He roused spontaneously and no further workup was performed.

Hospital course

His hospital course was notable for three episodes of in-hospital cardiac arrest during initiation of induced hypothermic protocol, the first two being pulseless ventricular tachycardia events, and the third consisting of ventricular fibrillation arrest secondary to prolonged QTc during amiodarone infusion, initiated after the second pulseless ventricular tachycardia arrest. Chest CT showed freshwater aspiration pneumonitis with fluid in the upper lobes. Bronchoscopy samples were sterile. An extensive laboratory workup was unremarkable.

Echocardiography showed normal structures except septal wall thickening (18 mm at widest point mid-septum) without evidence of left ventricular outflow obstruction. Cardiac MRI did not show evidence of significant structural disease including anomalous coronaries, infiltrative cardiomyopathy, or arrhythmogenic right ventricular dysplasia, aneurysm, or scar. Atrial sizes were normal. There was mild septal hypertrophy, mild aortic insufficiency, with mild left and right ventricular dilation and left ventricular ejection fraction of 72%, and right ventricular ejection fraction of 58%. No anomalous coronary arteries were seen on cardiac Computed Tomography Angiography (CTA). Electrophysiology studies showed no evidence of dual or accessory pathway physiology, inducible arrhythmias with ventricular stimulation protocol, inducible catecholaminergic polymorphic ventricular tachycardia, or Brugada syndrome. Myocardial ischaemia workup was negative. Genetic testing for 30 standard inherited genetic variants associated with arrhythmia was negative, except for heterozygosity for desmoplakin DSP variant p.Lys2103Glu.

The patient underwent implantation of a dual-chamber implantable cardioverter defibrillator for secondary prevention of sudden cardiac arrest and was discharged the next day on his 9th day of hospitalisation, with no discernible motor, sensory, or cognitive deficits.

Five-year follow-up

The patient is followed for progression of cardiac disease. He was specifically instructed to avoid intense physical exercise following the arrest and was exercising minimally during the years of follow-up.

Eighteen months after the arrest, a follow-up transesophageal echocardiogram revealed normal left atrial size. Two years after the initial arrest, he underwent ablation for paroxysmal atrial fibrillation, which included pulmonary vein isolation, wide area circumferential ablation, and ablation of two left atrial tachycardias. No other abnormal rhythm events were recorded during this time period. Echocardiography noted the new development of mitral valve prolapse 3 years after the event with moderate mitral regurgitation and ejection fraction of 54%, and no other cardiac complications at the time of 5-year follow-up.

Discussion

This case presents an interesting case of a young athlete with out-of-hospital cardiac arrest associated with swimming in cold water. While out-of-hospital cardiac arrests often present a diagnostic difficulty, his case is further complicated by the presence of a pre-existing Noonan syndrome diagnosis. Despite an extensive workup, our case did not show clinically significant structural or electroconductive disease aside from increased septal thickness of 18 mm at the widest point mid-septum without the evidence of outflow obstruction. Although various other mutations at the desmoplakin gene have been associated with arrhythmogenic cardiomyopathy,[9] the clinical significance of heterozygosity for desmoplakin DSP variant p.Lys2103Glu in this patient is unclear.

The finding of aspiration fluid in the upper lobe on lung CT, as well as the onset of problems during lifeguarding exercises in cold water with subsequent collapse at poolside, hint that arrhythmia or hypoxia leading to drowning as the initial instigating event. Exercise, cold-water immersion, and breath-holding leading to latent hypoxia or "shallow-water blackout" are considered possible triggers for the arrest, as they can independently cause autonomic conductivity changes and lead to triggering of arrhythmia.[10]

Conclusion

There is limited evidence of increased risk of sudden cardiac events in patients with minimal cardiac anomalies but with Noonan syndrome dysmorphism. The only abnormal findings in this case were a focally increased interventricular septal thickness of 18 mm without left ventricular outflow tract obstruction and no other identifiable structural, electrophysiologic, or genetic abnormality except isolated heterozygous variant for desmoplakin DSP variant p.Lys2103Glu, with unknown clinical significance.

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Conflicts of Interest. None.

Ethical Standards. Patient permission was obtained for this publication.

References

1. Asif IM, Harmon KG. Incidence and etiology of sudden cardiac death: New updates for athletic departments. Sports Health 2017; 9 (3): 268–279. doi:10.1177/1941738117694153
2. Ackerman M, Atkins DL, Triedman JK. Sudden cardiac death in the young. Circulation 2016; 133 (10): 1006–1026. doi:10.1161/CIRCULATIONAHA.115.020254
3. Maron BJ, Doerer JJ, Haas TS, et al. Sudden deaths in young competitive athletes: analysis of 1866 deaths in the United States, 1980–2006. Circulation 2009; 119 (8): 1085–1092. doi:10.1161/CIRCULATIONAHA.108.804617
4. Prendiville TW, Gauvreau K, Tworog-Dube E, et al. Cardiovascular disease in Noonan syndrome. Arch Dis Child 2014; 99 (7): 629–634. doi:10.1136/archdischild-2013-305047
5. Sublett JA, Prada CE, Jefferies JL. Case report: left ventricular noncompaction cardiomyopathy and RASopathies. Eur J Med Genet 2017; 60 (12): 680–684. doi:10.1016/j.ejmg.2017.09.002
6. Colquitt JL, Noonan JA. Cardiac findings in Noonan syndrome on long-term follow-up. Congenit Heart Dis 2014; 9 (2): 144–150. doi:10.1111/chd.12102

7. Gelb BD, Roberts AE, Tartaglia M. Cardiomyopathies in Noonan syndrome and the other RASopathies. Prog Pediatr Cardiol 2015; 39 (1): 13–19. doi:10.1016/j.ppedcard.2015.01.002
8. Roberts AE, Allanson JE, Tartaglia M, et al. Noonan syndrome. Lancet (London, England) 2013; 381 (9863): 333–342. doi:10.1016/S0140-6736(12)61023-X
9. Favre B, Begré N, Marsili L, et al. Desmoplakin gene variants and risk for arrhythmogenic cardiomyopathy. Circ Genomic Precis Med 2018; 11 (9). doi:10.1161/CIRCGEN.118.002241
10. Shattock MJ, Tipton MJ. "Autonomic conflict": a different way to die during cold water immersion? J Physiol 2012; 590 (14): 3219–3230. doi:10.1113/jphysiol.2012.229864

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