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Aborted exercise-related sudden cardiac death in a young athlete: a case report

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Key words: out-of-hospital cardiac arrest; congenital coronary anomaly; anomalous origin of coronary artery; return of spontaneous circulation; pediatric resuscitation.

Abstract

Pediatric Out-Of-Hospital Cardiac Arrest (OHCA) is a rare but devastating event with an incidence of less than 10 cases per 100,000 population. We present a case of exercise-induced cardiac arrest in a previously healthy adolescent athlete, ultimately diagnosed with an anomalous origin of the left coronary artery. A 12-year-old athletic boy with no significant medical history experienced syncope at the finish line of a 3000-meter race. Initial assessment revealed severe hemodynamic instability progressing to cardiac arrest (bradycardic pulseless electrical activity) requiring cardiopulmonary resuscitation. Return of spontaneous circulation was achieved after 4 minutes. The patient subsequently developed acute pulmonary edema requiring emergency intubation. Cardiac computed tomographic angiography revealed an anomalous left coronary artery originating from the right coronary ostium with a malignant

inter-arterial course. The patient underwent successful surgical reimplantation of the left coronary artery. He was discharged after 18 days with no neurological sequelae and subsequently returned to competitive sports with cardiologic clearance. This case highlights the importance of rapid emergency response and comprehensive diagnostic evaluation in young athletes presenting with exercise-induced cardiac events. Anomalous coronary arteries should be considered in the differential diagnosis of exercise-related syncope or cardiac arrest in seemingly healthy young individuals.

Introduction

Pediatric Out-Of-Hospital Cardiac Arrest (OHCA) represents a critical medical emergency with an incidence of less than 10 cases per 100,000 population annually. In Switzerland, 307 pediatric cardiac arrests were reported between 2019 and 2023, with Return Of Spontaneous Circulation (ROSC) achieved on-site in 34.5% of cases. Sporting venues represent the third most common location for these events, following homes and public highways.[1]

The prognosis for pediatric OHCA remains poor, with survival rates of 8.2-8.6% for non-traumatic arrests. Among survivors, only 25% achieve favorable neurological outcomes enabling return to baseline function.[2,3] Exercise-related sudden cardiac death in young athletes occurs at an estimated rate of 3 per 100,000 person-years in Switzerland.[4] While hypertrophic cardiomyopathy represents the most common etiology in the general athletic population, coronary artery anomalies constitute one of the leading causes of cardiac arrest among middle school athletes.[5-7]

We present a case of aborted sudden cardiac death in a previously healthy adolescent athlete, ultimately diagnosed with an Anomalous Origin of the Left Coronary Artery (AOLCA).

Case Report

Pre-hospital phase

At the end of a 3000-meter junior race, a 12-year-old boy experienced acute dyspnea and lost consciousness upon crossing the finish line. He was previously healthy with no significant medical history, no prior cardiac symptoms, and no family history of sudden death or cardiac

disease. He was an active athlete who regularly participated in competitive sports and never experienced previous limitations.

Initial assessment by the on-site medical team revealed severe hemodynamic compromise. The patient demonstrated marked tachypnea with a respiratory rate of 60 breaths per minute and tachycardia at 120 beats per minute. Blood pressure measurement showed severe hypotension at 76/35 mmHg. His mental status was characterized by increasing agitation and he complained of abdominal pain. Peripheral oxygen saturation could not be reliably obtained due to poor peripheral perfusion, though blood glucose levels were within normal limits. Table 1 shows the timeline of events.

Diagnostic assessment

After Emergency Department (ED) admission, chest radiography demonstrated bilateral pulmonary edema and arterial blood gas analysis revealed severe hypoxemia requiring aggressive mechanical ventilatory support with high Positive End-Expiratory Pressure (PEEP) settings. The electrocardiogram showed sinus rhythm without acute ischemic changes. Cardiac biomarkers were significantly elevated with troponin levels consistent with myocardial injury.

Transthoracic echocardiography revealed a suspicious coronary artery pathway with abnormal Doppler flow patterns suggesting an inter-arterial course. Subsequent cardiac computed tomographic angiography provided definitive diagnosis of an anomalous left coronary artery originating from the right coronary ostium with a malignant inter-aorticopulmonary intramural course before resuming normal anatomical distribution (Figure 1).

Therapeutic intervention and outcome

Following stabilization in the pediatric intensive care unit, the patient underwent successful surgical reimplantation of the left coronary artery. The procedure was performed without complications, with excellent post-operative recovery.

Neurological evaluation revealed no sequelae from the hypoxic event. The patient was discharged home after a total of 18 days of hospitalization. After several months, the patient received cardiologic clearance to return to competitive sports.

Discussion

General considerations

This case illustrates the critical importance of rapid recognition and management of exercise-induced cardiac arrest in young athletes. Anomalous Origin Of A Coronary Artery (AOCA) represents a rare but potentially fatal congenital anomaly with a reported prevalence of 0.4-0.8% in the general population.[8,9] While anomalous origin of the right coronary artery is 3-8 times more common than left coronary anomalies, AOLCA carries a substantially higher risk of sudden cardiac death, particularly when the vessel follows an inter-arterial course.[8]

The pathophysiology of exercise-induced ischemia in AOCA involves compression of the anomalous vessel during periods of increased cardiac output. The inter-arterial segment, typically intramural in nature, becomes compressed between the dilated aortic root and pulmonary artery during exercise. This results in acute myocardial ischemia, ventricular dysfunction, and subsequent hemodynamic collapse. The characteristic presentation involves hypotension progressing to non-shockable cardiac arrest rather than ventricular fibrillation, as observed in our patient.[10]

Diagnosis of AOCA remains challenging, as only 54% of affected individuals report prodromal symptoms such as exertional chest pain, dyspnea, or syncope prior to a major cardiac event.[9] Standard preparticipation screening, including history, physical examination, and even electrocardiography, typically fails to identify these anomalies. This case underscores the importance of maintaining a high index of suspicion for coronary anomalies in young athletes presenting with exercise-related cardiac symptoms.

The successful outcome in this case can be attributed to several critical factors. Immediate availability of trained medical personnel at the sporting event enabled rapid assessment and intervention. The swift initiation of high-quality cardiopulmonary resuscitation proved crucial in maintaining cerebral perfusion and achieving a first return of spontaneous circulation within the critical time window of 4 minutes minimized hypoxic injury. Prompt transport to a tertiary care center with subsequent definitive diagnosis through advanced imaging allowed for identification of the underlying pathology. Finally, timely surgical intervention addressed the anatomical defect before any subsequent events could occur.

Current guidelines recommend surgical repair for all patients with AOLCA given the high risk of sudden death. Various surgical techniques exist, including coronary reimplantation,

unroofing procedures, and coronary bypass grafting. Our patient underwent reimplantation with excellent results, allowing eventual return to competitive athletics.

Clinical implications

This case emphasizes several important clinical considerations for healthcare providers and event organizers. The implementation of comprehensive emergency action plans at youth sporting events is essential for rapid response to cardiac emergencies. Widespread bystander CPR training and strategic placement of automated external defibrillators at athletic venues can significantly improve survival rates. When evaluating unexplained cardiac events in young athletes, transthoracic echocardiography should be carried out promptly, and, if inconclusive, advanced cardiac imaging including CT angiography should be considered to identify structural abnormalities.[10,11] Most importantly, this case demonstrates that excellent prognosis is achievable with prompt recognition, appropriate acute management, and definitive surgical correction of the underlying anomaly.

Patient and family perspective

The patient experiences complete amnesia of the event, which is common following cardiac arrest. His parents, who witnessed the resuscitation efforts, expressed profound gratitude for the opportunity to remain present during the emergency care, consistent with current pediatric resuscitation guidelines advocating for family presence. They report that witnessing the medical team's efforts helped them understand and accept the severity of their son's condition while providing emotional support during a critical time.

Conclusions

This case of aborted sudden cardiac death in a young athlete highlights the importance of maintaining vigilance for congenital coronary anomalies as a cause of exercise-induced cardiac events. The successful outcome demonstrates the critical value of coordinated emergency response systems, rapid resuscitation efforts, and comprehensive diagnostic evaluation. Early recognition and surgical correction of AOLCA can be lifesaving, potentially allowing return to full activities including competitive sports. Healthcare providers should maintain a high index of suspicion for coronary anomalies in young individuals presenting with exercise-related cardiac symptoms, even in the absence of prior warning signs.

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Table 1. Timeline of Events. CPR: cardio-pulmonary resuscitation; ROSC: return of spontaneous circulation.

Time	Events
T+0 minutes	Patient collapsed at finish line; initial medical assessment was immediately started
T+2 minutes	High concentration oxygen therapy initiated via face mask; intravenous access established; fluid resuscitation began
T+5 minutes	Despite initial interventions, patient deteriorated to severe bradycardia progressing to pulseless electrical activity (PEA) and subsequently to asystole. Cardiopulmonary resuscitation (CPR) initiated according to pediatric advanced life support protocols.
T+9 minutes	First ROSC achieved after 4 minutes of high-quality CPR. Post-ROSC Glasgow Coma Scale: 14 (E4, V4, M6).
T+12 minutes	Development of pink, frothy sputum consistent with acute pulmonary edema. Decision made for emergent endotracheal intubation.
T+15 minutes	First intubation attempt complicated by difficult airway ~~anatomy~~ and second episode of cardiac arrest (asystole). CPR resumed.
T+18 minutes	Second ROSC achieved following successful endotracheal intubation. Mechanical ventilation initiated with FiO2 1.0.
T+45 minutes	Arrival at tertiary care center emergency department.

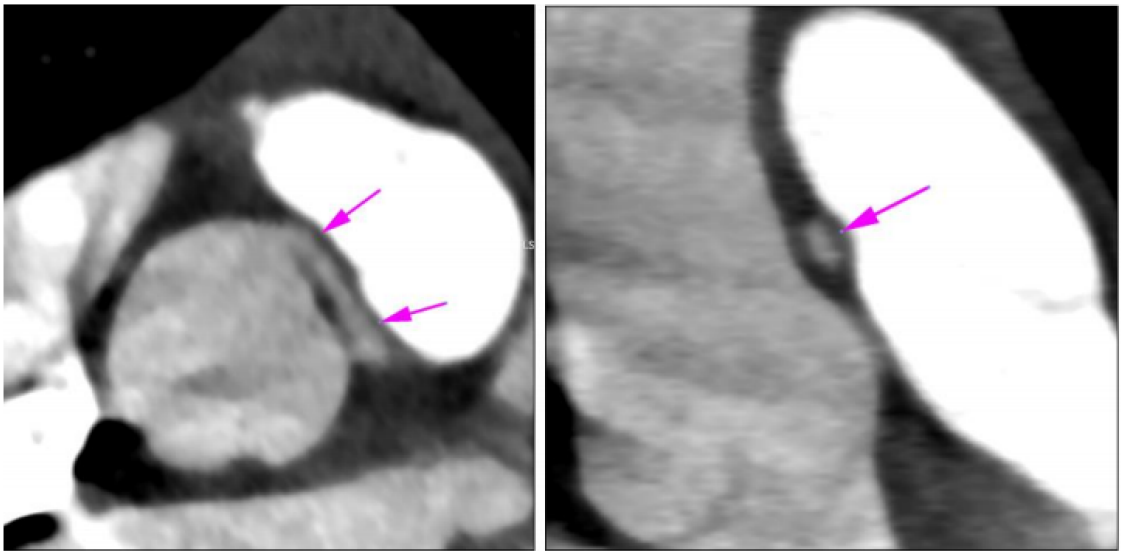

Figure 1. Cardiac computed tomographic angiography showing the malignant path of the left coronary artery.

Contributions: Magali S. Rüfenacht drafted the manuscript and was involved in the initial pre-hospital management of the patient. Tornike Sologashvili performed the surgical intervention and critically reviewed the manuscript. Fabienne Gebistorf was involved in the patient's intensive care management and critically reviewed the manuscript. Laurent Suppan was involved in the pre-hospital management of the patient, supervised the project, contributed to the conception of the case report, and critically revised the manuscript. All authors read and approved the final manuscript.

Conflict of interest: the authors declare no potential conflict of interest, and all authors confirm accuracy.

Ethics approval and consent to participate: no ethical committee approval was required for this case report by the Department, as it does not constitute a research study involving human participants or animals, but rather describes routine clinical care. Informed consent was obtained from the patient's parents for the publication of this case report and accompanying images.

Patient consent for publication: the patient's guardians gave their written consent to use the patient's personal data for the publication of this case report and any accompanying images.

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