JBMEDE
JORNAL BRASILEIRO de MEDICINA DE EMERGÊNCIA

Case report

Pseudo-pulseless electrical activity in foreign body airway obstruction

Pseudoatividade elétrica sem pulso em obstrução de vias aéreas por corpo estranho

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ABSTRACT

Foreign body airway obstruction is a common cause of mortality, especially in the pediatric population. Although there is no universally accepted definition for pseudo- pulseless electrical activity, it is used to describe the evidence of myocardial contraction on point-of-care ultrasound without palpable pulse. Some authors have proposed that these patients should be treated as in a profound shock. We report the case of a 7 years old boy who was taken to an Emergency Medical Services (EMS) station. Cardiopulmonary resuscitation was started and an object removed under direct laryngoscopy. After about 40 minutes of cardiopulmonary resuscitation, the monitor showed an extreme bradycardia with no palpable pulse, but with contractile activity visible on point-of-care ultrasound. We chose to leave the normal Advanced Life Support flowchart, starting norepinephrine while maintaining chest compressions and ventilations. After two cycles of cardiopulmonary resuscitation with pressors the patient had return of spontaneous circulation and was transferred to the local children's hospital. Point-of-care ultrasound during cardiopulmonary resuscitation can be a tool to identify the cause of cardiac arrest as well as a guide on choosing the interventions. The science of resuscitation is still permeated by interventions with a low degree of evidence and there are no robust studies on pseudo-pulseless electrical activity until this moment. Thus, targeting therapy based on the search for the cause seems reasonable, and the use of ultrasound has been shown to be a very useful tool.

Keywords: Cardiopulmonary resuscitation; Heart arrest; Vasoconstrictor agents; Foreign bodies; Case reports

RESUMO

A obstrução de vias aéreas por corpo estranho é uma frequente causa de morbimortalidade, principalmente em populações pediátricas. A utilização de ultrassonografia durante a parada cardiorrespiratória tem ganhado destaque e pode auxiliar na elucidação diagnóstica e na conduta. Ainda não há uma definição globalmente aceita do termo pseudo-atividade elétrica sem pulso, mas geralmente é considerado como a presença de contração miocárdica na ausência de pulso palpável. Alguns autores têm defendido mudanças na forma de abordar esses pacientes, tratando como um "estado de choque profundo". Relata-se aqui o caso de um menino de 7 anos atendido com obstrução de vias aéreas por corpo estranho. Foi iniciada reanimação cardiopulmonar, e o objeto foi retirado sob laringoscopia. Após aproximadamente 40 minutos de reanimação cardiopulmonar, durante a checagem de ritmo, o paciente apresentava bradicardia extrema, sem pulso palpável, porém, tinha atividade contrátil miocárdica à ultrassonografia. Optou-se por sair do fluxograma normal de Suporte Avançado à Vida, iniciando noradrenalina e mantendo compressões torácicas. Após dois ciclos da introdução de drogas vasoativas (DVA), o paciente apresentou retorno de circulação espontânea, com estabilização hemodinâmica suficiente para transporte, sendo conduzido até o hospital de referência local. A ultrassonografia durante a parada cardiorrespiratória pode auxiliar tanto na elucidação diagnóstica da causa do colapso cardiovascular como também ter papel na tomada de conduta. A ciência da ressuscitação ainda é permeada por intervenções com grau baixo de evidência. Apesar de ainda não haver estudos robustos sobre pseudo-atividade elétrica sem pulso , direcionar a terapêutica baseada na busca da causa nos parece fazer sentido, e a utilização da ultrassonografia tem se demonstrado grande aliada.

Descritores: Reanimação cardiopulmonar; Parada cardíaca; Vasoconstritores; Corpos estranhos; Relatos de casos

Received on: May 11, 2023 • **Accepted on:** 4/9/2023

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Source of financing: none.

Conflicts of interest: there are no conflicts of interest.

How to cite this article: Resener G, Nascimento A, Velho M. Pseudo-pulseless electrical activity in foreign body airway obstruction. JBMEDE. 2023;3(3):e23019.

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DOI: 10.54143/jbmede.v3i3.130

INTRODUCTION

Foreign body airway obstruction (FBAO) is a frequent cause of injuries and death in the pediatric population.[1] The mechanical airway obstruction restricts airflow and renders gas exchange ineffective, resulting in hypoxia and cardiac arrest, usually as pulseless electrical activity (PEA) initially. Even with the establishment of oxygen delivery after unobstructing the airway, the hypoxia can cause myocardial stunning, where cardiac contractile activity is ineffective.[2]

The presented report is an example of a complex and decisive clinical management in a medical emergency situation. Thus, it aimed to highlight the importance of continuous assessment, adaptive decision-making and the use of resources such as ultrasound and vasoactive drugs to approach specific complications that may arise during the care of a critical situation like airway obstruction by a foreign body.

CASE REPORT

The case report is of a 7-year-old male seen with FBAO. The patient was brought by the family to the ambulance station where an Advanced Life Support (ALS) unit from *Serviço Móvel de Atendimento de Urgência* (SAMU, acronym from Portuguese) was stationed. The patient presented in cardiac arrest and cardiopulmonary resuscitation (CPR) was started. The object obstructing the airway (**Figure 1**) was removed using a Magill forceps, followed by endotracheal intubation and ALS as per protocol. During the pauses for rhythm check, every two minutes, point-of-care ultrasound (POCUS) was also used, obtaining a subxiphoid view. After approximately 40 minutes of ALS, during a rhythm check the patient presented extreme bradycardia on the monitor, with no palpable pulse, but had discrete myocardial contraction on POCUS (**Figure 2**). It was opted by the attending physician to deviate from the protocol and start norepinephrine infusion (0.1 mcg/kg/minute) and maintain chest compressions, with the rationale that a boost both in chronotropy as well as in inotropy was needed. After two cycles of CPR with the infusion running, the patient had return of spontaneous circulation and was hemodynamically stable enough for transportation to the local pediatric hospital.

Figure 1. Object (whistle) extracted from the patient's trachea.

Figure 2. QR code for the clip of the point-of-care ultrasound image showing a stunned heart in pseudo-pulseless electrical activity.

DISCUSSION

According to the *Sociedade Brasileira de Cardiologia* (SBC), there are around 720 cardiac arrests daily in Brazil. Most of these are the result of underlying diseases, such as arrhythmias, coronary artery disease and strokes.[3] But a portion of the cases are due to acute events, such as FBAO.[4] The current definition of cardiac arrest is the lack of mechanical myocardial activity with loss of consciousness, loss of spontaneous breathing and no detectable pulse.[5] Cardiac arrests are divided into shockable (ventricular fibrillation and pulseless

ventricular tachycardia), where electrical therapy is indicated, and non-shockable (asystole and PEA). Although shockable rhythms tend to have better prognosis, cardiac arrests in PEA have grown.[6] A keystone of the treatment cardiac arrests is the identification of the cause, often using the "Hs and Ts" mnemonic: hypoxia, hypovolemia, hypo and hyperkalemia, hypothermia, acidosis, tension pneumothorax, tamponade, thrombosis of the coronary (myocardial infarction), thrombosis of the pulmonary artery (pulmonary embolism) and toxins.[7] In cases of non-shockable cardiac arrest, the American Heart Association (AHA) recommends CPR plus intravenous bolus of 1 mg of epinephrine every 3 to 5 minutes and treating the cause, if identifiable or suspected.[8]

Foreign body airway obstruction is an important cause of death and disability in children, having food as the main cause, especially milk for newborns and sausages and peanuts for older children, followed by non-edibles, such as toys and coins. Children tend to explore the world by placing objects in their mouth, putting them in harm's way.[9,10] The primary survey of these patients follows the ABC mnemonic, with attention to the history and possible presence of the "universal FBAO sign": both hands holding the neck whilst unable to breath.[10,11]

In cases of partial obstruction of the airway where some flow is still present, coughing may be enough to clear the obstruction, however sometimes other actions may be needed, particularly when no vocalization or breathing are present.[9] The Heimlich maneuver – subdiaphragmatic abdominal thrusts – should be performed, either until clearance of the airway or loss of consciousness. If the patient becomes unresponsive, CPR should be started. If the object is visible and accessible, digital removal may be attempted. Conversely, if not visible, blindly sweeping the mouth should be avoided as it may dislodge the object and worsen the obstruction.[12] If ALS is available and in the scope of practice of the provider, laryngoscopy and removal with forceps should be attempted. If still obstructed and no object is reachable but is believed to be above the vocal cords, cricothyrotomy can be performed; if the object is suspected to be below the vocal cords, the endotracheal intubation may be attempted as a way to push the object further down and make the obstruction selective for one of the lungs.[11,12] Prognosis is closely associated with the degree of the obstruction and time of hypoxia. Cases where there was transient or no loss of consciousness tend to have good prognosis, while a need for CPR is associated with higher mortality.[9,10]

With the popularization of POCUS, several protocols for its use during CPR have been proposed. One of the most widely adopted is American College of Emergency Physicians Cardiac Arrest Sonographic Assessment (ACEP's CASA), focusing on the search for signs of tamponade, pulmonary embolism and myocardial activity.[13] It has been seen that in several cases, although there is no palpable pulse there is myocardial contraction. This may happen in cases of severe hypovolemia, tamponade or in some situations where the contraction is not effective and the heart may look stunned, often after being deprived of oxygen. For these cases the term pseudo-PEA is being used. Another possible term is Pulseless Rhythm with Echocardiographic Motion (PREM).[2,14] Just as no single term is used for this situation, there is no clear consensus on its definition, with some considering that the presence of any contraction enough, while others use the valvar motion as criteria for the diagnosis.[2,13,14,15]The presence of contractile activity seems to be associated with better prognosis, especially when treatable causes, such as hypovolemia, tamponade, pulmonary thromboembolism and tension pneumothorax are found.[3,13,15]

Pseudo-PEA due to hypoxia post-myocardial infarction, where the heart seems stunned and the patient can be seen as in a profound cardiogenic shock – so profound that no pulse is detected – is still in uncharted waters. If in profound shock, the patient should be treated as such, not as per ACLS PEA algorithm, possibly substituting epinephrine

boluses for infusions or norepinephrine. The main rationale is that high doses of epinephrine can be arrhythmogenic and worsen the situation.[2,14,15] In the present case, that was the chosen intervention, with a positive outcome. Even though some advocate for no chest compressions, just treatment of the shock, the authors believe that in situations where no invasive arterial pressure and capnography are available, compressions should be performed when no pulse is detectable either by palpation or POCUS.

Although several guidelines exist, there is no strong evidence that supports the widespread use of POCUS during CPR, as it is not free from risks, such as delaying chest compressions, but there is great potential in a subset of selected patients.[3,15] Despite well-established protocols such as American Heart Association's ACLS not favoring the use of POCUS, it is our belief that emergency physicians should go beyond the guidelines and use the available tools for the benefit of the patient. For this, adequate training and proficiency is needed so that the intervention causes no harm. Also evident is the need for further research in pseudo-PEA, notably due the recent rise in case reports and increase in use of POCUS during CPR, which will make professionals face this kind of patient.

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