
Cardiopulmonary Resuscitation During Cessation of Circulation of Three year-old Child From a Romany Settlement

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Short title: Cardiopulmonary resuscitation of a 3-year-old child

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Abstract

Cardiopulmonary resuscitation (CPR) of children and adolescents in pre-hospital health care is not as common as resuscitation of adults. At the same time, the most common causes of cessation of circulation in childhood are different from those occurring in the adult population. Cardiac failure is the most common cause of death in adults, in contrast to airway obstruction and hypoxia in children. Therefore, based on the recommendations of the European Resuscitation Council (ERC), every CPR begins with 5 initial rescue breaths before chest compression in children. This case report describes the course of CPR during cessation of circulation of a three-year-old child with asphyxia after aspirating stomach contents. It describes the co-operation of rescue units starting with telephone-assisted basic emergency resuscitation by relatives and later by members of the police corps. This includes the procedure of extended resuscitation, from securing the airway to the restoration of circulation using "off-label" procedures and their explanations. It also describes the ongoing hospital post-resuscitation care, the results of the examinations of laboratory parameters and imaging methods, and a supplementary physical examination which also revealed previously hidden signs of physical abuse.

Keywords: cardiopulmonary resuscitation of children, airway obstruction, hypoxia, integrated rescue system

Introduction

Every health worker is trained in the procedures of CPR, but rarely encounter the need to actually perform it in their professional career. Anaesthesiologists, intensivists, doctors, and

paramedics in pre-hospital emergency medicine face such cases on a daily basis. According to data from the operations centre of the emergency medical services (OC EMS), 3 439 cases of CPR were recorded in pre-hospital care for individuals over 18 years of age in Slovakia in 2016 (1). In the age category of 0-18 years of age, there were 69 cases of emergency resuscitation (1). This results in a clear disparity when there is 1 child presenting with cessation of circulation per nearly 50 adults with this diagnosis. Other interesting figures provided by the OC EMS include, for example, the rate of success for CPR in children - 27.5% compared to CPR in adults - 32.5%. The automatic external defibrillator (AED) was only used in five cases, and always for patients over 18 years of age.

Case report

On Saturday midday, a call for an urgent medical assistance squad (UMA) from the 15km distant village was received at the Operations Centre (OC). In the description of the situation was indicated that a three-year-old child, who was eating, then ceased to breathe and communicate. It was reported that the child was suffocating and was unconscious. With the help of telephone assistance of an operator, the callers started to resuscitate the child. The urgent paramedic assistance (UPA) squad resident in the given municipality is at the time of a telephone call outside the station treating another patient. The OC, therefore, sends out a police patrol from that village and at the same time the nearest free squad of the UMA. The report was received at 11:42, the squad set off at 11:43:25 and arrived at 11:58:55. Upon arrival, UMA squad is navigated to the shack. The squad takes the necessary basic equipment from the vehicle, monitor, suction cup, oxygen reservoir and ventilator for artificial lung ventilation (ALV). There are two police officers in the house who are providing an external heart massage, family of the female patient - and her grandmother and mother. The child is unconscious GCS 3b, pupils mydriatic 4/4, no photoreaction, cyanotic to livid colouring, no palpation on the carotid artery, about 12kg, dressed only in a T-shirt and underwear – both pieces of clothes were wet. The police officers are invited to continue heart massage. The doctor of the UMA squad ventilates the patient with aerobat and facial mask, rescuers are preparing intubation aids, and connect the child to monitor of vital signs - ECG, SpO₂, BP (blood pressure). At the same time, the history and circumstances of the given condition are taken.

The grandmother says that the girl was eating and started to suffocate to such extent that she lost consciousness. They called the emergency line and were trying to take the rests of the food out of her mouth. According to them, they were trying to resuscitate the girl, poured over her with water and continued until the police arrived.

During direct laryngoscope in the oral cavity, residues of digested food are present, Cormack-Leanne 1, or tracheal canola intubation (OTC) no. 4.5 but there is an obstruction in the subglottic area, so the canola is removed. Endotracheally, a suction catheter was administered with which the obstruction (susp. rests of food) was extracted. Then intubation by canola no. 3.5 followed. Ventilation with aerobat with 100% oxygen and flow rate of 8l/min. Chest excursions symmetrical, bilateral bronchial phenomena with spastic component present at the audio test. On electrocardiogram (ECG), asystole present, non-measurable pulse oximetry (SpO₂) and blood

pressure (BP). Ensured intravenous line via venous jugulars external l.sin. Administered adrenaline at 0.1 mg without interrupting cardiopulmonary resuscitation according to the protocol. After a repeated dose of adrenaline - without restored circulation, 10 ml of 4.2% bicarbonate is applied. After the administration of the third dose of adrenaline, a return of spontaneous circulation (ROSC) occurs. Present supraventricular rhythm with a regular frequency of 80 / min, measured by NIBP 60/30 mmHg, the child does not regain consciousness, the condition of pupils is without change, we apply 10ml of 20% maintop. The child is transferred to the vehicle, BP stabilizes without the need for vasopressin support with a middle arterial pressure (MAP) of about 50 mmHg, she is connected to APV in pressure control mode with a positive end-expiratory pressure (PEEP) with carbon dioxide expiratory monitoring (EtCO₂). Child observed by midazolam at a dose of 7 mg, administered syntophylline 48 mg and re-administration of 20% maintop 10 ml. At the presence of the police escort, the patient was transported to the Clinic of Paediatric Anaesthesiology and Intensive Medicine (I. KPAIM) after the previous telephone conversation.

After the patient's admission to I.KAIM (the 1st Department of Anaesthesiology and Intensive Medicine), the attending doctors continue with the APV, monitoring vital functions and providing additional invasive inputs. Basic laboratory screening (Table 1) is performed and due to the physical finding, ie extensive skin excoriations and discrepancy in the parental history, a total body CT scan was indicated.

The CT scan of the brain demonstrates extensive enema with decreasing neurostructure density in brain hemispheres and brain stem. Differentiation between white and gray matter was impossible. From the next finding, haemorrhagic collections were present in the fronto-parietal region both bilaterally and temporally to the right. Poscontusion hemorrhagic formations are also present in these areas (Fig. 1). A consulted neurosurgeon recommends a conservative cerebroprotective regime. Continuous analgesication, vasopressin support and antiedematous therapy. Internal environment troubles were corrected. Because of anemia and coagulopathy, erythrocyte concentrates and fresh frozen plasma were administered. The secondary finding in the CT scan is subcutaneous haematoma with nasal sprain, old fracture of the left femur at the remodelling stage, older fractures of ribs 5-8 left and 5th and 6th ribs on the right with the creating of callus (Fig. 2).

After 12 hours, analgosedation was terminated and the patient was examined by neurologist with finding are flex coma. Under valid legislation, the patient was further managed as a potential organs donor. The clinical condition of the child, however, was rapidly worsening despite complex therapy, multiorgan failure progressed and patient exited

Table 1. Biochemical parameters of the child.

Parameter	At admission	later	Reference values (age 3 years)
pH	7,549	7,049	7,0 ±0,4
pCO ₂	3,4 kPa	8,56 kPa	4,3- 6,0 kPa
pO ₂	10,4 kPa	12, kPa	11,1- 14,4 kPa
HCO ₃ ⁻	24,7 mmol/l	14,3 mmol/l	22-26 mmol/l
BE	-0,1 mmol/l	-12,7 mmol/l	-2,5 – 2,5 mmol/l
Lactate	2,1 mmol/l	2,2 mmol/l	0,5- 2,2 mmol/l
Na ⁺	145,0 mmol/l	178,0 mmol/l	138-145 mmol/l
K ⁺	3,02 mmol/l	3,76 mmol/l	3,4- 4,7 mmol/l
Cl ⁻	113,6 mmol/l	124,0 mmol/l	97-110 mmol/l
Albumine	26,3 g/l	-	35- 53 g/l
Glucose	13, 6 mmol/l	5,43 mmol/l	3,9- 5,6 mmol/l
Hgb	76 g/l	104 g/l	115- 135 g/l
RBC	2.82 x10 ¹² /l	3,76 x10 ¹² /l	3,9-5,3 x10 ¹² /l
WBC	15,59 x10 ⁹ /l	11,41 x10 ⁹ /l	5,0- 15,5 x10 ⁹ /l
PLT	250 x10 ⁹ /l	140 x10 ⁹ /l	150-450 x10 ⁹ /l
PT-INR	1,65 INR	1,35 INR	0,8- 1,2
APTT	1,32 ratio	0,88 ratio	0,8- 1,2
FBG	0,38 g/l	1,34 g/l	1,7- 4,0 g/l

4. Discussion

Cessation of circulation and providing CPR to children out of hospital environment is not a common situation in our circumstances. In the provision of health care in risky areas, it is necessary to cooperate with several components of the integrated rescue system. At the time of

the incident, the urgent paramedic assistance squad located in that village was called for a treatment of hand injury after a 29-year-old man fell off a bicycle. Although it was an indicated trip, the injury could have been treated at the traumatological outpatient clinic even without prior treatment by the UPA squad.

The OC operator sends out the police officers to the spot. It was a risky area where Roma citizens tend to aggressively attack rescue forces in aggravated situations. The PF (Police force) staff had an incomparably shorter time to come, but they are primarily trained in CPR procedures. They took over a telephone assisted laic CPR. Although PF is not normally equipped with AED. If this changed, we could assume that the provided primary resuscitation would be even of more quality although efficiency has not been confirmed (2, 3).

The average time of the UPA squad arrival is 11:07 in the territory of the Slovak Republic in 2015 (3). The travel time of this case was nearly 17 minutes, which is unacceptably long for a patient requiring advanced life support ALS. The arrival time for the UPA squad, if they had been at their station, would have been several times shorter. This only confirms the fact that the positions of the emergency medical service (EMS) in the territory of the Slovak Republic are deployed strategically favourable (4). The issue of the need to intervene in non-life-threatening situations to the detriment of those patients who require urgent health care is not part of this case.

ALS administrated by UMA was performed with the best knowledge and conscience. However, even in this interval of complex care, the controversial parts were present. Primary intubation was not successful due to obstruction in the infraglottic region. Children have this area physiologically narrowed compared to adults (5). Therefore, it is not surprising that obstruction of airway occurred.

Administration of bicarbonates is not indicated (6) according to the latest CPR recommendations for 2015 unless the acid-base balance (ABB) parameters are known. The decision to administer sodium bicarbonate was based on the fact that in long-term apnoea, the development of respiratory acidosis (RAC) and subsequent hypoxia and metabolic acidosis were assumed. Additionally, despite repeated application of adrenaline, systolic persisted. After administration of the sodium bicarbonate, the third dose was administered to the ROSC. Upon admission to the hospital, ABB shows a HCO_3^- -level in the physiological range and therefore 24.7 mol/l and base excess (BE) -0.1 (Table 1). These results confirm that bicarbonate treatment was fully indicated in the prolonged CPR with benefit to the patient and successful cardiac restoration.

In the early post-resuscitation period, the patient was monitored by midazolam and 20% maintop 20 ml converted to 0.34 g/kg (7) was administrated in order to treat cytotoxic brain enema. To ensure the auditory finding of spastic phenomena, a single dose of 4 mg/kg of syphophyllin is administered iv.

In the course of hospitalization, the treatment of post-resuscitation disease focused on cerebroprotective management continued, pathological biochemical parameters were corrected. In addition, a clinical examination implied a possible Child Abuse and Neglect syndrome (CAN)

which was even more supported by total body CT examination (8). The police were informed about these findings.

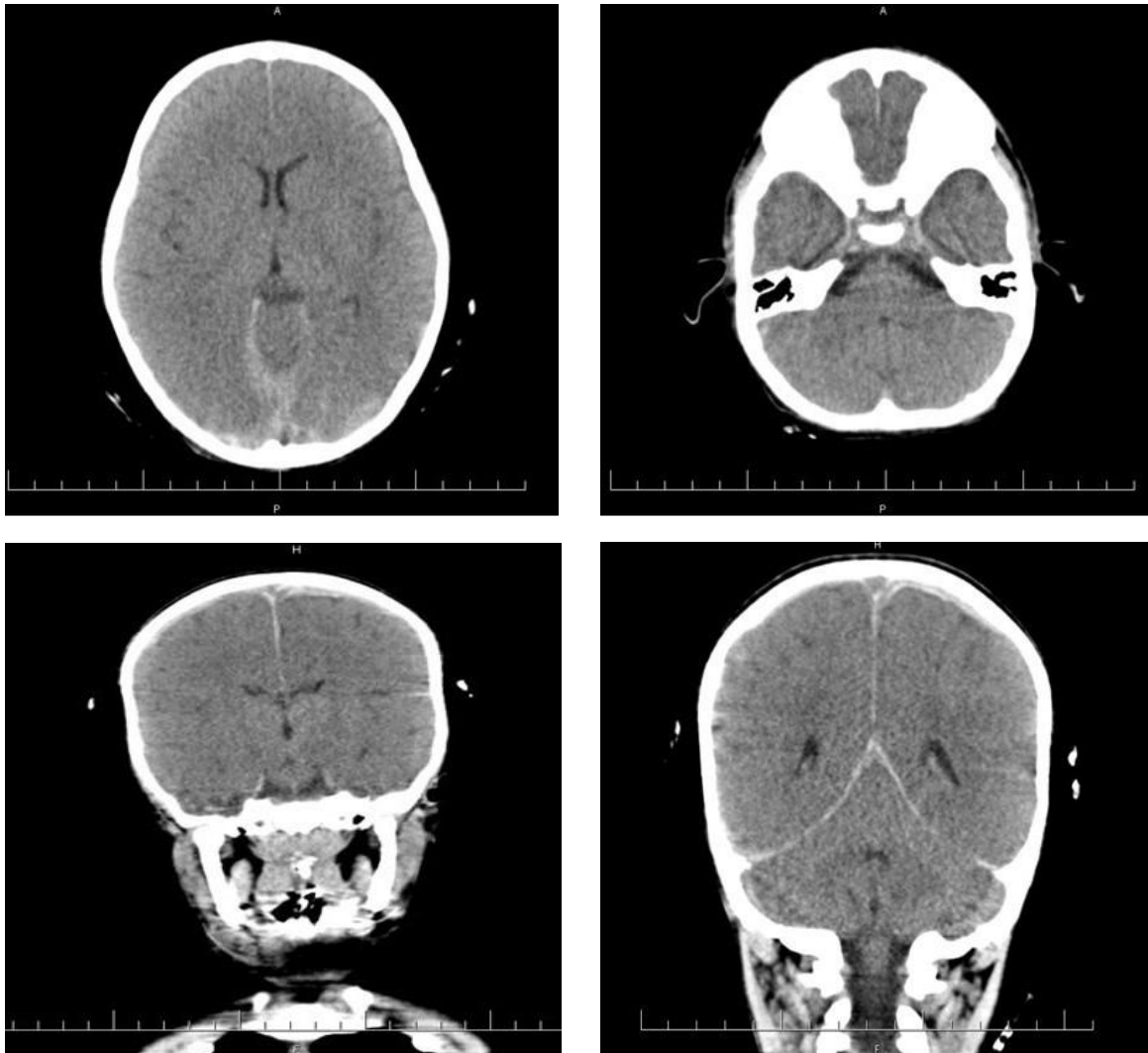


Figure 1. CT finding in a three-year-old child.

Conclusion

This case report describes the events of a successful pre-hospital CPR of a three-year-old child in a chronological sequence from the co-operative rescue, through performance to after resuscitation care. The reason of cessation of circulation was obstruction of the airways by food

pieces leading to asphyxia and consequent disturbance of consciousness and circulatory failure. This only supports the well-known fact that respiratory insufficiency is the main cause of cessation of circulation in children. This fact is also taken into account in the recommended procedures of paediatric CPR.

An internal good feeling of all members of the rescue team after the child was handed over to the paediatric intensive caregivers was replaced by sadness after finding out that the child died two days later. This report is a sort of a memorial to a little girl who left this world very early.

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