CASE REPORT

Value of an automatic external defibrillator printout as a diagnostic tool after successful AED use on a child

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SUMMARY

A 6-year-old girl without any medical history experienced a drowning incident for a duration of 2 min, according to witnesses. This was followed by cardiopulmonary resuscitation, during which the automatic external defibrillator (AED) detected a shockable rhythm and subsequently delivered a single electroshock. At the time of admission, her medical history was unclear, and as her chest had been wet, it was not clear if the AED had been capable of correctly analysing the rhythm. The AED printout, however, revealed ventricular fibrillation (VF), which proved to be a primary cardiac cause at the time of the incident. This case report confirms the assumption that the AED can adequately perform rhythm analysis on children and convert VF into sinus rhythm. Moreover, the AED printout can provide information about the rhythm that is necessary for the diagnosis of an underlying cardiac disease.

BACKGROUND

Most causes of collapse are harmless and resolve spontaneously. However, prompt treatment is required in the rare case of a severe underlying cardiac cause. The differential diagnosis, ranging from vasovagal collapse to ventricular fibrillation (VF), makes it difficult to establish a definitive diagnosis. During an out-of-hospital collapse, the automatic external defibrillator (AED) can help diagnose the underlying cause of collapse, and in the event of a cardiac cause, it has been proven to be life-saving in adults.¹ Until recently, however, it was uncertain whether the AED could be used effectively and safely on children. Retrospective case studies demonstrated that the AED can perform rhythm analysis on all age groups.² This case report confirms this assumption and describes the successful use of the AED on a child's wet chest. Moreover, it also demonstrates the AED's diagnostic value, with important consequences for follow-up and treatment. Hence, this case report emphasises the importance of obtaining the AED printout.

CASE PRESENTATION

A 6-year-old girl without any medical history was brought into the emergency room (ER) after collapsing in a swimming pool. During a swimming lesson, she had lost consciousness and became pale and flaccid. The swimming instructors had lifted her out of the pool within 1–2 min after the collapse. Since the girl had no pulse, looked cyanotic

and performed no spontaneous movements, the swimming instructors started cardiopulmonary resuscitation (CPR). They connected the AED, which detected a shockable rhythm and gave one electroshock. After the electroshock, the girl regained cardiac output and full consciousness. The total estimated time of CPR had been less than 10 min. When the ambulance arrived, the girl was ABC stable with normal vital parameters and normal body core temperature. She was alert and responding normally (expired minute ventilation 15). In the ER, neither physical examination nor monitor observation showed abnormalities.

MANAGEMENT

An ECG was performed and showed no anomalies; nor were there signs of aberrant conduction or prolonged QT time. Lab results showed normal electrolytes and glucose levels. Family history showed no relevant medical information. The child was admitted for observation, and a cardiac 24-hour Holter recording was started.

No AED printout was available at the time of presentation. Since the electrodes had been placed on a wet chest, the possibility was considered that the cardiac rhythm might not have been adequately detected by the AED or that the electroshock had been ineffectively performed. Based on these uncertainties, a primary cardiac cause was considered to be less likely than a vasovagal syncope after getting into cold water, taking into account the child's uneventful history concerning cardiac arrhythmia as well as the short time of submersion, which made hypoxia unlikely as the cause of the arrest, the absence of abnormalities during examination and further investigation, and the prosperous clinical recovery.

Five days after the incident, the AED printout (figure 1) became available. It revealed VF (possible torsades de pointes) followed by a sinus rhythm after electroshock. Since there was no history of intoxication or medication use as a possible cause of VF, or of hyperkalaemia, an underlying cardiac cause now seemed more plausible, and diagnostic work-up was aimed at possible causes, such as idiopathic ventricular tachycardia, Brugada syndrome, long QT syndrome or catecholaminergic polymorphic ventricular tachycardia.

OUTCOME AND FOLLOW-UP

Repeated ECGs of the patient and her parents remained normal. Cardiac ultrasound and exercise

To cite: van Sambeek SJ, van Gent R, Schroër C, et al. *BMJ Case Rep* Published online: [please include Day Month Year] doi:10.1136/bcr-2012-007532

Figure 1 Automatic external defibrillator printout showing ventricular fibrillation converted into a sinus rhythm after electroshock (black arrow).

stress tests were normal. Genetic tests on SCN5A mutation and LQT mutation were performed and came out negative, as did an ajmaline test and an isoprenaline test. Cardiac mapping during electrophysiological testing was carried out. Pending these test results, a β -blocker was started and increased during the hospital stay. Furthermore, lifestyle advice was given concerning dietary restrictions, medication and physical activity, as this can influence potassium current in ion channels, which can lead to an extended cardiac action potential. As all the test results turned out to be negative, the most likely cause for VF was considered to be idiopathic ventricular tachycardia. An internal recording device (Reveal loop recorder) was placed.

DISCUSSION

This case report shows that the AED can correctly identify a shockable rhythm and effectively perform electroshock on a child, even if the electrodes are placed on a wet chest. Moreover, an AED printout can help establish a definite diagnosis, and thus direct the focus of diagnostic work-up to cardiac causes. This has major implications for preventive measures aimed at reducing the chance of recurrence.

Sudden cardiac death in children is increasingly recognised and may account for 11% of all deaths in children between 1 and 20 years of age.³ In contrast to adults, cardiac arrest in children usually results from cardiac hypoxia, which may be related to airway or lung disease or sepsis, and rarely from a primary cardiac cause or VF. However, recent literature has shown that VF in cardiac arrest is more common in children than was previously assumed. In the age group 0–8 years, VF is the initial cardiac rhythm in 3% of paediatric in-hospital and out-of-hospital cardiac arrests.⁴ In the age group 8–19 years, this number increases to 17–19%.^{3 4}

Early recognition and defibrillation of VF increases the chance of survival after cardiac arrest.¹ If defibrillation occurs within 2 min after cardiac arrest, there is an 80% chance of survival. However, with every minute that defibrillation is postponed, the chance of survival decreases by 10%.

In out-of-hospital cardiac arrest, the AED offers the fastest opportunity for defibrillation, since the ambulance emergency response time is 10–15 min. Previous studies have shown that the AED provides excellent rhythm analysis in VF and non-

shockable rhythms in all age groups, with a high specificity and sensitivity.²

An important observation of this case study is the fact that the AED electrodes were placed on a wet chest but were nevertheless effective under these circumstances. It also demonstrates the importance of the AED printout in differentiating between a cardiac and non-cardiac cause, and in determining subsequent work-up and treatment. Until the AED printout is available, hospital admission and monitor observation are advised, even if there are no symptoms of cardiac disease.

Learning points

- ▶ An automatic external defibrillator (AED) can effectively perform an electroshock in a child, even if the electrodes are placed on a wet chest.
- ▶ The AED can provide information on the rhythm that is necessary for establishing the diagnosis of an underlying cardiac diagnosis.
- ▶ Until the AED printout is available, hospital admission and monitor observation are advised, even if there are no symptoms of cardiac disease.

Competing interests None.

Patient consent Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

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