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CASE REPORT

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Sudden cardiac arrest in a shockable rhythm induced by energy drinks: a case report.

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ABSTRACT

Sudden cardiac arrest (SCA) is a life-threatening condition often caused by ventricular fibrillation, which requires immediate defibrillation. Automated external defibrillators (AEDs) are a crucial tool in the chain of survival in such situations, allowing rapid restoration of a perfusing rhythm and preventing the death of the patient. This article aims to present the role of AEDs in cases of SCA due to ventricular fibrillation and to analyse the impact of poor dietary habits, particularly excessive consumption of energy drinks, on the risk of SCA. The case of a 26-year-old man who experienced SCA after consuming large amounts of energy drinks illustrates the mechanism through which stimulants in these drinks can induce dangerous arrhythmias, such as ventricular fibrillation. Excess caffeine and other stimulants can lead to overstimulation of the nervous and cardiovascular systems, resulting in disturbances in heart rhythm. In the described case, the quick intervention of the patient's coworkers, who immediately initiated cardiopulmonary resuscitation (CPR) and used an AED, led to return of spontaneous circulation (ROSC). The patient was subsequently transported to the hospital, where an ICD was implanted as a preventive measure to avoid recurrent arrhythmias. The article highlights the risks associated with excessive consumption of energy drinks and a poor diet, emphasising the need for education about their potential health hazards. Excessive energy drink intake can lead to severe heart rhythm disturbances and increase the risk of SCA, making it important to promote healthy eating habits and awareness of the dangers associated with stimulants.

KEY WORDS: Sudden cardiac arrest (SCA), automated external defibrillator (AED), implantable cardioverter defibrillator (ICD), ventricular fibrillation (VF).

INTRODUCTION

Sudden cardiac arrest (SCA) is one of the most serious life-threatening conditions, characterised by the sudden and unexpected cessation of heart function, leading to immediate halt of blood circulation [1]. One of the most common mechanisms leading to SCA is ventricular fibrillation, one of the shockable rhythms in the ERC 2021 cardiac arrest algorithms, characterised by chaotic and uncoordinated electrical activity in the heart. This condition requires immediate defibrillation to restore normal heart rhythm and ensure effective circulation [2,3]. An automated external defibrillator (AED) is a critical device that enables a rapid and effective intervention aimed at restoring sinus rhythm, which can prevent death of the patient [4,5].

In recent years, there has been an increasing number of cases of SCA among young adults, partially related to unhealthy dietary habits, such as excessive consumption of energy drinks. These products, rich in caffeine and other stimulants, can lead to significant stimulation of the nervous and cardiovascular systems, increasing the risk of dangerous arrhythmias, including ventricular fibrillation [6].

The purpose of this article is to present the role of AED in cases of SCA due to ventricular fibrillation and to analyse the impact of poor dietary habits, particularly excessive consumption of energy drinks, on the risk of SCA [6]. We describe the case of a 26-year-old man who suffered SCA at work after prolonged consumption of large amounts of energy drinks. The objective of the article is to emphasize the importance of rapid defibrillation with an AED as a key life-saving intervention and to highlight the potential health risks associated with the abuse of stimulants.

CASE REPORT

PATIENT INFORMATION: According to the patient's coworkers: On the day of the incident, the patient was at his work place performing routine office duties and consuming energy drinks. Suddenly, he collapsed, losing consciousness without any prior warning signs, except for sudden weakness and pallor. After falling, the patient did not respond to stimuli and his pulse was undetectable.

The immediate reaction of his colleagues was crucial. One of them, trained in first aid, began cardiopulmonary resuscitation (CPR) by performing chest compressions and rescue breaths. Simultaneously, another employee called the emergency number, reporting the case of SCA. An Automated External Defibrillator (AED) was located nearby and it was immediately retrieved and applied by the trained co-worker. After connecting the device, the AED detected ventricular fibrillation (a shockable rhythm) and advised the shock. After defibrillation, a perfusing rhythm was restored and the patient's pulse became palpable.

Following the return of vital signs, the patient remained unconscious. Co-workers monitored his vital signs, including pulse and breathing, and maintained airway patency. While waiting for the emergency medical team (EMT) to arrive, they continued to monitor his vital signs.

The emergency medical team arrived at the scene 11 minutes after receiving the call. On arrival, they found the patient unconscious and lying on the floor. Despite restoration of vital signs by earlier use of the AED, the patient remained unconscious, but his pulse (80 beats per minute) was palpable and he was breathing (16 breaths per minute). Information obtained from co-workers indicates that the patient had been regularly consuming energy drinks with a high caffeine content (approximately 2 litres per day) for several months.

CLINICAL FINDINGS (EMT): Emergency medical personnel immediately evaluated the patient's condition. They followed the ABC protocol, connected the patient to a cardiac monitor to continuously monitor his heart rhythm, oxygen saturation (SpO_2), respiratory rate and blood pressure. Oxygen saturation was 92% and blood pressure was 100/60 mmHg. A 12-lead ECG was performed showing a sinus rhythm at a rate of approximately 80 beats per minute, with no signs of acute coronary syndrome or other additional rhythm disturbances. The recording was stable, suggesting an improvement in the patient's condition following the ventricular fibrillation incident.

DIAGNOSTIC ASSESSMENT: Post-sudden cardiac arrest the patient was resuscitated and defibrillated using an automated external defibrillator. After the restoration of a perfused rhythm, the patient was unconscious but had a stable heart rate and breathing. To secure the airway, the patient was intubated.

THERAPEUTIC INTERVENTION: To stabilize the patient, intravenous access was established in the left forearm and 1000 ml of 0.9% sodium chloride (NaCl) solution was administered to ensure adequate hydration and blood pressure. As part of antiarrhythmic prophylaxis, 150 mg of amiodarone, diluted in 100 ml of 5% glucose, was administered intravenously within 10 minutes. Due to the presence of a physician on the EMT team and the patient's unconscious state, which required airway protection, sedative and muscle relaxant drugs were used. Midazolam was administered at a dose of 2.5 mg intravenously to ensure sedation and fentanyl at a dose of 50 mcg intravenously for analgesia. In addition, rocuronium was administered at a dose of 1 mg/kg body weight, allowing full muscle relaxation and facilitating intubation. After intubation, the patient was connected to a ventilator to provide appropriate mechanical ventilation. A pressure-controlled mode was established, with tidal volume adjusted to the patient’s body weight, which was 6 ml/kg, corresponding to 420-560 ml per breath. The respiratory rate was set at 12 breaths per minute and positive end-expiratory pressure (PEEP) at 5 cm H_2O. Initially, the fraction of inspired oxygen (FiO_2) was set at 100% to ensure maximum saturation, which was monitored and maintained at over 94%. End-tidal CO2 (EtCO2) was also monitored and maintained at approximately 40 mmHg.

Less than an hour after the appearance of SCA, the patient was admitted to the Emergency Department of the Military Institute of Medicine – National Research Institute in Warsaw. The patient arrived at the Emergency Department (ED) with ROSC, unconscious, after resuscitation and successful defibrillation with an AED. He had stable heart rate and spontaneous breathing, although he was intubated to secure the airway. His condition required further intensive medical care and monitoring.

CLINICAL FINDINGS (ED): At the time of admission to the emergency department, the patient's oxygen saturation was 95%, indicating adequate oxygenation of the blood. The patient's blood pressure was stable at 120/80 mmHg. The Glasgow Coma Scale (GCS) score was 4, indicating deep unconsciousness. The patient's body temperature was 36.2°C, which was within the normal range. These parameters indicated stabilization of basic vital functions. The results of laboratory tests are presented in Table 1.

Table 1. Laboratory test results.

Parameter	Result	Normal Range
Sodium (Na)	137 mmol/L	135-145 mmol/L
Potassium (K)	4.0 mmol/L	3.5-5.0 mmol/L
Ionized Calcium (Ca^{2+})	1.1 mmol/L	1.1-1.3 mmol/L
Chloride (Cl)	100 mmol/L	98-106 mmol/L
Glucose	98 mg/dL	70-99 mg/dL
pH	7.40	7.35-7.45
pCO_2	38 mmHg	35-45 mmHg
pO_2	80 mmHg	75-100 mmHg
HCO_3^-	23 mmol/L	22-28 mmol/L
BE (Base Excess)	+0.5 mmol/L	-2 to +2 mmol/L
Troponin I	0.05 ng/mL	<0.04 ng/mL
Urea	30 mg/dL	10-50 mg/dL
Creatinine	0.9 mg/dL	0.6-1.2 mg/dL
Hemoglobin (Hb)	14.0 g/dL	13.8-17.2 g/dL
White Blood Cells (WBC)	7.5 x 10^9/L	4.0-11.0 x 10^9/L
Platelets (PLT)	230 x 10^9/L	150-450 x 10^9/L
Caffeine	14 µg/mL	up to 5 µg/mL

The above results indicated an elevated level of troponin I, which may suggest a minor myocardial injury. Other parameters, including electrolytes, glucose, and blood gas indices, were within normal ranges. Toxicology tests showed an elevated level of caffeine, suggesting excessive consumption of this substance. Figure 1 shows the ECG recording taken in the Emergency Department.

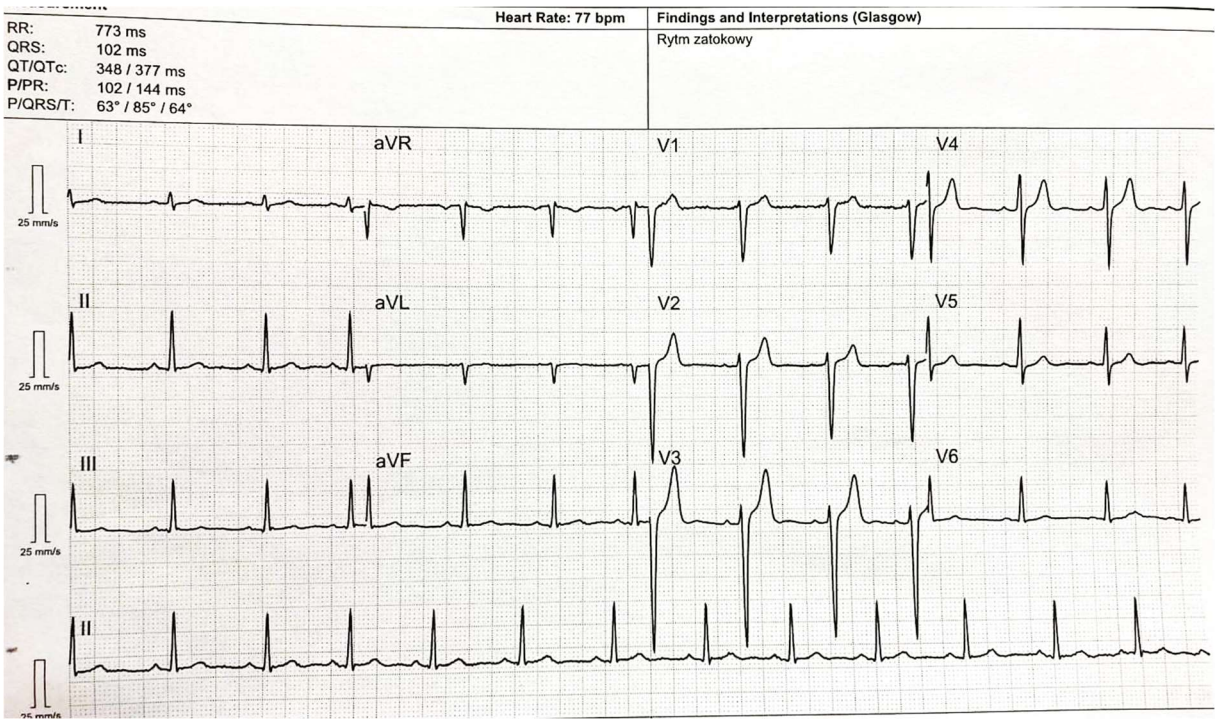

Figure 1. ECG recording taken in the Emergency Department.

Hemodynamics laboratory

After the initial assessment of the patient's condition according to the ERC 2021 guidelines, the patient was immediately transferred to the hemodynamics laboratory, where a coronary angiography was performed. The angiography revealed that all major coronary vessels were patent, without significant stenosis or atherosclerotic changes. The left main coronary artery, the left anterior descending artery and circumflex branch showed no significant changes that could affect blood flow. No significant stenosis was found in these vessels. The right coronary artery was also patent, with minimal atherosclerotic changes that were insignificant and did not cause flow-limiting stenosis. The examination results did not confirm the presence of ischemic heart disease, ruling it out as the cause of sudden cardiac arrest. All major coronary vessels were fully patent, indicating the absence of pathological changes that could lead to impaired blood flow to the heart muscle.

Cardiac Intensive Care Unit

After coronary angiography, the patient was transported directly to the Cardiac Intensive Care Unit (CICU). In that place, intensive treatment and monitoring of the patient's condition continued, providing comprehensive medical care. Upon the decision of the attending physician, after stabilizing the patient's condition, extubation was performed, which involved removing the endotracheal tube and discontinuing mechanical ventilation. The patient regained spontaneous breathing and continued to be monitored in the Cardiac Intensive Care Unit. An interview with the patient was conducted on energy drink consumption. The patient confirmed that she ate approximately 1.5-2.0 litres of the product daily for nearly six months.

The composition of the indicated product was as follows: water, sugar and/or glucose-fructose syrup, acidity regulators: citric acid and sodium citrates, carbon dioxide, flavouring, caffeine (0.045%), inositol (0.02%), colourants (E 101 and E 150d), vitamins: niacin, pantothenic acid, B6 and B12. In the following days of stay in the Cardiac Intensive Care Unit (CICU), the patient continued intensive treatment and underwent detailed diagnostic tests. The results of the echocardiography performed on the patient showed a normal left ventricular ejection fraction (EF) of 55%, indicating good systolic function. The end-diastolic diameter of the left ventricular was 52 mm, and the end-systolic diameter 35 mm. The thickness of the interventricular septum and the posterior wall of the left ventricle was 9 mm, which is within the normal range. The left atrium had a diameter of 35 mm and the right ventricle measured 25 mm in diastole, with no significant deviations. No pathological findings were found in the right atrium. Examination did not reveal significant valve defects. The mitral and tricuspid valves functioned normally, with no signs of significant regurgitation. The aortic valve was normal, with minimal physiological regurgitation, and the pulmonary valve did not show abnormalities. Echocardiography results suggested the absence of significant structural heart pathologies, indicating that structural heart disease was not the cause of sudden cardiac arrest.

Cardiology Ward

After four days of intensive care in the Cardiac Intensive Care Unit, the patient, in good health, was transferred to the general ward of the cardiology department. As part of further diagnostics and monitoring of the patient's health status, a Holter ECG examination was performed, which included 24-hour monitoring of the patient's heart rhythm. The Holter ECG examination showed that the patient had a sinus heart rhythm with an average rate of about 70 beats per minute. During the 24-hour monitoring, no episodes of atrial fibrillation or ventricular fibrillation were recorded, which could indicate a recurrence of life-threatening arrhythmias.

However, sporadic occurrences of single premature atrial contractions (PAC) and single premature ventricular contractions (PVC) were recorded, which were asymptomatic and did not affect the overall well-being. No episodes of bradycardia or tachycardia that required intervention were noted. By the decision of the medical council, the patient was qualified for the implantation of an implantable cardioverter-defibrillator (ICD) as a preventive measure to prevent the potential recurrence of life-threatening arrhythmias. The patient was informed about the indications, procedure, and potential benefits and risks associated with the implantation of the device. After receiving detailed information, the patient consented to ICD implantation.

The ICD implantation procedure was performed on the eighth day of hospitalisation. After local anaesthesia, an incision was made in the subclavian area, creating a pocket for the device generator. The leads were inserted through the subclavian vein into the heart and placed in the right ventricle and the right atrium. After the correct placement of the leads under X-ray guidance was ensured, they were connected to the ICD generator, which was placed in the pocket. The surgical wound was then closed.

On the ninth day of hospitalisation, an ICD test was conducted. The test involved the controlled induction of ventricular arrhythmia and the evaluation of the device's ability to detect and effectively defibrillate it. The testing demonstrated the proper functioning of the ICD, with correct detection of arrhythmia and successful termination by the device. On the tenth day after the SCA, the patient was discharged from the hospital in good general condition. The patient was informed of the need for regular ICD checks, which would include both the evaluation of device parameters and its functioning in clinical practice. These check-ups are crucial for monitoring the technical condition of the ICD and adjusting it to any changes in the patient's clinical condition. The patient also received instructions on daily life, including the need to avoid strong magnetic fields and devices that could interfere with the ICD's operation. Regular visits to the cardiology clinic were also scheduled to monitor heart condition and device function. The patient left the hospital fully aware of the need for continued care and follow-up.

TIMELINE:

Day 1, 11:00 AM:	Workplace Sudden Cardiac Arrest (SCA), use of Automated External Defibrillator (AED);
Day 1, 11:11 AM:	Emergency Medical Team (EMT) - intubation, administration of sedative and muscle relaxant drugs;
Day 1, 12:00 PM:	Emergency Department (ED) - laboratory tests, decision to perform coronary angiography;
Day 1, 1:30 PM:	Hemodynamics Laboratory - additional tests, assessment of coronary artery patency;
Day 1, 2:30 PM:	Cardiac Intensive Care Unit (CICU) - intensive care, monitoring;
Day 4:	Cardiology Ward - transfer, continuation of treatment, Holter ECG examination;
Day 8, 9:00 AM:	Operating room procedure for implanting an implantable cardioverter-defibrillator (ICD);
Day 9, 10:00 AM:	Cardiology Ward - testing of the implantable cardioverter-defibrillator (ICD);
Day 10, 2:00 PM:	Discharge from the hospital - recommendations for further care and cardiological monitoring.

DISCUSSION

This article discusses the case of a 26-year-old man who experienced sudden cardiac arrest after consuming a large amount of energy drinks. The discussion focusses on analysing the impact of poor dietary habits, particularly excessive energy drinks, and the role of automated external defibrillators in saving lives. Excessive consumption of energy drinks, rich in caffeine and other stimulants, can cause severe heart rhythm disturbances such as ventricular fibrillation. Mangi et al. highlighted that components of energy drinks can cause tachycardia, increased blood pressure, and, in extreme cases, aortic dissection [7].

Ward et al. describe cases of young adults experiencing severe cardiovascular events after consuming energy drinks, emphasising the risks associated with their consumption, especially in individuals with preexisting heart conditions [8]. Goldfarb et al. analysed cases of cardiovascular events related to energy drinks, showing that young adults are particularly vulnerable to such events, often associated with the simultaneous consumption of alcohol or other substances [9].

The ingredients in energy drinks, such as caffeine and taurine, can have synergistic effects on the cardiovascular system. La Vieille et al. emphasise that moderate consumption (up to 500 ml daily) of energy drinks typical of the Canadian market is safe for healthy adults and adolescents. However, children, pregnant women, and people sensitive to caffeine should avoid these drinks. The consumption of energy drinks in combination with alcohol can amplify their negative effects, as highlighted in studies by La Vieille et al. The consumption of these drinks can lead to tachycardia, increased blood pressure, and, in extreme cases, severe arrhythmias and aortic dissection [10].

Mangi et al. point out that young people, who are the primary consumers of energy drinks, are often less tolerant to caffeine, which increases their susceptibility to the toxic effects associated with its consumption. Additionally, energy drinks are often consumed in combination with alcohol, which can exacerbate their negative effects. Alcohol prolongs the half-life of caffeine, which can lead to a greater risk of caffeine intoxication and related cardiovascular events [7]. According to research conducted by the Substance Abuse and Mental Health Services Administration, the number of emergency room visits related to energy drink consumption more than doubled between 2007 and 2011, highlighting the growing health problem associated with these products. Although the number of cases reported may be underestimated, these data suggest that energy drinks can pose a significant public health risk, particularly among young adults [7].

Excessive consumption of energy drinks can lead to severe rhythm disturbances. The increasing number of SCA cases among young adults associated with excessive energy drink consumption underscores the need for widespread educational and preventive measures. Energy drinks, due to their high caffeine content and other stimulants, can cause serious heart rhythm disturbances such as ventricular fibrillation, directly increasing the risk of SCA. Implementing measures to limit the consumption of these products and raising awareness of their potential health risks is crucial for cardiac prevention.

However, even with the best preventive measures, SCA can occur unexpectedly, highlighting the importance of preparing for immediate intervention. In such situations, AEDs play a critical role. AEDs are invaluable in emergencies, allowing rapid defibrillation and the restoration of sinus rhythm, significantly increasing the chances of survival for patients with ventricular fibrillation. Studies conducted by Karlsson et al. have shown that the availability of AEDs in public places significantly improves survival rates.

One to the key elements of saving lives in cases of SCA is rapid and effective intervention with AED. Studies conducted by Karlsson et al. demonstrated that the availability of AED in public places significantly increases the survival rate of patients after SCA. AEDs allow immediate defibrillation, which is crucial for restoring sinus rhythm and preventing death [4]. Bak et al. emphasise that AEDs do not only restore sinus rhythm, but also collect important data regarding heart rhythm and the course of resuscitation, which can contribute to a better understanding of the causes of CRS and the effectiveness of emergency procedures [11].

The availability of AEDs and the participation of bystanders can significantly improve survival rates after out-of-hospital cardiac arrest (OHCA). Bkgaard et al. indicate that the median survival to hospital discharge was 40% in cases where AEDs were used before the arrival of emergency services, with the highest survival rates observed in cases where defibrillation was performed by bystanders who were not alerted first responders [12]. Murakami et al. highlight the important role of location of AEDs, noting that the use of AEDs by bystanders increased significantly in places such as train stations and sports facilities, positively impacted survival rates with favourable neurological outcomes [13].

Interventions such as AEDs and ICDs are not only effective in saving the lives of patients after SCA, but also contribute significantly to improving long-term outcomes. It is necessary to continue to promote the availability of AEDs in public places, educate the society, and conducting research to optimise strategies for preventing sudden cardiac death. Raising awareness of the risks associated with energy drinks can be an important step in cardiac prevention, helping to prevent cases of SCA through education on healthy eating habits. The abuse of energy drinks, which can cause severe heart rhythm disturbances, requires special attention from healthcare services and society to reduce the risk of such cardiac events in the future.

CONCLUSIONS

Products such as energy drinks containing large amounts of caffeine can cause excessive stimulation of the nervous and cardiovascular systems, increasing the risk of arrhythmias, including ventricular fibrillation. In the case described, the use of an AED by bystanders led to ROSC, which was confirmed by the arriving emergency medical team.

SUPPLEMENTARY INFORMATION

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Informed Consent Statement: *Informed consent was obtained from all subjects involved in the study.*
Data Availability Statement: *The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.*
Conflicts of Interest: *The authors declare no conflicts of interest.*

Shortcuts:

AED - Automated External Defibrillator
BLS - Basic Life Support
CARES - Cardiac Arrest Registry to Enhance Survival
eCPR - Extracorporeal Cardiopulmonary Resuscitation
ED - Energy Drink
ICD - Implantable Cardioverter Defibrillator
IHD - Ischaemic Heart Disease
MCS - Mechanical Circulatory Support
NICM - Non-Ischaemic Cardiomyopathy
NZK - Sudden Cardiac Arrest (SCA)
OHCA - Out-of-Hospital Cardiac Arrest
OINK - Cardiac Intensive Care Unit (CICU)
PAD - Public Access Defibrillation
PEEP - Positive End-Expiratory Pressure
RKO - Cardiopulmonary Resuscitation (CPR)
ROSC - Return of Spontaneous Circulation
SCD - Sudden Cardiac Death
SOR - Emergency Department (ED)
SRCR - Swedish Register for Cardiopulmonary Resuscitation
VF - Ventricular Fibrillation

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