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Case Report

Successful resuscitation of prolonged cardiac arrest occurring in association with '*skunk*' and toluene toxicity

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ABSTRACT

We report a case of prolonged and successful resuscitation following cardiotoxicity-related arrest occurring after inhaling toluene and *Skunk*, which is an increasingly popular synthetic cannabinoid (SC). Following presentation to the emergency department because of lethargy, nausea and chest pain, a 28-year-old male user of *Skunk* and toluene suffered from cardiac arrest due to ventricular fibrillation (VF). Cardiogenic shock, severe metabolic acidosis and regular wide QRS tachycardia were observed in the patient, and he developed VF every 5–10 minutes over the course of 10 hours. The patient responded to prolonged resuscitation and was discharged on 8th day of his admission in a healthy condition. This case report is the first report that cardiac arrest occurring as a result of *Skunk* and toluene inhalation, which was resolved without sequelae after prolonged resuscitation.

1. Introduction

Synthetic cannabinoids (SCs) are some of the most popular recreational drugs.[1] *Skunk* is a new SC derivative containing a high level of Δ9- Tetrahydrocannabinol (Δ9-THC) However, limited data pertaining to the toxicity of *Skunk* are available in the literature.

Dependence on volatile substances, such as organic solvents, is a significant public health problem, particularly among teenagers and adults in developing countries. The low cost and easy availability of these volatile substances are risk factors that increase dependence on them. Toluene is an organic solvent and aromatic hydrocarbon that causes central nervous system depression, fatal cardiac dysrhythmia and renal and hepatic toxicity following inhalation or ingestion.[2,3]

This case report is about a patient who suffered cardiac arrest after *Skunk* and toluene inhalation and was discharged in a healthy condition following prolonged resuscitation, which was performed for approximately 10 h.

2. Case presentation

A 28-year-old male with a known history of dependence on SCs and toluene presented to emergency department of a public hospital with new-onset epigastric and chest pain. Because of wide regular QRS tachycardia observed on electrocardiography (ECG) and severe metabolic acidosis observed on an arterial blood gas (ABG) test, the patient was referred to our hospital. At that moment, ventricular fibrillation (VF) occurred and the patient was intubated following cardiopulmonary resuscitation (CPR) performed for approximately 20 min.

During the patient's initial assessment in our hospital, his Glasgow coma scale (GCS) score was 7 (E2V1M4); blood pressure was 90/50 mmHg; heart rate was 130/min and body temperature was 36.7 °C. The pupils were isocoric, and both eyes showed positive light reflexes. The physical examination findings were normal. On ECG upon arrival at our hospital, left bundle branch block was observed and QRS width was 240 ms (Fig. 1a). Global hypokinesia was observed on bedside echocardiography, and ejection fraction (EF) was estimated to be 30%. The patient had severe metabolic acidosis with increased anion gap in ABG and serum lactate levels were elevated (Table 1). Moreover the urine toxicology test was positive for Δ9-THC. Depending on patient's history, clinical and laboratory findings, the patient diagnosed with substance abuse-related cardiogenic shock and cardiac arrest.

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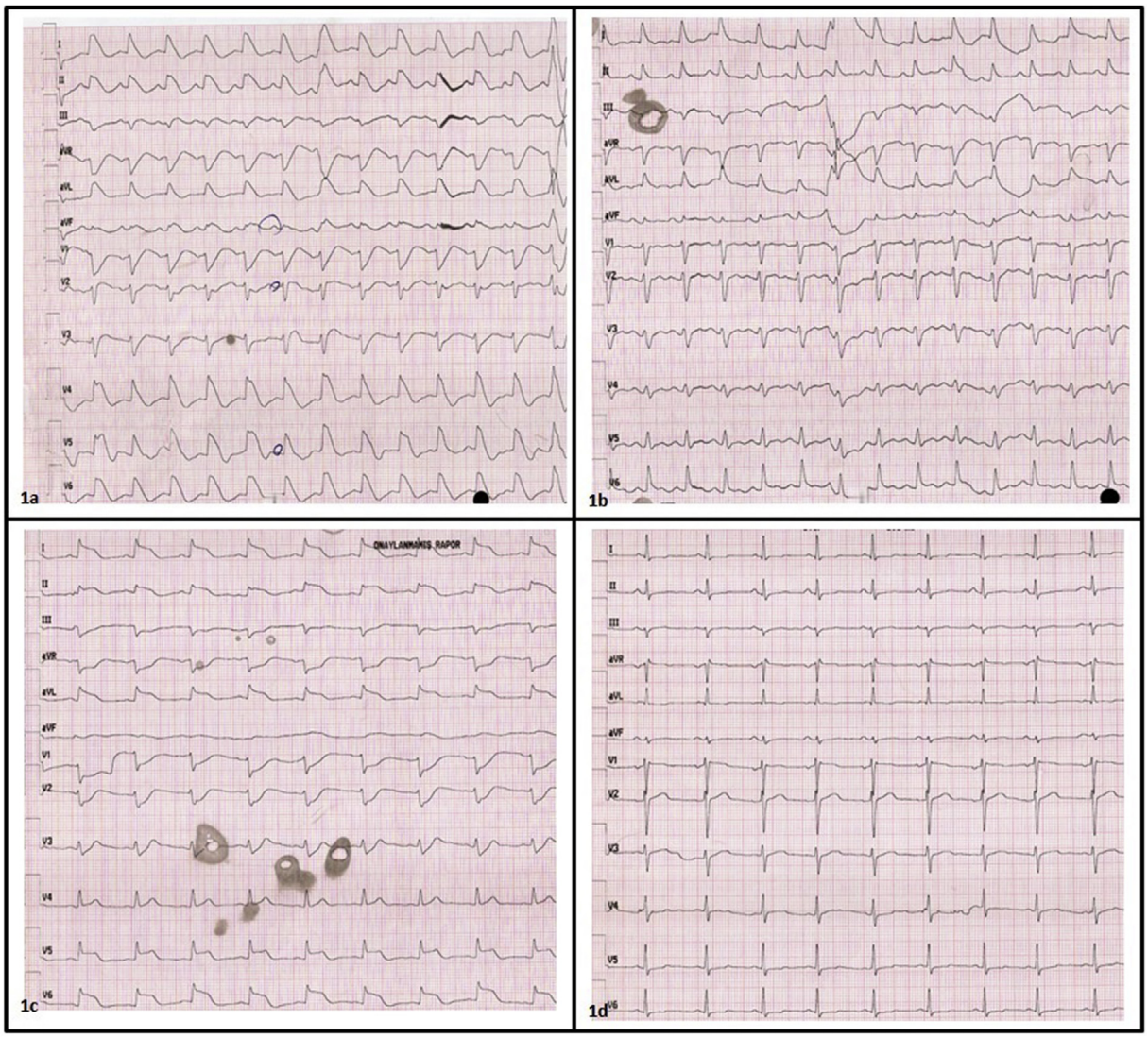

Fig. 1. ECG images at different time points [1a. During resuscitation (regular wide QRS tachycardia); 1b. At the end of resuscitation (sinusal tachycardia), 1c. At 24-h of follow-up and (D1, D2 avL, V5-6 ST segment elevation); 1d. After discharge (normal sinus rhythm)].

Table 1
Patient's serum laboratory values.

		Normal Range			Normal Range
Glucose	171 mg/dL	74–106	pH	7.05	7.35–7.45
BUN	21 mg/dL	6–20	CO_2	31 mmHg	35–45
Cr	1.36 mg/dL	0.6–1.1	HCO_3	7.8 mEq/L	22–27
AST/ALT	52/44 U/L	0–45	BE	−23	-7–2
Na	144 mEq/L	136–146	Lactate	149.8 mg/dL	4.5–19.8
K	3.8 mEq/L	3.5–5.1	Mg	2.1 mg/dL	1.7–2.55

Abbreviations: BUN: Blood Urea Nitrogen, Cr: Creatinine, AST: Aspartate Aminotranferase, ALT: Alanine Aminotranferase, BE: Base Excess.

The patient developed VF after 15 min of monitoring in the emergency department. Cardiac flow was re-established with defibrillation and CPR for 2 min. Wide QRS tachycardia was observed on the ECG, and the patient was administered amiodarone by infusion at a starting dose of 0.5 mg/min after loading dose 300 mg. VF occurred every 5–10 min over approximately 5 h. The presence of cardiac functions was checked with echocardiography (ECHO) and ECG was recorded after resuscitation. The patient was administered with sodium bicarbonate to treat severe metabolic acidosis and possibility of Na channel blockage (1 mEq/kg, IV bolus; 3 mEq/kg/h, IV infusion). Additionally we administered positive inotropes (noradrenalin: 2 mcg/kg/min, dopamine: 20 mcg/kg/min and dobutamine: 20 mcg/kg/min; IV infusions) and lidocaine (2 mg/min, IV infusion) to treat the patient's recurrent VF and hypotension. Because of the lipophilic nature of the SCs and toluene that were suspected to be associated with this unstable condition, the patient also underwent lipid rescue therapy (1.5 mL/kg, IV bolus, 0.25 mL/kg/min) throughout resuscitation.

Coronary angiography was performed for excluding coronary thrombosis or vasospasm. The findings revealed no pathology in the coronary vessels (Fig. 2). VF re-developed at 5–10 min intervals during the follow-up, and asystole developed at the 8th hour of the follow-up. Continuous CPR was then performed for 90 min, and a temporary transvenous pacemaker was inserted during resuscitation. The patient responded to this resuscitation, and no VF was observed at subsequent follow-ups. ECGs after resuscitation and pacemaker insertion are shown in Fig. 1b. The patient's vital signs remained stable with treatment, and ABG test results were normal. The patient was defibrillated approximately 45 times because of recurrent VF over the course of approximately 10 h. The patient was

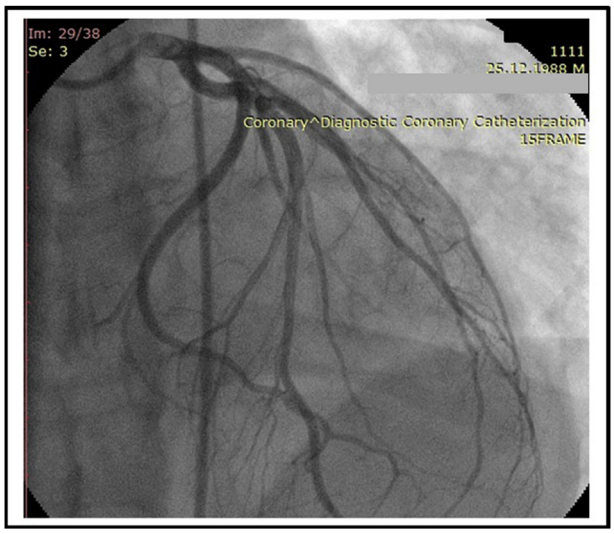

Fig. 2. Patient's coronary angiography image.

extubated at the 10th hour of admission to the coronary intensive care unit when his GCS score improved to 15 and he became clinically stable. At history, the patient reported that he used both *Skunk* and toluene before loss of consciousness. A control ECG at the 24th hour of follow up revealed ST elevations in D1, D2, avL, V5 and V6 derivations (Fig. 1c). However, because of the absence of any pathology in his previous coronary angiogram and the absence of typical chest pain, and the absence of any regional wall motion abnormality in ECHO; the ECG was monitored and no ST elevation was observed on the subsequent control ECG. No dysrhythmia occurred at the subsequent follow-up, and clinical, laboratory and ECG findings were normal. The patient was discharged in a healthy condition following psychiatric counselling (Fig. 1d).

3. Discussion

SCs have been reported to be associated with a number of pathological conditions, including metabolic acidosis, renal failure and multiorgan dysfunction. In addition to these disorders, cardiovascular complications, such as myocardial infarction, ventricular tachycardia, VF and stroke, and fatal cases have been reported in the literature.[4–7] Although the mechanism underlying SCs-related cardiotoxicity remains unclear, the inhibitory effects of SCs on myocardial voltage, sodium channels and L-type calcium channels have been reported in addition to coronary vasospasm or slow coronary flow.[8,9] There is no antidotal therapy capable of reversing the cardiovascular and toxic effects of SCs on the CNS. Case series in which lipid rescue therapy was performed because of the solubility of lipids have been reported in the literature; however, the level of evidence for the effectiveness of this therapy remains insufficient.[10] Gold standard support therapies included in the advanced life support protocol, which directed towards our patient's recurrent VF and cardiogenic shock, were administered at maximal levels. Because of the lipid solubility of cardiotoxic agents, additional lipid therapy was performed.[11] However, any explanation regarding the effectiveness of this lipid therapy in the re-establishment of cardiac flow in our patient could not be provided. In addition, no side effects such as lipid pneumonia or pancreatitis were observed during the follow-up after lipid therapy.

The underlying cause of cardiotoxicity developed following hydrocarbon exposure is the sensitisation of ion channels in the myocardium, although this has not been completely elucidated.[12] However, hypokalaemia and sodium channel blockage and vasospasm associated with endogenous catecholamines or ischaemia may underlie cardiotoxic effects caused by toluene, such as cardiomyopathy, recurrent VF and death.[2] Increased lactic acidosis as a result of cardiogenic shock is the key factor underlying the cause of severe metabolic acidosis in our patient. There is no specific treatment for cardiotoxicity developing following hydrocarbon exposure. Potential underlying causes, such as electrolyte or acid–base anomalies and severe metabolic acidosis (particularly following exposure to toluene), must be treated. Lidocaine, which shows a beta-adrenergic antagonist effect, should be used as a pharmacological agent against recurrent VF.[13]

Due to the low levels of evidence concerning the effectiveness of antidotal therapy in the intoxication-associated cardiac arrest algorithm, antidotes are used in limited indications during CPR.[13] We think that the main reason for this case improving without sequelae despite prolonged resuscitation was the correct and high-quality application of the standard ACLS protocol throughout 10-h CPR. Sodium bicarbonate and lipid emulsion therapies based on severe QRS prolongation findings at ECG in this case of exposure to cannabinoids and toluene, toxic agents capable of Na channel blockage and having lipophilic properties, may have contributed to successful reanimation. However, it is difficult to identify which treatment was more effective in saving the patient. This is because clinical improvement in response to treatment not appearing immediately after or in the early period of treatment represents an obstacle to determining which of concurrently applied therapeutic protocols is superior.

4. Conclusion

This case report is the first report of cardiac arrest occurring as a result of *Skunk* and toluene inhalation, which was resolved without sequelae, following prolonged resuscitation. In addition, the present case report raises awareness regarding the importance of the quality of CPR performed during witnessed arrests, particularly those with reversible causes. In such cases, good neurological outcomes are obtained despite prolonged resuscitation.

Grant

No.

Conflict of interests statement

The authors declare that they have no significant competing financial, professional or personal interests that might have influenced the performance or presentation of the work described in this manuscript.

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