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Case Report

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A Rare Case of a Patient with 6.3 pH due to Carbon Monoxide Poisoning Returned to Life with a Cardiopulmonary Resuscitation

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Abstract

Normal human blood pH is between 7.35-7.45 [1]. According to physiology and medical texts, it is possible to survive with a pH interval of 6.8-7.8; however outliers to this pH interval is incompatible with life. We describe a case of successful resuscitation in a patient who was stuck in a fire place with unknown time interval and initial arterial blood pH:6.3, COHb:29.6% and lactate:13.3 mmol/L. The patient was brought to the emergency department intubated and in respiratory and cardiac arrest. After 5 minutes of effective cardiopulmonary resuscitation (CPR), the patient went into ventricular fibrillation and the heart rhythm was recorded 2 minutes after defibrillation. Approximately 5 hours after CPR performed and the patient was under mechanic ventilation, his blood pH returned to 7.27, COHb:3.4% and lactate:9.0 mmol/L. With this case, we emphasize the importance of performing CPR even with extremely abnormal blood test results that areincompatible with life. Also we believe that this is the lowest recorded PH after carbon monoxide poisoning that returned the life after an effective CPR.

Keywords: Cardiopulmonary Resuscitation; Cardiopulmonary Arrest; Acidemia; Carbon Monoxide.

Introduction

The body pH in extracellular fluid is strictly controlled to maintain the normal cellular function [2]. Acidosis in human body means pH lower than 7.35. According to physiology and medical texts, it is possible to survive with a pH interval of 6.8-7.8; however, outliers to this pH interval is incompatible with life. Patients with extreme acidosis on arrival (PH<7.0) are in a critical condition with poor prognosis depending on their etiology [3,4,5]. There is not any case that exists in the literature of a patient with 6.3 pH and lactic acidosis returned to life after respiratory and cardiac arrest with a 5-minutes cardiopulmonary resuscitation (CPR). This case presents a case with 6.3 pH and arrest on arrival to emergency room due to fire exposure, carbon monoxide poisoning and lactic acidosis and returned back to life and optimal blood test results after performing only 5 minutes of CPR.

Case Presentation

A 36-year-old Caucasian male patient presented to emergency department, having being found in the fire place.The patient was brought to the emergency department undergoing CPR and gotintubated by the paramedics . The patient was in respiratory and cardiac arrest with no heartbeat on arrival to emergency room. His Glasgow Coma Scale was 3 (eyes 1, verbal 1, motor 1) with unknown medical history. His first arterial blood gas was: pH:6.3, PCO2:137 mmHg, HCO3:8.1 mEq/L, PO2: 8.1 mmHg and COHb: 29.6% (Table 1).

The high anion gap metabolic acidosis because of carbon monoxide poisoning and lactic acidosis with contaminant acute respiratory acidosis were seen together. In his physical examination, there was a second degree burn area of approximately 20 cm on the flexor part under the left knee, 3 cm and 1 cm superficial incision on the right wrist and 3 cm incision on the right eyelid. We started CPR and adrenalin administration every 3 minutes. After 5 minutes of effective CPR, the patient went into ventricular fibrillation and the heart rhythm was recorded 2 minutes after the first defibrillation (Figure 1). His heart rhythm was confirmed with bedside ultrasonography. After the first heart rhythms, his vitals were: Blood pressure: 68/40 mmHg, Pulse: 103 beats per minute, SpO2:96% and Blood glucose 358 mg/dL.

We connected the patient to mechanical ventilation. We started norepinephrine infusion. After the patient's stabilization, his arterial blood gas results had improved greatly until morning. Roughly 5 hours after CPR performed and the patient was under mechanic ventilation, his arterial blood pH returned to 7.27, Po2:205 mmHg, COHb:3.4% and lactate:9.0 mmol/L (Table 1). In his thorax computed tomography (CT), bilateral minimal pleural effusion were seen and in his brain CT, brain edema was suspected. In the following hours, the patient was transferred to intensive care unit.

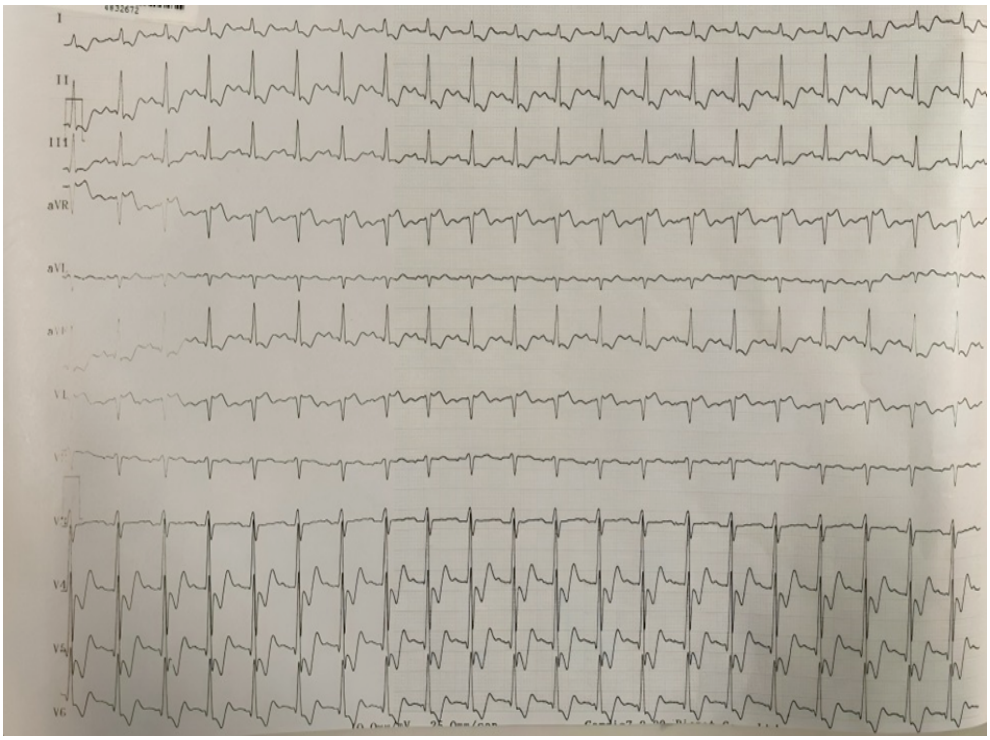
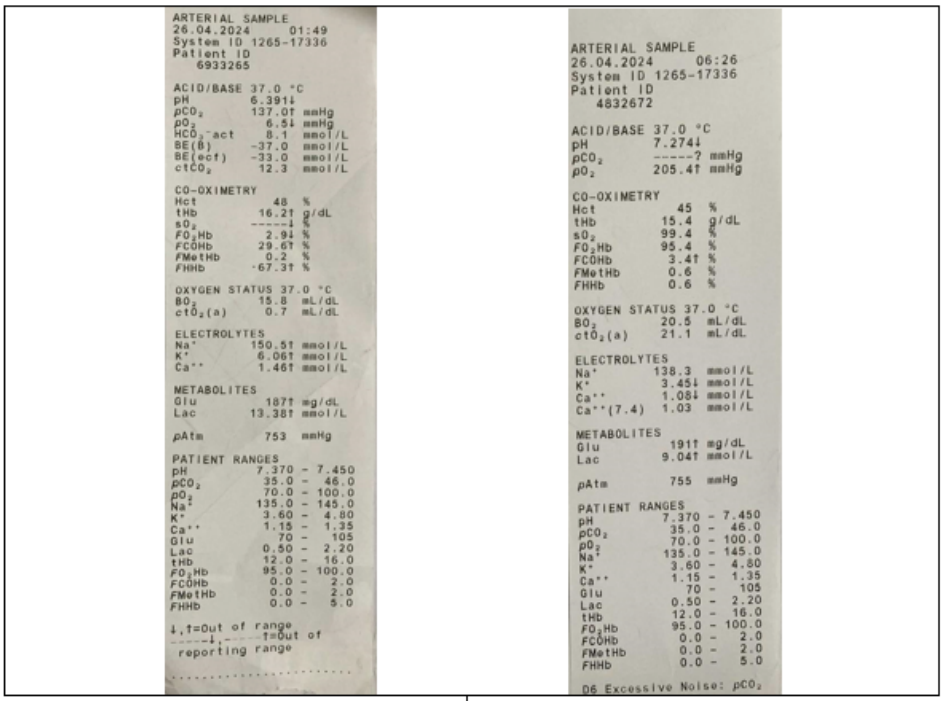


Figure 1: An electrocardiogram (ECG) after the first heartbeats.



ARTERIAL SAMPLE
26.04.2024 01:49
System ID 1265-17336
Patient ID
6933265

ACID/BASE 37.0 °C
pH 6.391↓
pCO_2 137.0↑ mmHg
pO_2 6.5↓ mmHg
HCO_3^-act 8.1 mmol/L
BE(B) -37.0 mmol/L
BE(ecf) -33.0 mmol/L
$ctCO_2$ 12.3 mmol/L

CO-OXIMETRY
Hct 48 %
tHb 16.2↑ g/dL
sO_2 -----↓ %
FO_2Hb 2.9↓ %
FCOHb 29.6↑ %
FMetHb 0.2 %
FHHb -67.3↑ %

OXYGEN STATUS 37.0 °C
BO_2 15.8 mL/dL
$ctO_2(a)$ 0.7 mL/dL

ELECTROLYTES
Na^+ 150.5↑ mmol/L
K^+ 6.06↑ mmol/L
Ca^{++} 1.46↑ mmol/L

METABOLITES
Glu 187↑ mg/dL
Lac 13.38↑ mmol/L

pAtm 753 mmHg

PATIENT RANGES
pH 7.370 - 7.450
pCO_2 35.0 - 46.0
pO_2 70.0 - 100.0
Na^+ 135.0 - 145.0
K^+ 3.60 - 4.80
Ca^{++} 1.15 - 1.35
Glu 70 - 105
Lac 0.50 - 2.20
tHb 12.0 - 16.0
FO_2Hb 95.0 - 100.0
FCOHb 0.0 - 2.0
FMetHb 0.0 - 2.0
FHHb 0.0 - 5.0

↓,↑=Out of range
-----↓,-----↑=Out of reporting range

ARTERIAL SAMPLE
26.04.2024 06:26
System ID 1265-17336
Patient ID
4832672

ACID/BASE 37.0 °C
pH 7.274↓
pCO_2 -----? mmHg
pO_2 205.4↑ mmHg

CO-OXIMETRY
Hct 45 %
tHb 15.4 g/dL
sO_2 99.4 %
FO_2Hb 95.4 %
FCOHb 3.4↑ %
FMetHb 0.6 %
FHHb 0.6 %

OXYGEN STATUS 37.0 °C
BO_2 20.5 mL/dL
$ctO_2(a)$ 21.1 mL/dL

ELECTROLYTES
Na^+ 138.3 mmol/L
K^+ 3.45↓ mmol/L
Ca^{++} 1.08↓ mmol/L
$Ca^{++}(7.4)$ 1.03 mmol/L

METABOLITES
Glu 191↑ mg/dL
Lac 9.04↑ mmol/L

pAtm 755 mmHg

PATIENT RANGES
pH 7.370 - 7.450
pCO_2 35.0 - 46.0
pO_2 70.0 - 100.0
Na^+ 135.0 - 145.0
K^+ 3.60 - 4.80
Ca^{++} 1.15 - 1.35
Glu 70 - 105
Lac 0.50 - 2.20
tHb 12.0 - 16.0
FO_2Hb 95.0 - 100.0
FCOHb 0.0 - 2.0
FMetHb 0.0 - 2.0
FHHb 0.0 - 5.0

06 Excessive Noise: pCO_2

Table 1: Arterial blood gas on the arrival at 01:46 am and arterial blood gas at 06:30 am.

Discussion

This case reports the lowest (6.3) pH recorded after carbon monoxide poisoning that returned to pH interval that is compatible with life after an effective CPR. Some examples of survival after arterial pH values <6.8 have been seen in literature [7,8]. In our case, level of arterial blood gas variants had improved after a successful resuscitation.

Decision of performing or stopping a CPR in patients brought to emergency room in arrest is a challenge. It has both ethical and clinical aspects. The scenarios where the 2015 American Heart Association (AHA) guidelines suggest that emergency medicine service givers do not start resuscitation of patients are explained [9]. Also there are some criteria where advanced life support personals may terminate CPR. Apart from the scenarios, which were spoken above, none of the things can determinate initiation or termination of CPR including PH, PCO2, HCO, PO2, as well as COHb levels.

Although laboratory findings can not make us determine the decision of initiation or termination of a CPR, the relationship between laboratory findings and the outcome of cardiopulmonary arrest have been investigated in different studies. Yanagawa et al. (2009) demonstrated that patients with better outcome from cardiopulmonary arrest are prone to have higher PH, PO2, total protein and platelets and lower Pco2, ammonia, phosphorus in comparison with those with a poor outcome [10]. According to their study, there were no factors separately related to the outcome by multivariate analysis so the blood work can not be used to determine clinical decisions. Geddes et al. (2006) [11] investigated the relationship between arterial blood gas and both cardiopulmonary arrest data and serum potassium level, using a pig model with ventricular fibrillation. According to this study, the poor result has longer estimated time span of cardiopulmonary arrest than in the favourable result. As a result, a higher value of PCO2 and potassium and a lower value of PO2 have poor outcome in comparison with the better outcome were seen in this study. Also there were no trends with regard to pH during cardiopulmonary arrest were observed in this paper. Makino et al. (2005) [12] announced that phosphorus and lactate levels of cardiopulmonary arrest patients were higher than those of mild traumatized patients.

The study of Hoshino et al. (2023) [13] demonstrated that mortality rate for burn patients with out-of-hospital cardiac arrest was high (%88) and the majority of them died soon after being admitted to hospital. In their study, non-survivors were resuscitated but died within a short period of time. Carbon-monoxide poisoning was the most frequent cause of death and following central nervous system lesions, cardiomyopathy and tissue hypoxia made long-term survival difficult, even with a temporary resumption of return of spontaneous circulation.

Conclusion

In our case, performing a CPR was not terminated after seeing the

first arterial blood gas from our patient. It is seen with our patient that arterial blood gas results can provide critical information about a patient's oxygenation, ventilation, and acid-base status; they are not the only criteria for making such significant decisions.

Disclosures

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Author Contributions Statement (CReDiT): Elif Betül Balcı: Resources (lead); writing (original draft) (lead); Başar Cander: Supervision (equal); visualization (supporting); Bahadır Taşlıdere: Supervision (equal); writing (review and editing) (equal); Alaa Saad Ahmed Aldujaili: Writing (review and editing) (supporting).

Informed consent: The text and the figures in the text do not contain introductory information/material about the patient. Required consent was obtained from the patient.

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