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Rapid Management of a Heat Stroke with Multiorgan Dysfunction and Disseminated Intravascular Coagulation: Case Report of A 58 Years Old Water Well Driller

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Abstract **Case Report**

Heat stroke is a medical emergency with a high rate of mortality. Patients with heat stroke present multiple organ dysfunctions due to heat injury and inflammatory mechanisms. We report a case of a 58 years old man, water well driller, who suffered a heat stroke and was admitted in the intensive care unit of the provincial hospital of Zagora. The patient was initially in a convulsive state; a careful approach was taken regarding the use of mechanical ventilation that was not needed eventually due to the rapid improvement of his neurological state. During his hospitalization, he had atrial arrhythmia and acute kidney failure that improved after hydration, and acute disseminated intravascular coagulation treated with steroids, vitamine K and plasma. The hydration followed the parkland formula since the patient had 1st and 2nd degree sun burns estimated at 15% following the Wallace rule. The patient was discharged 6 days after his admission and transferred to the neurological department of the nearest university hospital for further medical care.

Keywords: Medical emergency, Heat stroke, neurological state, hospitalization.

INTRODUCTION

Heat stroke is a life threatening medical emergency that causes multiple organ dysfunctions and is often fatal. It is defined as a severe illness characterized by a core temperature >40°C and central nervous system abnormalities such as delirium, convulsions, or coma resulting from exposure to environmental heat (classic heat stroke) or strenuous physical exercise (exertional heat stroke) [1]. Deaths among elderly people exceeds 50% [2].

It is more common in females than males and it causes a systemic inflammatory and coagulopathy response [3]. Patients with heat stroke are at a high risk of cardiovascular events [4].

The region of Draa-Tafilalet is located in the south east of Morocco, its climate is arid and it is experiencing a widening of the hot season and shrinking of the cold season [5]. The temperatures reach more than 45°C during the months of July and August [6]. It is considered a water-scarce area and the temperatures are constantly increasing due to climate change [7].

Heat related illnesses are a major health threat in countries like Morocco [8] especially in the south region, but studies are yet to be published highlighting the dangers of these illnesses and the importance of an early and adequate management and above all the importance of prevention.

CASE REPORT

HB, a 58 years old water well driller with no reported medical or surgical history was brought to the emergency department of the hospital of Zagora in the middle of July 2024 after falling at work. The initial evaluation found no injuries in the head, facial myoclonus and a downward fixed eye gaze indicating a convulsive state. He was placed in a lateral safety position, a Guedel cannula was inserted inside the oral cavity, oxygen was delivered with a high concentration mask at 10L/min and he received 10mg of diazepam. He had a respiratory rate above 25 breaths per minute and his oxygen saturation level was around 98%. His heart rate was 170 bpm and blood pressure was 150/90 mmHg, He had a hyperglycemia with capillary blood glucose at 2,6 g/l and his temperature was above 42°C. He had sunken eyes and a decreased skin turgor with first and second degree sun burns in various locations (15%

following Wallace rule). The initial urine output was low indicating oliguria. The head CT scan showed no concussion or abnormality.

The patient was admitted in the intensive care unit. Ice packs placed on the patient groin and under his armpits were used to cool the hyperthermia with cloth submerged in ice water around the head and neck. He received 1,5L of saline solution 0,9% (20ml/kg), 1g of paracetamol,160mg of Phenobarbital and 3g of ceftriaxone (3g every 12hours).

The temperature dropped to 40°C in an hour and the Glasgow coma scale was evaluated at 9/15 (eye opening: 2, verbal response: 2, motor response, 5), the pupils were reactive and the intubation was delayed with an hourly monitoring of the neurological state.

Blood and bacteriology screenings were performed (prior to the administration of ceftriaxone) and an initial EKG showed atrial fibrillation.

By the beginning of the second day of his admission, the neurological state had improved with a GCS evaluated at 13/15 (eye opening: 3, verbal response: 4, motor response: 6), the patient had a temperature at 38,5°C and the blood screening showed an acute disseminated intravascular coagulation with elevated D-Dimers > 8000 ng/mL, platelet count rapidly dropping from 45 000 to 14 000/mm^3 and a Prothrombin Ratio dropping from 92 to 17%, it also showed an acute kidney injury with blood creatinine at 25,5mg/L and urea at 0.93g/L. Serum sodium and potassium levels were correct and the urine output remained normal.

The bacteriology screening showed only a urinary tract infection responsive to ceftriaxone.

Hydration was maintained 3L a day (2 mL/kg/percentage of total body surface area burned) and oral hydration was started gradually since day 3; 250 ml of sodium bicarbonates serum 14% was given twice a day for two days. The patient received 300mg of Hydrocortisone a day for two days, 10mg of vitamin K a day for 4 days and 15ml/kg of Plasma.

By the sixth day of his admission the patient had a GCS at 15/15, his EKG showed a sinus rhythm with a heart rate at 70 bpm, he had a platelet count around 50000/mm3 and a Prothrombin Ratio at 60%, the blood creatinine level was 12mg/L and blood urea 0,4g/L.

The patient was transferred to the neurological department of the Marrakech's Mohammed VI University Hospital for further medical care.

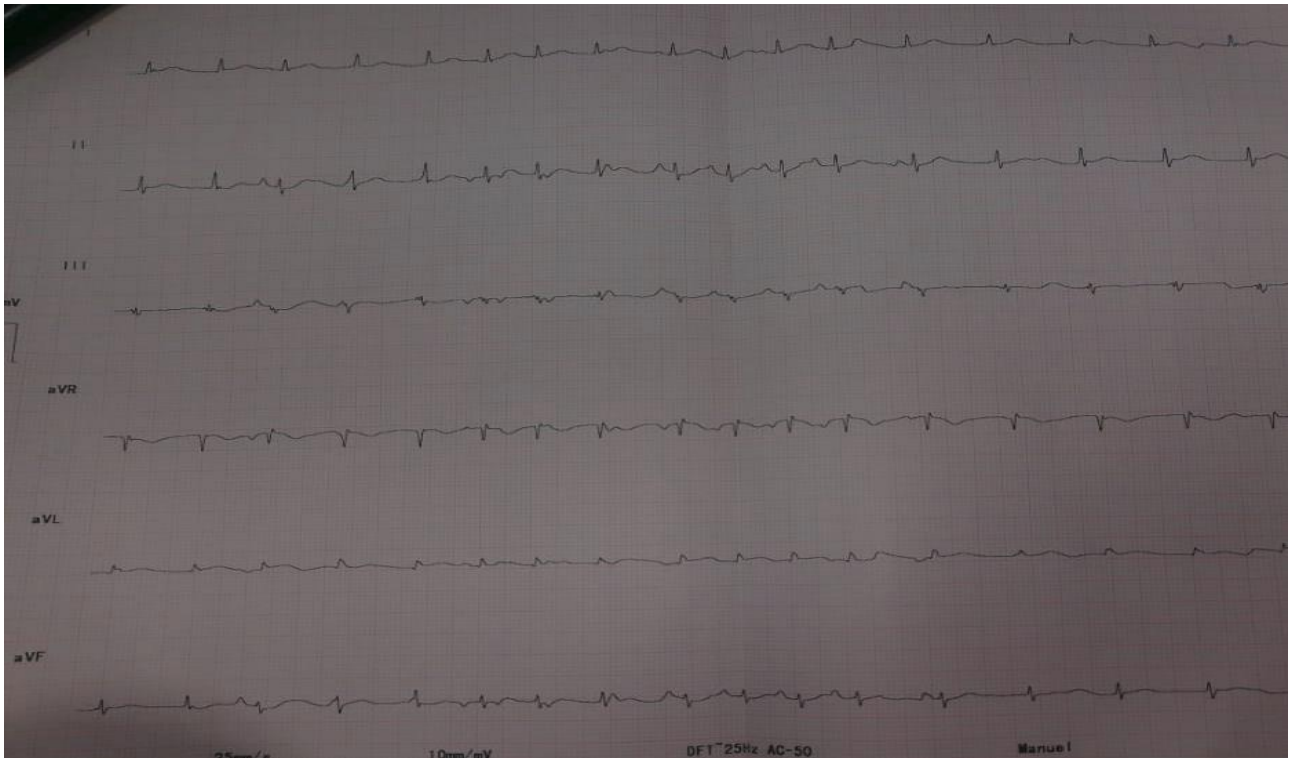

Fig 1: Initial EKG showing cardiac arrhythmia with atrial fibrillation

Fig 2: Images of second degree sun burns on the patient's body

DISCUSSION

Heat related illnesses are a major health threat; they can range from a heat rash and heat cramps to heat exhaustion or a life threatening heat stroke [8].

Heat stroke is the result of an imbalance between heat accumulation and heat dissipation which causes an important and dangerous rise in the core body temperature and imposes the use of active cooling [9].

The diagnosis of heat stroke is mainly clinical. It required the existence of the triad: hyperthermia, neurological abnormalities and a history of exposure to hot and humid weather or vigorous muscle exertion. It is important to rule out certain conditions such as meningitis, malaria or neuroleptic malignant syndrome [10].

The management and treatment of this condition is based on the removal of the patient from the causing environment to shaded or indoor cool areas [8], immediate cooling, support of airways, breathing, and circulation (ABCDE) and the management of the complications [3, 10].

In order to lower the body temperature, the active cooling is the first step of management and it could be done by various methods that aim to create a gradient for heat from the skin to the environment via conduction, convection, or evaporation. Conduction techniques include: tap-water immersion, ice-water immersion, application of ice packs over parts or the whole body, cooling blankets; invasive ways include: iced gastric lavage or iced peritoneal lavage. Evaporation and conversion techniques include: wetting of the body surface during continuous fanning, use of alcohol sponge. The use of Dantrolene is controversial [9, 11].

We chose conduction techniques including ice packs application on areas with large vessels such as the groin and the armpits; this method is proven to be an efficient way to reduce body temperature [9]. In our case the temperature dropped more than 2 degrees in an hour.

The patient presented hematological, cardiovascular, neurological, and renal dysfunctions on admission; these manifestations are associated with high mortality [13].

The initial assessment found a patient in a convulsive state which had to be managed along with his hyperthermia. The quick management of the seizures and hyperthermia were followed by a rapid improvement of the neurological state.

The patient had on admission atrial fibrillation which is a common and early cardiac complication; it happens in response to volume depletion and adrenergic stimulation. Patients with underlying cardiac conditions are most likely to have cardiac complications of heat stroke. In addition to arrhythmias: myocardial ischemia, vascular and hemodynamic changes, conduction system impairment, heart failure and sudden death are all cardiac manifestations of heat stroke [14].

He also presented first and second degree sun burns and hydration was performed using the modified parkland formula [12]; 20ml/kg of saline solution 0,9% was initially given then the patient received hydration following the formula during the first 48 hours which lead to an important improvement of the neurological, renal and cardiovascular systems. In a small hospital with no tools to perform blood gas tests, sodium bicarbonate was used to prevent myoglobin-induced renal injury [11] and hydration was monitored by the volumes of intakes and urine output. The most suitable

method of hydration in the case of heat stroke is yet to be researched.

It is known that heat stroke is associated with elevated levels of inflammatory cytokines in the plasma, not reversible after cooling of the body to a normal temperature. Corticosteroids may attenuate this inflammatory response and improve survival [1]. DIC appears in general during the first 72 hours of the heat stroke [3]; the systemic inflammation causes alterations in the vascular endothelium leading to coagulofibrinolytic activation [1, 15]. Some early studies suggest that steroids could prevent DIC or improve coagulation by suppressing the production of inflammatory cytokines [16, 17]. In addition to plasma and vitamine K, we chose an early and short treatment with hydrocortisone which may have participated in the resolution of the inflammatory reaction and the DIC.

It is important to highlight that prevention strategies must be applied to avoid heat-related deaths and illnesses such as the use of air conditioner; the ample consumption of fluids; wearing hats and loose-fitting light-colored clothing, getting adequate sleep, taking frequent showers and being aware of heat symptoms to provide first aid. Adults with comorbidities and children should avoid physical exercise and outdoor activities during daytime and in high temperatures. [8, 13].

CONCLUSION

Rapid cooling, treatment of hypovolemia and systemic inflammation may be the three pillars of an adequate management of heat stroke. Conductive techniques of active cooling reduce effectively the body temperature and the early use of steroids may be beneficial to reduce the inflammatory response and reverse the heat stroke complications. And above all, prevention is the key to avoid this fatal condition and its life threatening manifestations.

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