






Case Report

The ugly side of the earthquake: a case of pediatric Crush Syndrome

Depremiñ çirkin yüzü: Bir pediatrik Crush Sendromu vakası

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ABSTRACT

Crush syndrome (CS) is a systemic consequence of prolonged sustained pressure on muscle tissue, accompanied by rhabdomyolysis. As a result, CS may cause organ dysfunction and death, especially acute kidney damage. We describe a 3-year-old boy who was under the rubble for 18 hours, and developed CS. Right lower extremity fasciotomy was performed due to compartment syndrome. Dialysis was not required with intensive hydration therapy. Acute renal failure is the main complication that determines survival in crush injuries. Early fluid resuscitation is the primary treatment for the prevention of acute renal failure.

Keywords: *Crush syndrome, earthquake, rhabdomyolysis*

ÖZET

Crush sendromu (CS), rabdomiyolizinin eşlik ettiği, kas dokusu üzerindeki uzun süreli sürekli basıncın sistemik bir sonucudur. Sonuç olarak, CS özellikle akut böbrek hasarına, organ fonksiyon bozukluğuna ve ölüme neden olabilir. 18 saat enkaz altında kalan 3 yaşında bir erkek çocukta CS gelişti. Kompartman sendromu nedeniyle sağ alt ekstremitte fasyotomisi uygulandı. Yoğun hidrasyon tedavisi ile diyaliz gerekmedi. Akut böbrek yetmezliği ezilme yaralanmalarında sağkalımı belirleyen ana komplikasyondur. Akut böbrek yetmezliğinin önlenmesi için erken sıvı resüsitasyonu birincil tedavidir.

Keywords: *Crush sendromu, deprem, rabdomiyoliz*

INTRODUCTION

Crush syndrome (CS) is a systemic consequence of prolonged sustained pressure on muscle tissue, accompanied by rhabdomyolysis. As a result, CS may cause organ dysfunction, especially acute kidney damage, and even death (1-2).

CS is often seen in war settings, earthquakes and various disasters (1). On February 6, 2023, at 04:17, a devastating earthquake measuring 7.8 on the Richter

scale struck southeastern Turkey. The earthquake, which caused significant destruction in 10 provinces of the country, affected around 14 million people, 16% of Turkey's population. The children, who were rescued under the rubble, were transferred to hospitals in the surrounding regions after emergency interventions were made in the disaster area.

Received: 25.05.2023 · **Accepted:** 04.07.2023 · **Published:** 15.11.2023

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Cite this article as: Durak C, Guney Sahin E, Can YY, Boydag Guvenc K, Varol F. The ugly side of the earthquake: a case of pediatric Crush Syndrome. *Pediatr Acad Case Rep.* 2023;2(supp1):4-7.

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To our knowledge, data on CS in children are limited compared to adults in the medical literature. Therefore, in this case report, we reported a previously healthy case under the rubble and developed CS.

CASE REPORT

A 3-year-old boy who was trapped in the rubble for 18 hours after the earthquake was brought to the emergency department. In his first evaluation, he was conscious, GCS: 14, right lower extremity was pale and cold, capillary refill time was >2 seconds, and peripheral pulses were weak but detected in the right lower extremity. Diagnostic criteria for CS were evaluated according to Gonzalez et al. (2). The patient was transferred

to the pediatric intensive care unit located in the earthquake zone. Alkalization and hydration were initiated rapidly, and the extremities were gradually warmed. Fractures, pneumothorax and other traumas were excluded by radiological imaging. A bladder catheter was placed for close urine output monitoring and urine output was detected. As the patient progressed to compartment syndrome in the right lower extremity, the patient was evaluated by the Plastic and Reconstructive Surgery team with lower extremity Doppler ultrasonography, and right lower extremity fasciotomy was performed. The patient was transferred to our pediatric intensive care unit by air ambulance for follow-up and continuation of therapy.



Figure 1. Right lower extremity fasciotomy lines of the patient on the day of admission to the intensive care unit

Upon admission to the PICU, the patient was conscious and hemodynamically stable. There were four fasciotomy lines in total in the medial and lateral tibial region of the right lower extremity and the dorsal region of the right foot. Capillary refill time was fewer than two seconds, and peripheral pulses were taken. His laboratory results were notable for potassium of 4,93 mmol/L, phosphorus of 3,21 mg/dL, calcium of 8,54 mg/dL, blood urea nitrogen of 14 mg/dL, creatinine of 0,21 mg/dL, creatinine kinase (CK) of 14,563 IU/L. His head computed tomography (CT) and C-spine CT was negative for any acute injury or pathology. The fasciotomy areas of the patient, whose lower extremity pulses were palpable, were followed up closely by Plastic Surgery and Orthopedics surgery teams.

A broad and appropriate spectrum of antibiotics was administered. Analgesia control was achieved.

Enoxaparin was continued. He received intensive fluid hydration at a rate of 20 meq/lt sodium bicarbonate at an isotonic concentration of 10 ml/kg per hour to sustain urine output. Hyperbaric oxygen therapy is delivered for his crush injuries. The following day, the patient's CK value decreased to 8,011 IU/L. With continued aggressive intravenous fluids his creatinine trended down during the following five days to 461 IU/L.

On the 5th day of his hospitalization, his fasciotomy was closed by the Plastic Surgery team. The patient did not require dialysis during his hospitalization. He received 12 sessions of hyperbaric oxygen therapy in total. On the 12th day of his hospitalization, the patient, who did not have an intensive care indication, was transferred to the Orthopedics Service for follow-up and treatment.



Figure 2. The patient's right lower extremity closed fasciotomy lines on the 10th day of the stay

DISCUSSION

Bywaters and Beall first described the condition as "Crush Syndrome" in 1941, after the aerial bombardment of London during World War II. Patients removed from the rubble initially appeared unharmed, but later, these patients developed progressive swollen extremities, dark urine, and shock and died of acute renal failure within a few days (3).

CS is one of the life-threatening complications of crush injuries that can be prevented or reversed (4). It is mainly characterized by hypovolemic shock, rhabdomyolysis, and acute renal failure. As victims were entrapped under prolonged debris, complications, such as hypothermia, environmental hyperthermia, metabolic abnormalities, airway dust impaction, head injury, spine injury, and cardiac arrhythmias, could be seen (1,2).

Acute renal failure is the main complication that determines survival in crush injuries. Early fluid resuscitation is the primary treatment for the prevention of acute renal failure (5,6). In mass disasters, isotonic saline is the preferred electrolyte solution, since it is readily available in sufficient quantities even in disaster conditions. Isotonic saline is given at 10-15 ml/kg/hour. Sodium bicarbonate can be started at 50 meq/l for alkalization. The aim is to keep the urine pH above 6.5 and to prevent the accumulation of intratubular myoglobin and uric acid (4). Urine output should be closely monitored. The use of mannitol is controversial, due to conflicting reports on its efficacy and potential side effects, such as nephrotoxicity, volume overload and heart failure. Colloids should be avoided due to the increased risk of adverse consequences, such as allergy, coagulation problems, and tubular injury (7). Our patient, who was trapped in the debris for 18 hours without any oral intake and became dehydrated and had rhabdomyolysis due to external compression in the lower extremity. However, since early aggressive hydration and for-

ced diuresis could be achieved after removal from the rubble, acute renal failure was not observed in our patient despite myoglobinuria.

Acute compartment syndrome (ACS) occurs when there is a loss of perfusion due to increased pressure in an enclosed area, leading to muscle ischemia (8). In general, ACS is considered a clinical diagnosis and the examination addresses the definition of the 'five P's': pain, pallor, paralysis, paresthesia, and pulselessness (2). Frequent serial examinations are crucial in patients with crush injuries. In the vast majority of cases of ACS, fasciotomy is indicated to decompress all involved compartments. Delays in performing a fasciotomy increase morbidity, including the requirement for amputation and mortality (9). In our case, the patient's right lower extremity was followed closely and progressed to compartment syndrome and fasciotomy was performed in the early period and amputation was not required.

Hyperbaric oxygen therapy (HBO) has been proposed as adjunctive therapy for many acute traumatic and ischemic syndromes, such as crush injuries (10). The pathophysiology of CS is well defined. HBO mediates the effects of CS through a combination of increased tissue oxygenation, reduced edema through hyperoxia-induced vasospasm, protection from reperfusion injury and secondary ischemia, and antimicrobial effects. In a study by Bouachour et al., patients with crush injuries were compared for normobaric and hyperbaric oxygen therapy. The HBO-treated group showed significantly more complete recovery and required fewer skin flaps, grafts, vascular surgery or amputation (11). In our case, the patient did not require amputation. Only one fasciotomy area was closed with a small graft.

There is limited information on the crush syndrome in the pediatric population. Studies have shown that children are not like adults, and their management

is different. The findings obtained in these studies suggest that aggressive and early management of children can significantly impact their morbidity and mortality. To our knowledge, no randomized studies of CS are available. However, we recommend that all hospitals facing the possibility of natural disasters establish guidelines for managing pediatric CS.

Patient Consent Form / Hasta Onam Formu

The parents' of this patient consent was obtained for this study.

Conflict of Interest / Çıkar Çatışması

The authors declared no conflicts of interest with respect to authorship and/or publication of the article.

Financial Disclosure / Finansal Destek

The authors received no financial support for the research and/or publication of this article.

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