A Case of Crush Syndrome Induced by the Kneeling Seiza Position

Tomoatsu TSUJI, Shigeaki INOUE, Takeshi YAMAGIWA, Seiji MORITA and Sadaki INOKUCHI

Department of Emergency and Critical Care Medicine, Tokai University School of Medicine

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Crush syndrome results in a characteristic syndrome of rhabdomyolysis with myoglobinuric acute renal failure. The most commonly described crush injury is that which affects victims of natural disasters such as earthquakes. Here, we report a rare case of crush syndrome that was induced by the kneeling seiza position.

Key words: crush syndrome, compartment syndrome, seiza, rhabdomyolysis, emergency department

INTRODUCTION

Crush syndrome results in a characteristic syndrome of rhabdomyolysis, which induces myoglobinuric acute renal failure [1]. The most commonly described crush injury is that which affects victims of natural disasters such as earthquakes, mining or industrial accidents, war, or any other situation that results in the collapse of buildings and falling debris. Examples of recent natural disasters that cause crush syndrome casualties are the earthquakes in Iran in 1990 [2], in Japan in 1995 [3−5], and in Kashmir in 2005 [6]. Here, we report a rare case of crush syndrome that was induced by the kneeling seiza position.

CASE REPORT

A 52-year-old man presented with consciousness disturbance and swelling of the left lower extremity. He had epilepsy, hypertension, and diabetes medicated with pioglitazone. His height was 178 cm and weight was 106 kg. He was found in decreased conscious level, with his left legs folded at a narrow space in his house. His initial vital signs at the emergency medical center at Tokai University Hospital were as follows: Glasgow coma scale score, 4−4−6; Japan coma scale score, 2; blood pressure, 72/42 mmHg; and heart rate, 99/minutes. Although he was in hypovolemic shock state with dried mouse and extended capillary refilling time (3 seconds), his left lower leg was swollen and cyanosed (Figure A). His left dorsal and medial malleolar arteries were palpable, but he had reduced motor and sensory perception in his left lower extremity from the toe to the knee. A computed tomographic (CT) scan showed a swollen left soleus muscle with increased density of the subcutaneous tissue (Figure B). Three-dimensional CT angiography revealed stenosis of the left anterior tibia artery (Figure C). Initial laboratory examination results showed the following values: potassium, 6.8 mEq/L; creatine kinase, 59,949 U/L; creatinine, 1.6 mg/dL; blood urea nitrogen, 116 mg/dL; and lactate, 29 mg/dL; carbamazepine, 0.8 μg/mL (therapeutic range: 4−12 μg/mL); and sodium valproate, 3.0 μg/mL (therapeutic range: 50−100 μg/mL). Electrocardiography revealed peaked T waves. Because of increased compartment pressures in the left lower limbs (anterior, 90 mm Hg; superficial posterior, 100 mm Hg; and deep posterior, 110 mm Hg), he was diagnosed with compartment syndrome, for which fasciotomy was immediately performed. Head CT and magnetic resonance imaging revealed bleeding and infarction in his brain. His disturbed consciousness was recovered 1 hour after his arrival at the hospital, where he was admitted to the intensive care unit (ICU). Fluid resuscitation with normal saline and glucose insulin therapy effectively decreased his potassium and creatinine levels without renal replacement therapy. He was discharged from the ICU at day 11.

DISCUSSION

Crush syndrome results from muscle reperfusion with subsequent secondary systemic effects. These are all direct and indirect consequences of prolonged, continuous pressure on the limbs. The destruction of muscle tissue and the influx of the circulation levels of myoglobin, potassium, and phosphorus result are classic features of traumatic rhabdomyolysis/crush syndrome. Cases occur commonly in catastrophes such as earthquakes; however, cases of crush syndrome induced by general anesthesia with a muscle relaxant agent [7] and intoxication [8] were also reported. The present case was caused by the seiza position with the legs folded.

Seiza is one of the most commonly used sitting postures in various enrichment lessons of Japanese origin. Seiza with large knee flexion was reported to produce harmful effects on the cartilage of knee joints and hemodynamics of the lower legs [9]. Seiza decreases blood flow in the lower extremities after decreased tissue oxygenated hemoglobin/myoglobin concentration in the soleus muscle and plantar somatosensory thresholds [9]. In this case, prolonged and continuous pressure on the limbs by prolonged seiza positioning may lead to decreased oxygen levels and the destruction of muscle tissue induced by rhabdomyolysis.

Shigeaki INOUE, Department of Emergency and Critical Care Medicine, Tokai University School of Medicine, 143 Shimokasuya, Isehara, Kanagawa 259-1193, Japan Tel: +81-463-93-1211 Fax: +81-463-95-3711 E-mail: sg-inoue@is.icc.u-tokai.ac.jp

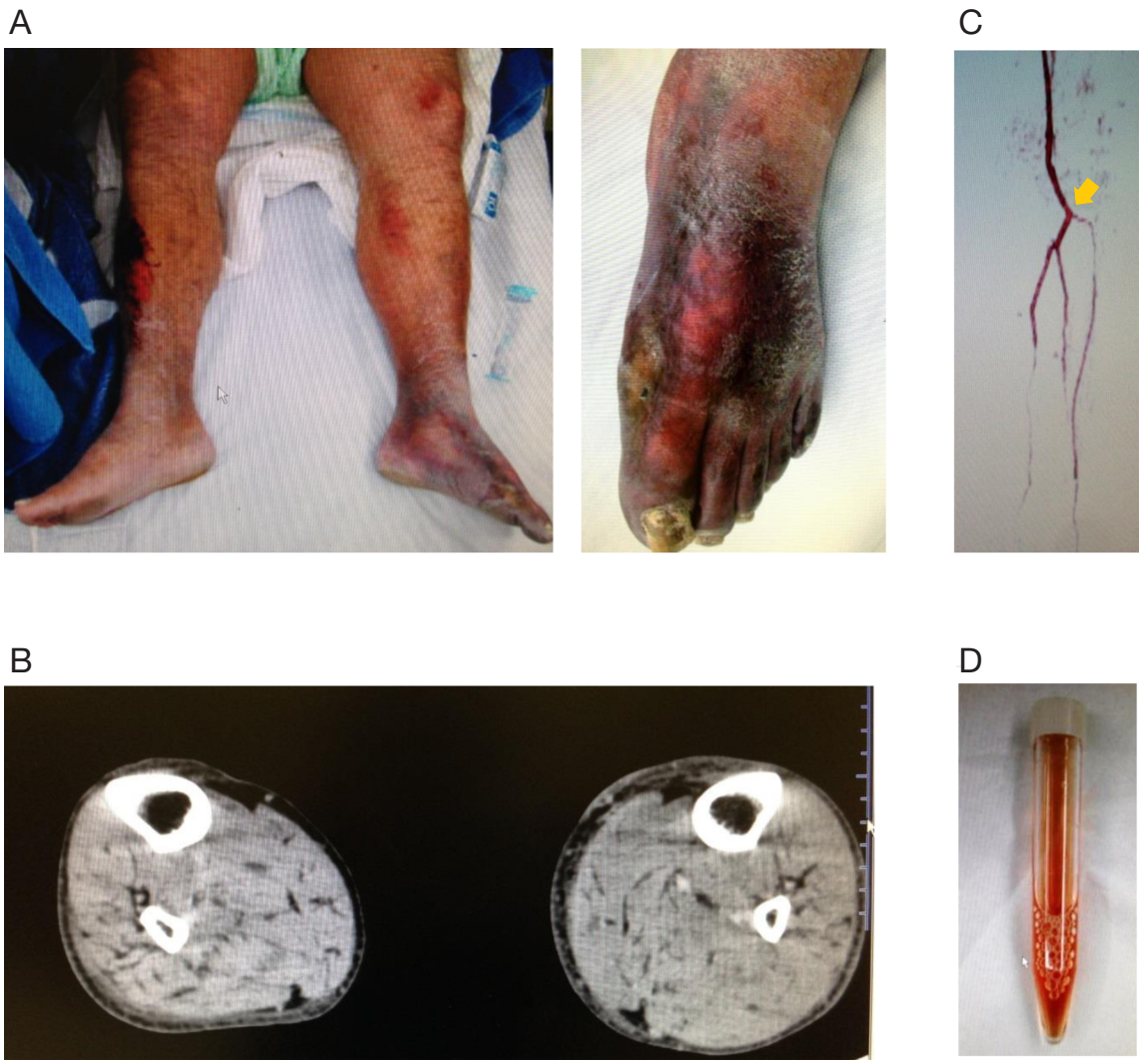

Figure: Initial physical and computed tomographic (CT) findings of the patient
A: Swollen and cyanosed left lower leg. B: CT scan showing the swollen left soleus muscle and the subcutaneous tissue with increased density. C: Three-dimensional CT angiographic image showing stenosis of the left anterior tibia artery (arrowhead). D: Initial urine appearance demonstrating myoglobinuria.

Crush syndrome is also a reperfusion injury that results from traumatic rhabdomyolysis with influx of circulation levels of myoglobin, potassium, and phosphorus [10]. These symptoms sometimes cause acute renal failure and hyperkalemia, which lead to arrhythmia. Therefore, fluid resuscitation and potassium control are performed as a critical initial treatment to prevent arrhythmia. In the present case, initial resuscitation and glucose insulin therapy effectively decreased the serum potassium level without renal replacement therapy.

This study had some limitations. First, we could not determine the exact total entrapment time (time under rubble plus removal from the site) in this case because nobody noticed the exact time the patient collapsed. Crush syndrome is fundamentally based on the following three criteria: 1) involvement of muscle mass; 2) prolonged compression (usually 4–6 hours, but possibly 1 hour); and 3) compromised local circulation. The total entrapment time (time under rubble plus removal from the site) may not reflect the true severity of injury or the potential medical complications because renal and cardiac complications are also particularly sensitive to the magnitude of pressure and size of the compressed muscle groups with respect to overall compression time. Compression for 1 hour is likely to result in a crush syndrome, but crush syndrome has been observed in as short as 20 minutes of compression [1]. Furthermore, we speculate that because the patient was overweight (106 kg), the pressure magnitude might have increased and triggered the extensive crush syndrome over a short period.

Second, stenosis of the left anterior tibia artery revealed by initial three-dimensional CT angiography has a possibility of peripheral arterial diseases. However, emergency fasciotomy dramatically decreased pressures of compartments of left lower extremity, following to recanalization of left anterior tibia artery. Therefore, stenosis of the left anterior tibia artery was caused by increased pressures in compartments of left lower extremity, not occlusion regarding with peripheral arterial diseases.

Third, the exact cause of the loss of consciousness could not be determined. However, the decreased se-

rum concentrations of sodium valproate and carbamazepine with hyperlacteremia led us to speculate that epilepsy attack might have led to the collapse after the onset of crush syndrome in this case.

CONCLUSION

We report a rare case of crush syndrome that was induced by the kneeling seiza position. The possibility of rhabdomyolysis and acute renal failure should be considered when oxygen supply to the muscles is impaired owing to folding of the legs.

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