



Rhabdomyolysis after tourniquet use in proximal tibial osteotomy: a case report and review of the literature

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Rhabdomyolysis following pneumatic tourniquet use is an extremely rare complication. In this case report, we aimed to present an unusual tourniquet complication following proximal tibial osteotomy. A 55-year-old female patient was operated on for genu varum in our clinic. Postoperatively, anuria developed, and liver and kidney function test levels increased. The patient was diagnosed with acute rhabdomyolysis, and an aggressive treatment was begun.

Keywords: Complication; proximal tibial osteotomy; rhabdomyolysis; tourniquet.

Tourniquets are used in orthopedics, particularly during lower extremity surgery. Although the technique aids the surgery by providing a bloodless area, in some instances it can cause complications such as ischemia, neurological deficit, myonecrosis, vascular endothelial injury, or skin injuries.^[1] Characterized by necrosis of myocytes, rhabdomyolysis is a very rare tourniquet complication, which is defined as an acute increase in serum creatine kinase concentrations; additionally, it causes acute renal failure (ARF).^[2] Dissolution of striated muscle fibers—with leakage of muscle enzymes, myoglobin, potassium, calcium, and other intracellular constituents—can occur in any patient under particular circumstances, the consequences of which can be severe to fatal.^[3] In this case report, we present an unusual tourniquet complication after following tibial osteotomy surgery.

Case report

A 55-year-old woman was admitted to our clinic with

medial knee arthrosis. Her lower extremities were in the position of genu varum. Preoperative tibiofemoral anatomic angle (TFAAa) was 188° and postoperative TFAAa was 176° (Figure 1a, b). The patient had no history of chronic disease or drug allergy. Her body mass index was 29.2 kg/m². A proximal tibial osteotomy was planned for her left knee, with bone grafting from the iliac crest. All hematological parameters were normal before surgery. Renal and liver function test results were creatinine, 0.61 mg/dl (0.5–0.9); urea, 25 mg/dl (17–43); alanine aminotransferase (ALT), 8 U/L (0–38); and aspartate aminotransferase (AST), 15 U/L (0–31).

Blood pressure was 80–135 mmHg before anesthesia. One g of cefazolin sodium was applied for surgical prophylaxis, and 1 µg/kg fentanyl was used before anesthesia induction to avoid hemodynamic instability due to intubation. General anesthesia was induced with 5 mg/kg intravenous thiopental and 0.1 mg/kg vecuronium.

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Fig. 1. (a) Preoperative and (b) postoperative X-rays of the patient.

um for muscle relaxation, which was maintained with O_2 /air, 3/3; 1% Sevoflurane; and $0.1 \mu\text{g}/\text{kg}/\text{min}$ remifentanyl infusion. One hundred mg tramadol was used for pain management. A pneumatic thigh tourniquet was applied intraoperatively at an inflation pressure of 330 mmHg. Before osteotomy, a microfracture procedure was conducted for the medial femoral condyle, and a partial menisectomy was applied arthroscopically to the medial meniscus for 45 min. When the arthroscopy procedure was complete, the tourniquet was released for 25 min, and a bicortical bone graft was harvested from the iliac crest. Following this, an Esmarch bandage was placed on the leg to expel the venous blood, and the tourniquet was inflated to a pressure of 330 mmHg. At that

time, the blood pressure was 85–125 mmHg. A medial open wedge proximal tibial osteotomy procedure was conducted for 72 min. Postoperative blood pressure was 70–125 mmHg. One thousand ml isotonic sodium was used for hydration postoperatively. No intraoperative or postoperative hypotension or hypertension was observed. During surgery, 2,000 ml of crystalloids and 300 ml of colloids were administered, and 2,500 ml of urine were collected. No surgical complication occurred during the surgery. There was no body temperature change during and after surgery. Postoperative hormonal examination was normal.

Anuria developed on postoperative Day 1. Blood chemistry results were creatinine, 2.04 mg/dl (0.5–0.9);

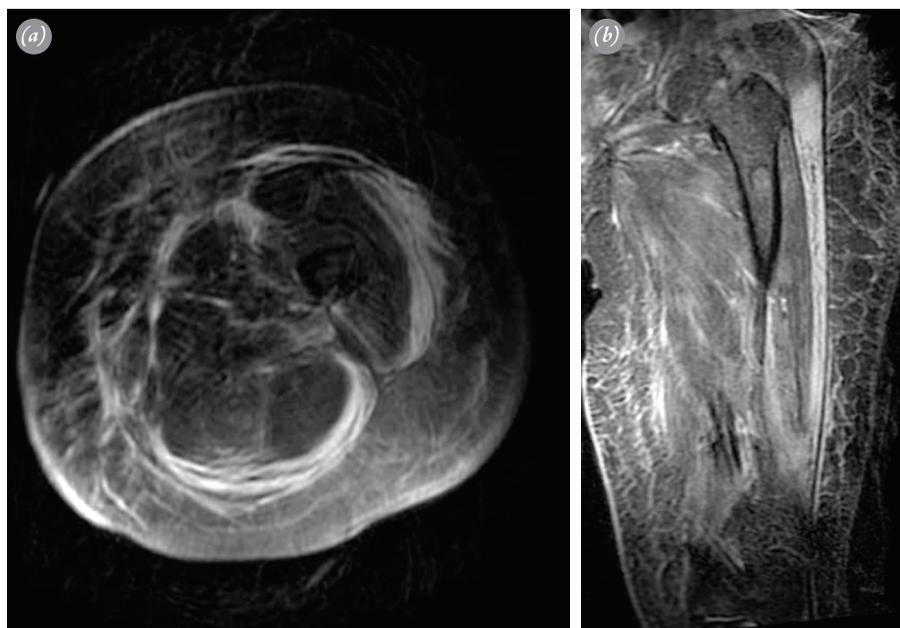


Fig. 2. (a) Axial T2 weighted magnetic resonance images demonstrate inter/intra muscular edema and necrosis in adductor muscles. (b) Coronal T2 weighted magnetic resonance images demonstrate muscular edema on hamstring and vastus muscles.

urea, 48 mg/dl (17–43), ALT, 7 U/L; and AST, 15 U/L. Hydration and forced diuresis were attempted with intravenous diuretics. Although oliguria occurred following the diuretic treatment, kidney and liver function test values increased on postoperative Day 2 (creatinine, 4.83; urea, 89; AST, 1,563; ALT, 618; creatine kinase (CK), 4,443). The urine was dark colored, and myoglobinuria was detected. Thus, hemofiltration was applied immediately. The blood pressure was 70–100 mmHg before hemofiltration.

The patient experienced confusion at the time of clinical examination, but no neurovascular deficit was observed. The thigh and leg were not tensioned, and there was no compartment syndrome. The thigh was examined by magnetic resonance imaging (MRI) on Day 3 postoperatively, which revealed adductor, hamstring and quadriceps muscle involvement (Figs. 2a, b). MRI was used to examine the thigh muscle trauma as in the literature.^[4]

Acute rhabdomyolysis was diagnosed according to the increased level of CK, the presence of myoglobinuria, kidney function test results, and MRI findings.

Treatment was applied by a consultant nephrologist and anesthetist. The patient was informed that data from the case would be submitted for publication and gave her consent.

At the 12-month follow-up, thigh muscle atrophy was found, when compared to the unoperated side (circumference difference: approximately 5 cm). An aggressive physical therapy was started. Kidney function tests were in the normal range on all follow-ups.

Discussion

ARF was manifested by an increase in the creatinine level and oliguria during the postoperative period in this case. This is a serious complication generally associated with the type and time of surgery. ARF usually occurs as a result of systemic hypotension, hypovolemia, insufficient cardiac function, or the use of nephrotoxic drugs. ARF seen following trauma is associated with rhabdomyolysis.

Hypertension was not evident during preoperative monitoring in our case, and the patient was hemodynamically stable during the postoperative period. No symptoms or findings indicated hypovolemia. The patient had no history of nephrotoxic drug use or illness besides hypertension. The body temperature had not changed, so malignant hyperthermia was ruled out. Our diagnosis of rhabdomyolysis was supported by the simultaneous increase in CK and AST and the lack of any other explanation for postoperative ARF.

A study in rats investigated the renal effects of isoflurane, sevoflurane, and desflurane anesthesia on the development of ARF in connection with rhabdomyolysis generated with a glycerol model.^[5] Compared with isoflurane, both sevoflurane and desflurane caused more renal damage. Similarly, Lochead et al. studied the renal effects of isoflurane, desflurane, and pentobarbital anesthesia on ARF development in connection with rhabdomyolysis created with a glycerol model.^[6] After 24 h, the blood urea nitrogen and creatine values were significantly higher in the groups in which desflurane and pentobarbital anesthesia was administered compared with the group in which isoflurane anesthesia was administered,

Table 1. Cases in the literature in which rhabdomyolysis developed after tourniquet use.

Case year	Ref no	Surgery	Tourniquet time (minute)	Pressure (mmHg)	Obesity	Age (year)	Sex	Anesthetic
1983	2	*	*	*	*	*	*	*
1990	9	Multitrauma (ipsilateral foot and knee)	117+106 (30-min break)	325	–	23	Male	**
1994	10	Knee arthroplasty	92	350	–	73	Male	Spinal anesthesia
1995	11	Knee arthroscopy	131	300	–	30	Male	**
2006	12	ACL+MCL repair	110	**	+	16	Male	Femoral block + Fentanyl
2006	13	Knee arthroplasty	50	350	+	62	Female	Thiopentane Rocuronium bromide Sufentanil Sevoflurane
2010	14	ACL repair	**	**	+	38	Male	**
2012	4	Knee multi-ligament repair	>300	**	+	16	Male	**

*Not available. **Not mentioned on the paper.

and no significant difference was found between the desflurane and pentobarbital groups. The kidney acute tubular necrosis (ATN) scores (between 0–4 according to necrotic cell ratios) determined histopathologically 24 h later were significantly lower in the group in which isoflurane anesthesia was administered than in the groups in which desflurane and pentobarbital was administered, and the ATN scores did not differ significantly between the desflurane and pentobarbital groups.

In the cases presented by Takahashi et al. and Obata et al., rhabdomyolysis developed in connection with the use of sevoflurane during tonsillectomy and strabismus surgery, and sevoflurane was determined to be the cause of postoperatively-developed rhabdomyolysis.^[7,8] After considering these cases, we believe that pentobarbital used to induce anesthesia and sevoflurane used for maintenance of anesthesia increased our patient's kidney damage in connection with rhabdomyolysis through an additive effect.

We found 8 cases in the literature in which rhabdomyolysis developed after the use of a tourniquet.^[2,4,9–14] We observed that it was the first event that developed after a proximal tibial osteotomy. The surgery method, tourniquet time, and pressure in these cases are presented in Table 1. Karcher et al. reported a case in which the patient had underwent knee arthroplasty and then experienced a tourniquet trauma that caused rhabdomyolysis. In that report, sevoflurane was used, as in our case.^[13]

Rhabdomyolysis can develop in orthopedic cases that use tourniquets for extended periods of time. CK, ALT, AST, lactate dehydrogenase, urea, and creatine values should be carefully monitored, and in cases of rhabdomyolysis, ARF should be prevented by means of aggressive liquid resuscitation and diuresis. Treatment is straightforward in the early period, and it should be recognized that late treatment may lead to the development of permanent kidney failure. It would be more effective to use alternative anesthetic agents instead of pentobarbital and sevoflurane.

Conflicts of Interest: No conflicts declared.

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