Case Report

**Rhabdomyolysis following minimally invasive transforaminal lumbar interbody fusion: Case report**

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**Abstract**

**Background:** Rhabdomyolysis results from the release of large quantities of muscle cell contents into plasma resulting in a classic triad of symptoms – muscle pain, weakness, and brown urine. Only a handful of rhabdomyolysis cases occurring after spinal surgery have been reported.

**Case Description:** A 36-year-old male underwent an uneventful right-sided, minimally invasive transforaminal lumbar interbody fusion (miTLIF) for intractable lower back pain and right lower extremity radiculopathy attributed to L4-S1 degenerative spondylosis (DS). Postoperatively, the patient complained of intractable lower extremity pain resistant to medical management. He was subsequently diagnosed with rhabdomyolysis, and aggressive intravenous fluid resuscitation resulted in complete recovery.

**Conclusions:** Rhabdomyolysis should be diagnosed and treated promptly with aggressive intravenous fluid resuscitation to avoid acute kidney injury following miTLIF surgery.

**Key Words:** Acute kidney injury, AKI, minimally invasive spine surgery, MISS, rhabdomyolysis, transforaminal lumbar interbody fusion, transforal lumbar interbody fusion

**INTRODUCTION**

Rhabdomyolysis (RM) results from the release of large quantities of muscle cell contents into plasma. Most frequent causes of RM include crush injury, strenuous exercise, toxins, infections, muscle dystrophies, disturbances in potassium or phosphate homeostasis, epilepsy, Lou Gehrig’s disease, acute psychotic disorders, Reye syndrome, bowel ischemia, graft-versus-host disease, and eosinophilic fasciitis.[4] Few cases of RM in patients undergoing spinal surgery have been described,[2,3,5-7] one report noted RM after minimally invasive surgery.[2] Here, we present a patient who developed RM after undergoing an uneventful minimally invasive (MI) transforaminal lumbar interbody fusion (miTLIF).

**CASE REPORT**

A 36-year-old male with two prior lumbar laminectomies (2012) presented in 2015 with increased lower back pain. He underwent an uneventful right-sided miTLIF for intractable lower back pain and right lower extremity radiculopathy attributed to L4-S1 degenerative spondylosis (DS). Postoperatively, the patient complained of intractable lower extremity pain resistant to medical management. He was subsequently diagnosed with rhabdomyolysis, and aggressive intravenous fluid resuscitation resulted in complete recovery.

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intratable lower back pain and right lower extremity radiculopathy of 3 months duration. Magnetic resonance imaging (MRI) of the lumbosacral spine revealed lumbar spondylosis with degenerative disc disease at L4-S1 with a right paracentral disc herniation and neuroforaminal stenosis at L4-5 and biforaminal stenosis at L5-S1. Social history was significant for manual labor and smoking one pack per day for approximately 14 years. On physical examination, the patient had a body mass index (BMI) of 23 kg/m², as well as nonfocal neurological examination except for decreased sensation on the lateral aspect of the right thigh and calf.

In 2015, he underwent an uneventful right-sided miTLIF using intraoperative computed tomography (CT) guidance. The patient was positioned on a Jackson table. Intraoperatively, he remained hemodynamically stable (medications: midazolam 2 mg, lidocaine 80 mg, propofol 280 mg, fentanyl 400 mcg, rocuronium 180 mg, cefazolin 1 g, acenitonphen 1 g, phenylephrine 2 mg, hydromorphone 1 mg, glycopyrrolate 0.5 mg, neostigmine 3.5 mg, ondansetron 4 mg, sevophlorane). The operative time to extubation was 6 hours and 57 minutes, and the surgical time from incision to skin closure was 4 hours and 53 minutes. The patient received a total of 2.5 L of normal saline, his urine output was 410 mL, and the estimated blood loss was 150 mL.

Postoperatively, he complained of severe lower back and leg pain, and was started on intravenous (IV) hydromorphone, valium, and oral cyclobenzaprine. On postoperative day (POD) one, severe pain continued, for which he was given celebrex, oxycodone, and fentanyl, via a patient controlled analgesia pump. On the evening of POD two, the patient was overnarcotized requiring Narcan, but his blood pressure remained within range. At this point, his serum creatine kinase (CK) was 11,492 unit/L. He was promptly started on IV fluids, and switched over to an oral pain regimen. His CK continued to decrease, and was 1,699 unit/L on the day of discharge, i.e. POD seven. Patient remained neurologically stable throughout the hospital stay with full strength in both lower extremities on the day of discharge.

On his first postoperative office visit, his CK had reduced to 400 unit/L, and he reported near complete resolution of his lower back pain. At the 3-month postoperative follow-up visit, the patient was off pain medication, pain free, and working.

**DISCUSSION**

RM is the result of skeletal muscle fiber breakdown with release of fiber contents into the bloodstream and urine. Usually, it presents as muscle fatigue, pain, cramps, and weakness. Reddish-brown urine indicating myoglobinuria is highly suggestive of RM.[4] Diagnostic laboratory testing is outlined in Table 1. An arbitrary value of 500 to 1,000 IU/L or 5 to 10 times of the upper limit from normal is frequently used to define RM.[8] Serial CK measurements can be used to track treatment success or failure.

Pathophysiology of RM involves muscle fiber lysis caused by damage to the sarcolemma or by metabolic disturbances related to a biochemical or genetic abnormality. The crucial factor in the mechanism of injury in RM is elevated intracellular free calcium (Ca) levels. Disruption of Ca homeostasis leads to activation of

| Test                  | Abnormal Value for RM | Comments                                                                 |
|-----------------------|-----------------------|--------------------------------------------------------------------------|
| Creatine Kinase       | >500 IU/L             | Diagnostic for rhabdomyolysis; increased risk of kidney injury if >5,000 IU/L |
| Potassium             | >6.0 mmol/L           | Marker of severity of muscle injury and renal dysfunction                |
| Phosphorous           | >6.0 mg/dL            | Marker of severity of muscle injury and renal dysfunction                |
| Calcium               | Decreased (< 8.0 mg/dL)| Deposition in damaged muscle                                              |
| Creatinine            | Increased             | Marker of decreased renal function                                        |
| BUN: creatinine       | <10:1, often < 6:1    | Increased conversion of muscle creatine to creatinine                    |
| Anion gap             | Increased             | Increased organic acids due to muscle injury or renal dysfunction         |
| Blood alcohol level   | Elevated              | Potential cause of rhabdomyolysis                                        |
| Urine blood dipstick  | Positive              | Detects myoglobinuria in absence of RBCs in urine                        |
| Urine drug screen     | Positive              | Potential drug-related cause of rhabdomyolysis                          |
proteases and phospholipases, which break down proteins that make up the contractile apparatus, cell membrane, and cytoskeleton.

Common causes of RM were outlined by Zimmerman et al., and can be divided into four categories – hypoxic, physical, chemical, and biologic – with direct muscle injury being the most common cause of RM [2] [Table 2]. To date, only a handful of cases developed RM due to spinal surgery, and only one report concerned with a MI direct lateral interbody fusion (miDLIF); however, none involved miTLIF.

There have been multiple case reports of RM after prolonged spinal procedures, but only one involved MI surgery. The etiology of RM was variously attributed to: Ziser et al.[9] prolonged surgery 7 to 10 hours; Foster[3] obese patient with 6 hour revision of lumbar fusion using the Jackson table; Nayak et al.[6] a 22-year-old with BMI of 35.6 kg/m², RM after 9 hours to resect an L3 giant cell tumor; Dakwasr et al.[2] five patients undergoing miDLIF, BMI from 25 to 40 kg/m², operative time of 5.25 to 10 hours, and various medical comorbidities. In our case, the only risk factor for RM was the relatively prolonged operative time.

The treatment of RM aims at prevention of acute kidney injury, and consists of early recognition and aggressive volume resuscitation to restore adequate renal perfusion.

**CONCLUSION**

RM is a rare complication typically of prolonged spinal surgery. It should be rapidly diagnosed and treated with aggressive fluid resuscitation to avoid renal failure.

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**Conflicts of interest**

There are no conflicts of interest.

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**Table 2: Causes of Rhabdomyolysis. This table is reproduced with the permission of the authors and Chest[8]**

| Hypoxic             | Physical                          | Chemical                        | Biologic                        |
|---------------------|-----------------------------------|---------------------------------|---------------------------------|
| Carbon monoxide exposure | Crush injury                     | Alcohol                         | External bacterial, viral, & parasitic myositis |
| Cyanide exposure  | Trauma                            | Prescription medications        | Organic toxins                  |
|                     | Burns                             | Over-the-counter medications    | Snake venom                     |
|                     | Electrocardioversion              | Illicit drugs                   | Spider bites                    |
|                     | Hypothermia                       |                                 | Insect stings (ants, bees, wasps) |
|                      | Internal                          |                                 |                                 |
|                     | Compartment syndrome              |                                 |                                 |
|                     | Vascular compression              |                                 |                                 |
|                     | Immobilization                    |                                 |                                 |
|                     | Bariatric surgery                 | Prolonged and/or extreme        |                                 |
|                     | Surgical                          | exertion                        |                                 |
|                     | Prolonged surgery                 | Seizures                        |                                 |
|                     | Sickle cell trait                 | Status asthmaticus              |                                 |
|                     | Vascular thrombosis               | Severe agitation                |                                 |
|                     | Vasculitis                         |                                 |                                 |

BUN: Blood urea nitrogen, RBC: Red blood cell, RM: Rhabdomyolysis[8]