Anesthesia-Induced Rhabdomyolysis During Corrective Spine Surgery: A Case Report

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Authors’ contributions

This work was carried out in full collaboration between both authors. Anuradha Patel and Sergey Pisklakov equally participated in drafting and revising of this manuscript. Both authors equally managed the analysis of the case and the literature searches. Both authors read and approved the final manuscript.

ABSTRACT

We present a case in which a pediatric cerebral palsy patient developed intraoperative myoglobinuria and rhabdomyolysis with elevated creatine kinase (CK) during prone scoliosis surgery. A diagnosis of rhabdomyolysis was established with the finding of tea-colored urine intraoperatively, and confirmed with elevated urine myoglobin and CK postoperatively. Cerebral palsy patients may develop anesthesia-induced rhabdomyolysis when inhalational anesthetics used.

Keywords: Anesthesia-induced rhabdomyolysis; intraoperative myoglobinuria; corrective spine surgery; perioperative complications.

1. INTRODUCTION

Rhabdomyolysis is the breakdown of muscle fibers causing release of myoglobin into the bloodstream. Rhabdomyolysis may be caused by any condition that damages skeletal muscle, especially muscular trauma, surgery and occasionally general anesthetics. There
are a significant number of risk factors and conditions which may lead to non-intraoperative and unrelated to anesthetics rhabdomyolysis. Those factors and conditions include acute alcohol consumption, cocaine, heroin or amphetamine use, heatstroke, prolonged shivering, deep venous thrombosis, sepsis, tetanus. Less common causes can include muscle enzyme deficiencies, electrolyte abnormalities, infectious causes, drugs, toxins, endocrinopathies, metabolic syndromes and autoimmune disorders [1] and even exertion and exertional heat loss [2]. Drugs such as antipsychotics, antidepressants or statins occasionally may cause rhabdomyolysis as well. Clinically rhabdomyolysis may range from an absolutely asymptomatic illness with mild or moderate elevation in the creatine kinase (CK) level to a life-threatening catastrophic event with highly elevated levels of CK, electrolyte imbalances, acute renal failure and disseminated intravascular coagulation. Rhabdomyolysis has been reported when a surgical intervention is done and general anesthetics used [3]. Perioperative acute rhabdomyolysis is the syndrome resulting from abrupt skeletal muscle injury with the release of cell content and has been primarily reported in association with three clinical scenarios: non-supine position during surgery, use of a tourniquet during prolonged surgery, and administration of succinylcholine to children with pre-existing neuromuscular disorders [4].

There have been numerous rhabdomyolysis cases reported secondary to inhaled anesthetics use in patients with neuromuscular disorders. Comparatively, there are almost no reports of rhabdomyolysis with the use of inhaled anesthetics in cerebral palsy (CP) patients [5, 6]. We present a case in which a pediatric cerebral palsy patient developed intraoperative myoglobinuria and rhabdomyolysis with elevated CK during prone scoliosis surgery.

2. PRESENTATION OF CASE

A 10 year-old male with a history of severe spastic cerebral palsy, developmental delay and scoliosis presented for spinal arthrodesis and instrumentation. The patient had previously received anesthesia for VP shunt insertion, cardiac valve surgery, and a left femoral osteotomy with no complications. According to patients medical record and available laboratory data patient did not have a history of elevated CK values. There was no family history of anesthetic related complications as well. General anesthesia was induced with 1 mg versed, 50 mcg fentanyl, 150 mg propofol, and 20mg rocuronium. The patient was maintained with 0.8% sevoflurane, propofol (80mcg/kg/min), and remifentanil (0.05mcg/kg/min). The patient was in the prone position. During the case, the urine output was approximately 10mL/hr, but was noted to be dark and “tea-colored” about four hours into the surgery. There were no episodes of hemodynamic instability, hyperthermia, hypercapnia, or seizure activity during the case.

Initial postoperative labs revealed a urine myoglobin of 159 μg/l (normal 3-80μg/l) and creatine kinase (CK) of 6046 μ/l (normal 94-491μ/l). Lactate dehydrogenase and alanine transferase were only moderately elevated. Potassium, BUN, and Cr remained within normal limits. Postoperative rhabdomyolysis was strongly considered. There was no postoperative acute renal failure. CK peaked to 10,235 μ/l on postoperative day #3, but proceeded to decrease and resolve over the next week. The patient had an uncomplicated recovery and was 43 discharged home on postoperative day #8.
3. DISCUSSION

This is an uncommon case of anesthesia induced rhabdomyolysis in a cerebral palsy patient after prone scoliosis surgery. A diagnosis of rhabdomyolysis was established with the finding of tea-colored urine intraoperatively, and confirmed with elevated urine myoglobin and CK postoperatively. Rhabdomyolysis leads to a number of devastating systematic complications if not diagnosed and treated on time [3]. Those complications and their pathogenesis mechanisms are summarized in Table 1.

| Complication               | Pathogenesis                                                                 |
|----------------------------|------------------------------------------------------------------------------|
| Acute tubular necrosis     | Toxic effect of urinary myoglobin, urate crystal formation                    |
|                            | Hypotension                                                                  |
|                            | Protease release from injured muscle                                         |
| Hyperkalemia               | Muscle breakdown                                                              |
| Hypocalcemia               | Binding of calcium by damaged cells                                          |
| Late hypercalcemia         | Release of calcium from muscle binding sites and impaired renal excretion of calcium |
| Hypovolemia                | Massive intramuscular capillary destruction                                  |
| Disseminated intravascular coagulation (DIC) | Release of tissue thromboplastins                                            |
| Hyperphosphatemia          | Release of phosphates from destroyed muscles                                 |
| Compression palsies        | Compartment syndrome caused by destroyed muscles                             |

There are very few reports on the association between CP and rhabdomyolysis. Intrathecal baclofen pump withdrawal, malignant hyperthermia, and repeated violent ballism were reported as causes of rhabdomyolysis in children with CP [7,8]. Propofol infusion syndrome, muscle trauma and muscular ischemia, mitochondrial disorders, numerous metabolic myopathies may be associated with rhabdomyolysis as well [9]. Muscle compression, immobilization and tissue ischemia, long operative time and morbid obesity are major risk factors for intraoperative rhabdomyolysis [10,11,12]. All those etiologies in this case were ruled out. Extremely high immediate postoperative levels of urine myoglobin and blood CK levels, but only moderately elevated LDH and ALT levels and especially remained normal potassium level were strongly suggestive of developed anesthesia-induced rhabdomyolysis. Described patient was not obese, no tourniquet was employed and the intraoperative course was hemodinamically smooth. Sometime surgery in prone position can be complicated by rhabdomyolysis. Possible causes of the rhabdomyolysis in prone position could be ischemic muscle injury, prolonged use of the tourniquet, occlusion of pelvic blood vessels, prolonged periods of hypotension, and compression of the thighs by gel pads used for positioning [5]. None of these took place in described case. Interestingly enough, rhabdomyolysis during
routine surgery was studied in patients who had surgery, with limited trauma to muscle, in the lateral and supine positions, and prone on the spinal frame. Authors performed CK measurement before surgery, and on the first, third and seventh day after operation. They showed that there is a CK increase in the 24 hours and the early appearance of myoglobin in the serum [13]. It is possible that in this case position and relatively long surgery itself could have caused rhabdomyolysis and myoglobinuria, but the extent and rapidity of CK increase strongly suggests gas anesthetic as a possible culprit. The surgery itself is less likely to elevate the CK value as high as in our case [6]. Occasionally spasticity itself may lead to increased CK values [6], but was not described with such a magnitude of enzyme increase.

Wide variety of adverse responses, including rhabdomyolysis, to volatile anesthetics (isoflurane, sevoflurane or desflurane) is well described in patients with neuromuscular disorders. There are a number of anesthetic concerns and precautions for different neuromuscular disorders [14]. Those concerns and precautions in regards to depolarizing, non-depolarizing muscle relaxant and volatile anesthetic use are summarized in the Table 2.

| Diseases                                  | Depolarizing muscle relaxants (succinylcholine) | Non-depolarizing muscle relaxants | Volatile anesthetics |
|-------------------------------------------|------------------------------------------------|----------------------------------|----------------------|
| Duchenne and Becker Muscular Dystrophy    | Avoid                                          | Increased sensitivity            | Probably avoid (weak evidence of malignant hyperthermia and rhabdomyolysis susceptibility) |
| Myotonic Dystrophy                        | Avoid                                          | Increased sensitivity            | Most probably safe   |
| Central Core Disease                      | Avoid                                          | Increased sensitivity            | Avoid                |
| Inflammatory myopathies                   | Avoid                                          | Variable sensitivity             | Safe                 |
| Mitochondrial Myopathies                  | Avoid                                          | Variable sensitivity             | Safe                 |
| Myasthenia Gravis                         | Poorly predictable sensitivity and duration     | Increased sensitivity            | Safe                 |
| Lambert Eton Syndrome                     | Avoid                                          | Increased sensitivity            | Safe                 |
| Guillain-Barre Syndrome                   | Most probably avoid                            | Variable sensitivity             | Safe                 |
| Amiotrophic Lateral Sclerosis             | Avoid                                          | Increased sensitivity            | Safe                 |
To elucidate a potential underlying neuromuscular disorder in this case, a follow-up muscle biopsy was recommended to the primary care service, but was not performed. The trend of CK elevation and decline was different from intraoperative cases previously described [11]. Prolonged surgery and positioning may obviously cause rhabdomyolysis, but not to such degree as described in this case. Sevoflurane exposure was suspected as one of the most probable etiologies of rhabdomyolysis and this deduction is reasonably supported by the literature [6,15].

4. CONCLUSION

Succinylcholine and inhaled anesthetics are not currently contraindicated for patients with CP [16]. The situation may be different if surgery is prolonged or extensive. CP patients may probably develop anesthesia-induced rhabdomyolysis when inhalational anesthetics are used for a long time and other rhabdomyolysis risk factors are involved. Therefore, to avoid potential complications, succinylcholine and inhaled anesthetics may need to be used with extreme caution or avoided and total intravenous anesthesia should be used in these patients [7].

CONSENT

Patient fully consented and case report was approved by Institutional Review Board (IRB).

ETHICAL APPROVAL

Case report was approved by Institutional Review Board (IRB).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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