CASE REPORT

Rhabdomyolysis is a Potential Complication of Total Hip Arthroplasty in the Morbidly Obese

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Abstract Rhabdomyolysis (RML) can complicate prolonged surgery and may lead to renal failure and death. Obese patients are at high risk for this complication. This complication has been recently described in bariatric surgery and prolonged spine surgery, but it is not well recognized in patients undergoing THA. We present an obese patient (BMI=50) who developed RML and acute kidney injury after a total hip arthroplasty.

Keywords total hip arthroplasty · rhabdomyolysis · acute kidney injury · obesity

Introduction

Rhabdomyolysis (RML), the rupture of skeletal muscle, has been attributed to multiple causes, with crush injury being one of the most common. Although initially described in patients injured in disasters such as the 1940 bombing of London during World War II and the 1908 earthquake in Sicily, prolonged positioning has been recognized as a potential cause of muscle compression injuries [6, 20]. RML may be considered with levels of creatine kinase (CK) above five times normal. Myoglobin has an extremely short half-life in the circulation, but myoglobinuria occurs with serum levels above 0.5–1.5 mg/dl. RML is a recognized complication of bariatric surgery, and has been reported in patients who undergo prolonged spine procedures. Risk factors described include morbid obesity (BMI>40) as well as prolonged operative time [1, 7, 9]. This is of particular concern,

as the prevalence of obesity has reached epidemic proportions. Presently, 71% of those aged 65 and higher in the US are affected [15]. In addition, obesity significantly contributes to the rising prevalence of osteoarthritis, which is the most common diagnosis leading to arthroplasty. Morbidly obese patients undergoing arthroplasty may also be at high risk for RML. Additional considerations in the surgical setting which are not related to compression include RML due to malignant hyperthermia, which occurs when genetically susceptible individuals are exposed to certain anesthetic agents, and RML due to vascular injury. RML may lead to renal failure and death, but when promptly diagnosed it can be successfully treated with intravenous isotonic saline infusion. Although RML has been described in arthroplasty case series published in 1989 and 1991 [12, 18], there has been little recent recognition of this complication in the arthroplasty population. We present a case of RML in a patient undergoing total hip arthroplasty (THA) to highlight this potentially treatable complication of arthroplasty especially when performed in morbidly obese patients. As the obesity epidemic is contributing to the skyrocketing rate of arthroplasty, and 83% of arthroplasty patients have BMI >30 [10], the incidence of RML may increase.

Case Report

The patient is a 68-year-old obese old man who developed limiting osteoarthritis of the hips. At the time of presentation, his right hip was more painful than the left, although both were severely affected. He could walk just one block before pain became limiting, and he slept in a recliner due to night pain. Because of these progressive and increasingly disabling symptoms, he sought definitive surgical therapy and planned admission for staged bilateral THA. His past medical history was significant for hypertension, hyperlipidemia, hypothyroidism, dermatitis secondary to venostasis

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with cellulitis but without history of thrombosis, and hyperuricemia with kidney stones. Medications at the time of admission included coumadin 6 mg nightly for venostasis, stopped 1 week prior to admission, levothyroxin 150 mcg, metoprolol 50 mg, diltiazem 240 mg, and allopurinol 300.

His physical examination at the time of his first admission revealed a BMI of 50.3 (height: 6'1", weight 381 lbs). His blood pressure was 170/82 with a pulse rate of 66. His cardiac and pulmonary exams were unremarkable. Examination of his extremities revealed restricted motion of both hips (right more than left), and dermatitis with pitting edema bilaterally. Preoperative evaluation included a normal EKG and echocardiogram, with normal wall motion and left ventricular function. He underwent an uncomplicated THA positioned for 4 h 20 min in the left lateral decubitus position, and remained in the recovery room for monitoring of presumed sleep apnea. His temperature remained normal (Table 1). A post-operative increase in serum creatinine to 1.8 from 1.2 mg/dl on his pre-admission tests prompted an evaluation which included a creatine phosphokinase (CPK) level, which was elevated to 8,075. He was treated with hydration and was discharged to an inpatient rehabilitation facility on post-operative day 5, with normalization of his serum creatinine to his pre-admission level. He was readmitted for a left THA 13 months later. His weight had increased to 410 lbs, BMI 54.1, without other changes in his physical exam. He underwent a LTHA in the right lateral decubitus position under combined spinal and epidural anesthesia. He was in the right lateral decubitus position for 3 h and 37 min. During surgery, his systolic blood pressure was maintained above 90 mmHg. He received 2,200 ml of lactated ringer's solution, and his estimated blood loss was 300 ml. He remained in the recovery room for observation for 2 days. His CPK increased to a maximum of 11,895, and his creatinine increased to 1.5 mg/dl in spite of vigorous hydration, but returned to baseline prior to discharge on post-op day 5.

Discussion

RML has been observed in patients undergoing prolonged surgical procedures, and has been best studied in patients undergoing bariatric surgery for obesity. Prospectively collected data revealed an incidence of 22.7–37.8% in this patient population [14, 5]. When 49 consecutive patients were followed prospectively, 26.5% showed elevations of CPK above 1,000 units/l. Risk factors identified were prolonged surgery (>4 h), diabetes mellitus, and BMI>40 [13]. There were no cases of RML when the operative time remained below 2 h [8]. Fatalities in

patients undergoing bariatric surgery have been reported in cases where gluteal necrosis led to severe RML with renal failure [3]. Underlying factors such as pre-existing renal disease make the patient more susceptible to renal damage, thought to be caused by myoglobin precipitation in the renal tubules, which produces acute tubular necrosis. Muscle pain and swelling have been described in affected muscle groups, as well as ulcers in the pressure zones [7]. Vascular disease may increase the risk of RML, with high rates of RML recognized after abdominal aortic surgery, where obesity was also found to be a risk factor [2]. In addition, RML has been reported after prolonged urogenital surgery in the lithotomy position and after neurologic surgery. Prolonged operative time contributes to RML in all surgical series [21, 1, 19].

Multiple case reports document the occurrence of RML after spine surgery, typically associated with the prone position, where the abdomen may not be completely decompressed in obese patients. Use of the Jackson table to optimize abdominal decompression by supporting the patient at the sternum and iliac crests has not prevented this complication [9, 17]. RML has also been reported in five cases after minimally invasive lateral approach spine surgery, in the lateral decubitus position. In these cases, the operative time ranged from 315 to 600 min, and BMI ranged from 25 to 40. All five patients complained of muscle pain and weakness [4].

RML complicating arthroplasty is less well recognized and understood. There is a paucity of information regarding RML after total knee arthroplasty (TKA), consisting of case reports only. An early case of RML involved an obese man in whom the tourniquet was inflated for 92 min, with a total anesthetic time of 2 h. As the tourniquet site was swollen and tender, the RML was attributed to compression by the tourniquet [16]. In a later case of RML after TKA, a diabetic patient whose BMI was 42.5, the tourniquet time was 50 min and the duration of anesthesia 70 min [11]. Both individuals developed acute renal failure, from which they recovered.

Cases of RML after hip arthroplasty were reported in two series of six contralateral limb complications. Factors felt to contribute to the RML involving the “down side” were prolonged operative time in the lateral decubitus position and increased weight [12, 18]. Changes in operative technique have included smaller incisions and muscle-sparing approaches which have reduced operative time since these cases were first reported in 1989 and 1991, but the prevalence of obesity, the other most frequently described risk factor, has markedly increased. Although improvements in anesthetic technique have led to improved tissue perfusion during anesthesia and

Table 1 Patient characteristics

	BMI	Time in lateral decubitus position	Maximal CPK	Maximal Cr mg/dl	Pre-admission Cr mg/dl
THA 1, 6/2	50	4 h 20 min	8,075	1.8	1.2
THA 2, 8/24	54	3 h 37 min	11,895	1.5	1.3

careful positioning and padding during the operation can minimize the potential for tissue and muscle damage, the increased operative time required for the surgical approach in the morbidly obese may have negated these benefits in regard to the risk of RML.

Unlike the majority of patients with RML after bariatric, spine, or knee surgery, our patient had no symptoms to suggest RML, and specifically had no complaints of pain in the unoperated side such as would be expected in a “downside” crush injury. Although the lack of symptoms may be the result of regional anesthesia and analgesia, this increases the difficulty of diagnosis. Additionally, the risk of RML was increased for our patient as each THA took greater than 3 h due to the increased difficulty in surgical exposure. This is significantly longer than the usual operative time of 1.5–2 h. It is not clear why the higher CK at the time of the second surgery did not result in greater renal damage, more aggressive hydration with a net positive balance of 9,055 ml compared to net positive 4,840 ml for the first admission likely contributed to the better outcome.

In summary, RML may complicate prolonged surgery in the obese, and may, therefore, be an under-recognized complication of arthroplasty in the obese. As the number of obese patients undergoing arthroplasty increases, with 83% of arthroplasty patients in one series with BMI >30 [10], the incidence of RML complicating arthroplasty can be expected to increase as well. As the current incidence of RML-complicating arthroplasty is unknown, post-operative renal insufficiency due to RML may be misdiagnosed and undertreated. We recommend careful positioning in the operating room as well as screening obese patients with BMI >40 undergoing surgery lasting greater than 2 h with post-operative CPK levels at 12 and 24 h to ensure prompt recognition and therapy of RML with copious intravenous infusion of normal saline to prevent the development of renal failure and death. We plan further study of RML-complicating arthroplasty so that we can better define those at risk, develop strategies to promptly recognize and treat incident RML, and eliminate this complication in the future.

Disclosures Each author certifies that he or she has no commercial associations (e.g., consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article. One or more of the authors or author's institution have received or will receive payments from a commercial entity that may be perceived as a potential conflict of interest.

Each author certifies that his or her institution has approved the reporting of this case, that all investigations were conducted in conformity with ethical principles of research.

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