RHABDOMYOLYSIS: A RARE, BUT MORBID COMPLICATION OF PROLONGED OPERATIVE TIMES. CAN HEIGHTENED AWARENESS CHANGE PATIENT OUTCOMES? DID COVID-19 PLAY A ROLE?

Anne Montal, MD[1], Hayayadhan Thuppal, MD[1], Vinoth Birabaharan, MD[1], Anna Liveris MD[2], Edward Chao, MD, FACS[2], Renee Huang, MD[1], Srinivas Reddy, MD, FACS[2]

[1] Montefiore Medical Center, [2] Jacobi Medical Center

Background

- Was COVID-19 infection the cause of rhabdomyolysis or was it patient positioning
- **Case 1:** 54M, BMI 39, underwent elective laparoscopic sigmoidectomy and takedown of colovesical fistula, lithotomy position with arms tucked, OR time was >8 hours, symptomatic on POD2 with bilateral upper extremity rhabdomyolysis and AKI, COVID+
- The incubation period of COVID-19 is ~5 days. The patient likely contracted COVID-19 preoperatively, symptomatic on POD2
- **Case 2:** 31M, BMI 35, underwent right femoral intramedullary nail and open reduction with internal fixation for GSW to right thigh, Hana table, both legs placed in distraction boots and secured, OR time 9 hours, symptomatic POD0-1, bilateral lower extremity motor and sensory deficit, low UOP, HTN, tachycardia, and 10/10 sharp burning bilateral lower extremity pain attributed to postoperative pain
- A variety of inciting events leads to muscle cell death with the common final pathway being increased intracellular calcium. This leads to ROS, mitochondrial dysfunction and sustained muscle contraction further depleting ATP leading to muscle cell death and the release of intracellular components like CK and myoglobin. Ultimately, electrolyte abnormalities, metabolic acidosis and AKI from ATN from volume depletion and myoglobin toxicity ensues.

Presentation

Clinical manifestations of rhabdomyolysis:

- Wide variety, but classic presentation includes myalgias (proximal muscles), dark urine due to myoglobinuria and weakness
- AKI: 15-20%
- Compartment syndrome

Laboratory findings:

- CK 5x ULN (>1,000-100,000)
- Peak CK 10,000-25,000 within 24-72 hours
- Half life of CK 1.5 days and decreases by 40-50%
- If CK doesn't decline as expected, persistent muscle injury may be present

Objective

Here we report two cases of prolonged operative times, unique operative positioning, obesity and COVID-19 infection in one case, leading to postoperative rhabdomyolysis and AKI

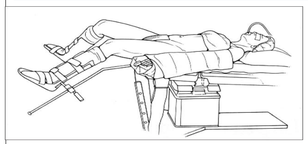
Demographics

Demographics	CASE 1	CASE 2
Gender:	Male	Male
Age:	54	31
BMI:	39	35
COVID-19:	Positive	Negative
Time to Diagnosis:	POD2	POD1
Positioning:	Lithotomy position with arms tucked	Hana table with bony prominences well padded and secured. Both legs were placed in distraction boots and secured
Operative Times:	>8 hours	9 hours
Procedure:	Elective Laparoscopic Sigmoidectomy and take down of colovesical fistula	Right femoral intramedullary nail and open reduction with internal fixation for GSW to right thigh
Estimated Blood Loss:	200	500

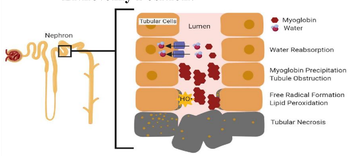
Results

Outcomes	CASE 1	CASE 2
CK Level initial	11,148	20,656
CK Level Peak	11,148	84,900
Myoglobin	Positive blood in urine, but myoglobin not tested	58
Cr Presentation	0.93	1.1
Cr Initial Up Trend	2.38	1.6
Cr Peak	7.34	2.2
Cr at Discharge	1.08	0.4
Potassium Peak	4.2	5.9
Presentation	POD1: Severe bilateral upper extremity pain and decreased mobility. POD2: Febrile, elevated Cr and oliguria	POD0: bilateral lower extremity motor and sensory deficit, low UOP, HTN, tachycardia, and 10/10 sharp burning bilateral lower extremity pain
Rhabdomyolysis Location	Upper Extremities	Buttock
Management	Aggressive intravenous hydration and Bamlinivimab	Aggressive fluid resuscitation, bilateral lower extremity fasciotomies, CRRT
Prolonged Neuro Deficit	Negative	Positive – Persistent foot drop

Figures



Lithotomy Position:



Pathophysiology of Rhabdomyolysis

Hana Table





References

1. Biswas S, Gnanasekaran I, Ivatury RR, et al. Exaggerated lithotomy position-related rhabdomyolysis. Am Surg 1997; 63:361. +
2. Taneja SS, Taneja SS, Shah O. *Complications of Urologic Surgery: Prevention and Management*. 5th ed. Elsevier; 2017. +
3. Fleisch MC, Bremerich D, Schulte-Mattler W, et al. The Prevention of Positioning Injuries during Gynecologic Operations. Guideline of DGGG (S1-Level, AWMF Registry No. 015/077, February 2015). *Geburtshilfe Frauenheilkd*. 2015;75(8):792-807. doi:10.1055/s-0035-1557776. +
4. Cote DR, Fuentes E, Elsayes AH, Ross JJ, Quraishi SA. *A "crush" course on rhabdomyolysis: risk stratification and clinical management update for the perioperative clinician*. J Anesth. 2020 Aug;34(4):585-598. doi: 10.1007/s00540-020-02792-w +
5. Clinical manifestations and diagnosis of rhabdomyolysis Author:Marc L Miller, MD Section Editors:Ira N Targoff, MD, Jeremy M Shefner, MD, PhD Deputy Editor:John F Dashe, MD, PhD +
6. Tram, Nathalie MD *et al*. Rhabdomyolysis and Acute Kidney Injury as Leading COVID-19 Presentation in an Adolescent. *The Pediatric Infectious Disease Journal*. October 2020; 39(10):e314-e315. doi: 10.1097/INF.0000000000002853 +
7. Rivas-García S, Bernal J, Bachiller-Corral J. Rhabdomyolysis as the main manifestation of coronavirus disease 2019. Rheumatology (Oxford) 2020; 59:2174. +
8. Husain R, Corcuera-Solano I, Dayan E, et al. Rhabdomyolysis as a manifestation of a severe case of COVID-19: A case report. Radiol Case Rep 2020; 15:1633. +
9. Jin M, Tong Q. Rhabdomyolysis as Potential Late Complication Associated with COVID-19. Emerg Infect Dis 2020; 26:1618. +
10. Suwanwongse K, Shabarek N. Rhabdomyolysis as a Presentation of 2019 Novel Coronavirus Disease. Cureus 2020; 12:e7561. +
11. Buckholz AP, Kaplan A, Rosenblatt RE, Wan D. Clinical Characteristics, Diagnosis, and Outcomes of 6 Patients With COVID-19 Infection and Rhabdomyolysis. Mayo Clin Proc 2020; 95:2557. +
12. Taxbro K, Kahlow H, Wulcan H, Fornarve A. Rhabdomyolysis and acute kidney injury in severe COVID-19 infection. BMJ Case Rep. 2020 Sep 2;13(9):e237616. doi: 10.1136/bcr-2020-237616. PMID: 32878841; PMCID: PMC7470512. +
13. Lauer SA, Grantz KH, Bi Q, Jones FK, Zheng Q, Meredith HR, Azman AS, Reich NG, Lessler J. The Incubation Period of Coronavirus Disease 2019 (COVID-19) From Publicly Reported Confirmed Cases: Estimation and Application. Ann Intern Med. 2020 May 5;172(9):577-582. doi: 10.7326/M20-0504. Epub 2020 Mar 10. PMID: 32150748; PMCID: PMC7081172. +

Discussion

- **Potential complications** that should be taken into consideration prior to placing patients in Lithotomy position include nerve palsies (sciatic, femoral, peroneal and brachial plexus), compartment syndrome, venous thrombosis and rhabdomyolysis (1, 2, 3).
- **Risk factors** that increase the risk of developing these complications including age over 70, prolonged operative times >120mins, improper positioning, overflexion of hips and knees when used in conjunction with steep Trendelenburg, and obesity (2,3).
- **Prevention** of these complications include padding of peripheral nerves (common peroneal, ulnar), avoid tension at hip and knees, avoid chest brace (brachial plexus injury), minimize operative times and/or time spent in steep Trendelenburg, and place lower extremities below the right atrium whenever possible (2,3).
- **Indications for diagnostic testing:** Patients presenting with postoperative myalgias in a clinical setting associated with increased risk of developing rhabdomyolysis should undergo diagnostic testing. These include, if the operation is greater than 6 hours or 4 hours in bariatric patients, non-supine positioning resulting in prolonged muscle compression, or aortic cross clamping (4, 5).
- **Diagnostic testing:** Key diagnostic studies in the diagnosis of Rhabdomyolysis include serum CK levels and urinalysis. The urine must also be sent for microscopic examination in order to discern heme+ from RBC or myoglobin (5). Workup should also include CBC, CMP, albumin, uric acid and ECG in order to assist with prompt recognition of potentially life-threatening manifestations, differential diagnosis and etiology. The diagnosis is made when a patient has myalgias or dark urine without other symptoms and a markedly elevated CK level.
- **Management:**
  - It's important to recognize rhabdomyolysis promptly and initiate fluid resuscitation as well as management of electrolyte abnormalities rapidly, even in the setting of normal kidney function, in order to prevent severe metabolic disturbances and acute kidney injury. Another key component is identifying the etiology and initiating countermeasures against the inciting event. It's imperative to recognize, evaluate and treat compartment syndrome to prevent further morbidity and mortality (5).
  - Fluid resuscitation is usually with isotonic crystalloid to replace intravascular volume, as well as dilute and augment clearance of myoglobin. Resuscitation is titrated to a goal urine output of 200-300cc/hr or 3-4cc/kg/hr. The routine use of mannitol or bicarbonate is not recommended in that it doesn't decrease mortality or the need for renal replacement therapy (4).
  - Renal replacement therapy may also need to be initiated for sequelae such as acidosis, volume overload and refractory hyperkalemia (4).
  - Treatment for patients with COVID-19 and rhabdomyolysis is the same as those not infected with aggressive crystalloid hydration +/- renal replacement therapy and diuretics (6, 7-13) .

Case 1: Due to his unusual presentation of rhabdomyolysis in his upper extremities, was COVID-19 the culprit of his postoperative course or the positioning? It is possible that his rhabdomyolysis and fever could be his presenting symptoms of COVID-19, based on the timing and presentation postoperatively, although his infection, prolonged surgery, obesity and operative positioning all may have contributed.

Case 2: During his postoperative check, the patient was noted to have severe pain and neurological deficits, but was attributed to postoperative pain. Due to the delayed diagnosis, could earlier intervention prevented his prolonged neurologic deficit and need for CRRT?

Conclusions

- **Although rhabdomyolysis is a rare postoperative complication, with heightened awareness, particularly in morbidly obese patients undergoing prolonged procedures in unique operative positioning, appropriate intervention can be initiated promptly.**
- **Prompt intervention could lead to improved patient outcomes and potentially prevent the development of AKI, compartment syndrome and need for RRT**