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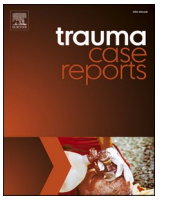

Case Report

Suspected gluteal compartment syndrome: Etiology predicts clinical course, outcomes and resource utilization

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ABSTRACT

Background: Gluteal Compartment Syndrome (GCS) is a rare subtype of acute compartment syndrome (ACS), complex to diagnose and potentially fatal if left untreated. The incidence of ACS is estimated to be 7.3 per 100,000 in males and 0.7 per 100,000 in females [1–3]. Given its rare occurrence, the incidence of GCS is not well reported. In the case of GCS, the most common etiologies are surgical positioning, prolonged immobilization secondary to substance use or loss of consciousness, and traumatic injury. Clinical findings are pulselessness, pallor, parasthesia, paralysis, and most notably pain out of proportion. Swift diagnosis and treatment are imperative to reduce morbidity and mortality, however the ideal management of GCS is difficult to ascertain given the rare occurrence and variable presentation.

Methods: Orthopaedic trauma database at a level 1 trauma center was reviewed to identify patients for whom the orthopaedic service was consulted due to suspicion of gluteal compartment syndrome. This yielded 11 patients between 2011 and 2019. Patients with a measured ΔP greater than 30 upon initial consultation and with a concerning exam requiring monitoring were included. Patient demographics, comorbidities, GCS etiology, laboratory values, physical exam findings, pain scores (0−10) and patient outcomes were collected via chart review. Patient demographic and injury characteristics were summarized using descriptive statistics.

Results: Prolonged immobilization patients had worse outcomes including longer hospital stays (40.5 days) compared to trauma patients (4.5 days). All adverse medical outcomes recorded including acute renal failure, prolonged neuropathic pain, cardiopulmonary dysfunction were exclusively experienced by prolonged immobilization patients.

Conclusions: Our descriptive study demonstrates the bimodal distribution of GCS patients based on etiology. Prolonged immobilization patients have a longer hospital course and more complications. Our study confirms prior reports and provides information that can be used to counsel patients and families appropriately about treatment and recovery following GCS.

Level of evidence: IV.

Study type: Epidemiological.

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Introduction

Gluteal Compartment Syndrome (GCS) is a rare subtype of acute compartment syndrome (ACS), complex to diagnose and potentially fatal if left untreated. Acute compartment syndrome is defined as an elevation in fascial compartment pressures that may lead to irreversible tissue ischemia, tissue necrosis, and neurologic and functional deficits. The incidence of ACS is estimated to be 7.3 per 100,000 in males and 0.7 per 100,000 in females [1–3]. Given its rare occurrence, the incidence of GCS is not well reported.

In the case of GCS, the most common etiologies are surgical positioning, prolonged immobilization secondary to substance use or loss of consciousness, and traumatic injury. Men under the age of 35 are at increased risk for GCS, likely due to the overwhelming preponderance of this demographic in the orthopaedic trauma population [3,4].

Clinical examination remains the cornerstone of GCS diagnosis. Clinical findings are pulselessness, pallor, parasthesia, paralysis, and most notably pain out of proportion. Pallor, pulselessness and poikilothermia are often late findings [2]. Evaluation for GCS may be supplemented by utilizing compartment pressures when clinical examination is not possible, such as in the obtunded or intubated patient.

The window of timing for irreversible ischemic changes is approximately 6–8 h after the onset of symptoms, with peripheral nerves being more susceptible to ischemia than muscle. Because neurons are highly sensitive to hypoxia, nervous tissue compromise may occur in 30 mins [5]. Swift diagnosis and treatment are imperative to reduce morbidity and mortality, however the ideal management of GCS is difficult to ascertain given the rare occurrence and variable presentation. Fasciotomy remains the most widely used treatment in suspected acute cases. However, fasciotomy also carries increased morbidity and risk for adverse outcomes [6].

We describe the presentation, diagnosis, and management of a cohort of patients who presented to our level one trauma center with suspected GCS.

Case presentation

Patient information

After Institutional Review Board (IRB) approval, our orthopaedic trauma database was reviewed to identify patients for whom the orthopaedic service was consulted due to suspicion of gluteal compartment syndrome. This yielded 11 patients between 2011 and 2019. Four patients were excluded due to known infection causing the presenting symptoms, connective tissue disorder, or an initial exam by the orthopaedic team not concerning for GCS. Patients with an initially measured ΔP greater than 30 upon consultation but with a concerning exam requiring monitoring after the initial evaluation were included. Patient demographics, comorbidities, GCS etiology, laboratory values, physical exam findings, pain scores (0–10) and patient outcomes were collected via chart review.

Patient demographic and injury characteristics were summarized using descriptive statistics (frequencies and percentages; medians and IQR). SAS software version 9.4 (SAS Institute Inc., Cary, NC (North Carolina), USA) was used for all analyses.

Intervention

Seven patients were included in our final analysis. All patients were males and ranged in age from 15 to 70 years. Prolonged immobilization ($n = 4$, 57 %) and trauma ($n = 3$, 43 %) were the etiologies for suspected GCS in our patient cohort. Substance use was the cause for all prolonged immobilization. Among our trauma patients, one patient presented with polytrauma after a rollover motor vehicle collision with injuries including bilateral sacroiliac joint dislocation, a distal femur fracture, and an olecranon fracture. A large hematoma within the soft tissues and left gluteal region with significant contrast extravasation was noted on CT. This patient underwent operative fixation of orthopaedic injuries and interventional radiology embolization without further vascular or neurologic sequalae. His left lateral sacral and inferior gluteal arteries were the source of extravasation.

The second trauma patient presented with a minor orthopaedic hand injury that was treated non-operatively. He had significant left gluteal swelling and ecchymosis. Vascular injury in this patient was thought to be a result of small subcutaneous vessel shearing. He was admitted for 24-h observation without operative intervention and remained hemodynamically stable throughout admission. Follow up revealed no persistent deficit. Our final trauma patient sustained a left inferior rami fracture without vascular injury and did not require operative intervention. He was observed for 48 h and followed-up outpatient.

There was significant variation in physical exam findings upon presentation in the cohort. Only one patient demonstrated pain with passive stretch of the hip. One patient had complete loss of ankle plantarflexion and dorsiflexion and the remaining six patients demonstrated decreased but intact foot dorsiflexion and plantarflexion on initial physical exam. Six patients had decreased hip flexion and knee extension strength on initial physical exam. Pain scores were recorded for four patients, with a range from 8 to 10 in the gluteal region. Compartment pressures were obtained on three patients. ($\Delta p = 9$ mmHg, 52 mmHg and 43 mmHg). Two patients with ΔP greater than 30 were included due to their concerning physical exam requiring continued monitoring and supportive care.

Clinical outcomes

Of the four patients presenting after prolonged immobilization, one underwent fasciotomy at an outside facility prior to transfer to our institution and the remaining three were observed. Of note, one of these patients with a ΔP of 9 was observed due to a delayed presentation of at least 12 h. Patients presenting secondary to prolonged immobilization did not have orthopaedic injuries. Except the patient undergoing fasciotomy, none of the prolonged immobilization patients required operative intervention. All patients presenting

as trauma had their GCS managed with observation, close monitoring, and supportive care. Average length of stay was 25 days for our cohort. Average length of stay for the prolonged immobilization group was 40.5 days while the average length of stay for the trauma group was 4.6 days.

Adverse outcomes in our patient cohort included acute respiratory distress (ARDS), prolonged neurologic deficit, acute heart failure and renal injury. We believe that this pattern of medical morbidities is the result of prolonged immobilization and subsequent ischemic neuromuscular damage. Renal injury secondary to rhabdomyolysis was the most common adverse outcome. There was a higher rate of complication in the prolonged immobilization group (Table 1). Both patient cohorts presented with an elevated CPK. The prolonged immobilization group presented with a higher creatinine which did not reach normal values upon discharge (Figs. 1, 2).

Discussion

We describe the spectrum of presentation of patients with suspected gluteal compartment syndrome at our institution. The occurrence of GCS at our hospital system was rare, with our final analysis including 7 patients spanning a nine-year period. Similarly, a recent combined meta-analysis reported 13 patients over an 11-year period [4]. Two of our seven patients had ΔP values that were inconsistent with the traditional definition of GCS, however they were included due to their concerning clinical exam findings requiring continued monitoring. Though only one patient presented with pain with passive stretch of the hip, all patients presented with distal motor weakness.

The etiology of GCS was bimodal in our cohort, with prolonged immobilization and blunt trauma as the two etiologies. Patients who presented due to prolonged immobilization had a more complicated clinical course and overall poorer outcomes. This was highlighted by complication rates and elevated creatinine levels. CPK was elevated in both groups, however values were higher in the trauma cohort. Although not intuitive, we suspect that this was due to acuity and the earlier hospital presentation of trauma patients.

Prolonged immobilization patients averaged longer hospital stays than the trauma patients (40.5 days vs 4.6 days). Two prolonged immobilization patients required ICU admission, ranging from 4 to 9 days. Hospitals should be prepared to utilize these resources for patients that present with GCS due to prolonged immobilization.

Current literature reports complications of GCS to include prolonged neurologic deficit, motor weakness, renal failure, and death [2,7,8]. While the overall survival rate is reported to be 95 % in GCS patients, the risk of permanent neurologic deficit in patients with a deficit on presentation is as high as 85 % in those only managed medically. In patients who undergo fasciotomy, the risk of permanent neurologic deficit decreased to 48 % [4]. The single patient undergoing fasciotomies in our study had a permanent neurologic deficit. Our overall rate of persistent neurologic deficit was 43 %. In addition to neurologic complications, renal failure and heart failure are potential adverse outcomes in GCS patients. Four of the seven patients in our cohort (57 %) sustained renal dysfunction and the rate of cardiac complications in our group was 29 %. Of note, all cardiac and renal complications manifested in the prolonged immobilization group. With respect to survival rate, all our patients were discharged to a skilled nursing facility or home after the index admission. One patient in the prolonged immobilization group died during a subsequent encounter due to substance abuse within 5-months of his GCS related admission. Early co-management with medicine, cardiology, and nephrology services may improve long-term outcomes. For patients with prolonged neurologic deficits, involvement of physical and occupational therapists may also aid in improved function. Counseling should be provided to those affected by substance use.

One patient in our cohort underwent an emergent bedside fasciotomy by an orthopaedic surgeon at an outside hospital. The patient was found obtunded by family and transported to the closest medical facility. His hospital course was complicated by deep vein thrombosis (DVT), septic shock requiring ICU admission, pressors and intubation. He also sustained renal injury requiring dialysis and an anoxic brain injury, remaining severely dependent upon discharge from our facility after 119 days. Another patient with a ΔP of 9 indicating compartment syndrome presented in a delayed fashion of greater than 12 h. He was managed conservatively from an orthopaedic standpoint and ultimately proceeded to multiorgan failure. He required hemodialysis and had permanent neurologic deficits including persistent right lower extremity apraxia and burning plantar dysesthesias. Irreversible tissue damage occurs within 6 to 8 h, which influences the decision to proceed with fasciotomies. Nervous tissue compromise may occur within 30 min [5]. Delayed presentation highlights an additional intricacy in the management of patients who present after prolonged immobilization due to substance use.

Suspected GCS due to trauma in our cohort experienced better outcomes and a shorter clinical course. Of our three trauma patients,

Table 1
Adverse outcomes stratified by injury etiology.

Adverse Outcomes	Prolonged Immobilization ($n = 4$)	Trauma (n = 3)	Combined Prolonged Immobilization and Trauma ($n = 7$)
Persistent Neuropathic Pain (Y/N)	2/4 (50 %)	0/3 (0 %)	2/7 (29 %)
Persistent Neurologic Deficit (Y/N)	3/4 (75 %)	0/3 (0 %)	3/7 (43 %)
Renal Dysfunction (Y/N)	4/4 (100 %)	0/3 (0 %)	4/7 (57 %)
Readmission (Y/N)	2/4 (50 %)	0/3 (0 %)	2/7 (29 %)
DVT (Y/N)	2/4 (50 %)	0/3 (0 %)	2/7 (29 %)
Pulmonary Embolism (Y/N)	1/4 (25 %)	0/3 (0 %)	1/7 (14 %)
Cardiac Dysfunction	2/4 (50 %)	0/3 (0 %)	2/7 (29 %)
Acute Pulmonary Dysfunction (ARDS, Required intubation or noninvasive respiratory support)	2/4 (50 %)	0/3 (0 %)	2/7 (29 %)

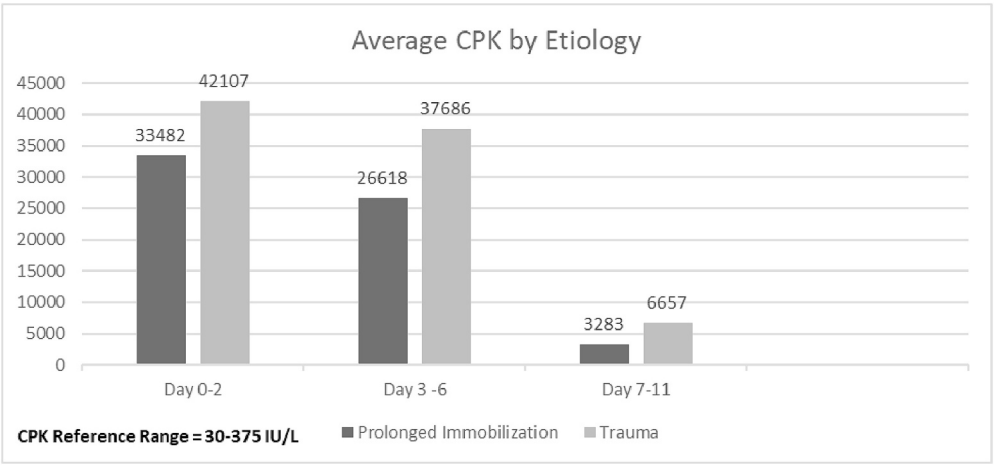

Fig. 1. Average CPK by etiology.

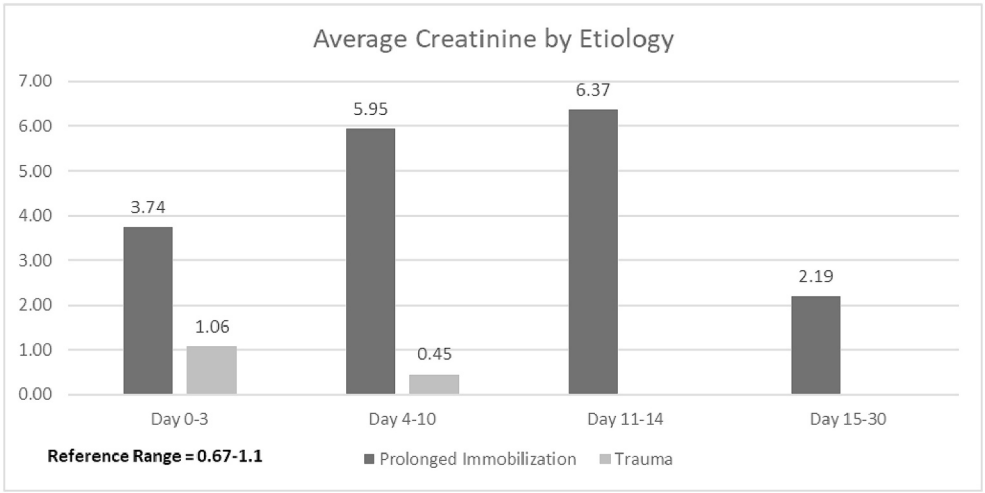

Fig. 2. Average creatinine by etiology.

two sustained vascular injuries with resultant hematoma. Adib et al. found that superior and inferior gluteal artery injury comprised 7 % of trauma related GCS in their meta-analysis of 139 patients. They suggest that hemodynamically unstable patients with active bleeding may need to undergo angiography prior to fasciotomy if warranted. None of our trauma patients experienced prolonged neurologic deficits. Based on our findings, we suggest that trauma patients should be reassured about their expected recovery with observation, even with a concerning initial physical exam.

The retrospective nature of this work presents limitations, including variation in clinical documentation and incomplete data.

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CRediT authorship contribution statement

Alicia M. Williams: Data curation, Methodology, Writing – original draft. **Suman Medda:** Data curation, Methodology, Writing – original draft. **Meghan K. Wally:** Conceptualization, Investigation, Methodology, Supervision, Writing – review & editing. **Rachel B. Seymour:** Conceptualization, Investigation, Methodology, Supervision, Writing – review & editing. **Alexander Hysong:** Data curation, Writing – review & editing. **Amber Stanley:** Data curation, Writing – review & editing. **Givenchy Manzano:** Data curation, Writing – review & editing. **Joseph R. Hsu:** Conceptualization, Investigation, Methodology, Supervision, Writing – review & editing.

Declaration of competing interest

Dr. Hsu reports consultancy for Globus Medical and personal fees from Smith & Nephew speakers' bureau. For the remaining authors, no conflicts were declared.

Data availability

Data from this study are available upon reasonable request to the corresponding author.

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References

[1] F. Adib, A.D. Posner, N.N. O'Hara, R.V. O'Toole, Gluteal compartment syndrome: a systematic review and meta-analysis, Injury 53 (3) (2022) 1209–1217, https://doi.org/10.1016/j.injury.2021.09.019.
[2] Davis BJ, Mak R, Schneider A, Brown NM. Acute gluteal compartment syndrome with nonclassical symptoms: a case report on an easily missed diagnosis. JBJS Case Connect. 2021;11(2):https://doi.org/10.2106/JBJS.CC.20.00887. Published 2021 Jun 11. doi:https://doi.org/10.2106/JBJS.CC.20.00887.
[3] F. Diaz Dilernia, E.E. Zaidenberg, S. Gamsie, et al., Case Rep. Orthop. 2016 (2016) 2780295, https://doi.org/10.1155/2016/2780295.
[4] M.R. Garner, S.A. Taylor, E. Gausden, J.P. Lyden, Compartment syndrome: diagnosis, management, and unique concerns in the twenty-first century, HSS J. 10 (2) (2014) 143–152, https://doi.org/10.1007/s11420-014-9386-8.
[5] J. Heemskerk, P. Kitslaar, Acute compartment syndrome of the lower leg: retrospective study on prevalence, technique, and outcome of fasciotomies, World J. Surg. 27 (6) (2003) 744–747, https://doi.org/10.1007/s00268-003-6691-7.
[6] G.D. Kuhlman, K.G. Gwathmey, Gluteal compartment syndrome with neurologic impairment: report of 2 cases and review of the literature, Muscle Nerve 57 (2) (2018) 325–330, https://doi.org/10.1002/mus.25630.
[7] V. Kumar, K. Saeed, A. Panagopoulos, P.J. Parker, Gluteal compartment syndrome following joint arthroplasty under epidural anaesthesia: a report of 4 cases, J. Orthop. Surg. (Hong Kong) 15 (1) (2007) 113–117, https://doi.org/10.1177/230949900701500 12.
[8] K.D. Osteen, S.H. Haque, Bilateral gluteal compartment syndrome following right total knee revision: a case report, Ochsner J. 12 (2) (2012) 141–144.