



Clinical Case Studies

Acute exertional compartment syndrome of the lumbar paraspinal muscles in a weightlifter. A case report[☆]

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ABSTRACT

Background: Compartment syndrome (CS) is a well-known phenomenon in orthopaedics associated with traumatic injury to an extremity or over exertion which ultimately leads to prolonged and elevated intrafascial pressures. CS was initially described by Volkmann in 1881 [1]. With any active muscle, there is a transient rise in intrafascial pressure from resting range of approximately 3 mmHg to 7.95 mmHg [2]. When this increase in pressure is too great or not transient, then a subsequent compartment syndrome develops. The consequences of such physiologic imbalance can induce muscle necrosis, nerve damage, vascular compromise, functional deficits, and potentially loss of limb [3,4]. Typical initial presentation of CS includes pain out of proportion to the severity of injury, which is intensified with passive motion of the muscle within the affected fascial compartment. [4] Non musculoskeletal manifestations of CS generally present themselves as the syndrome progresses and can include rhabdomyolysis, myoglobinuria, acute kidney injury, or acute tubular necrosis [4]. These non musculoskeletal manifestations of CS are potential etiologies causing patients to present for treatment [4].

Purpose: There have been approximately 20 previous case reports on paraspinal compartment syndrome with a combination of surgical and medical treatments in these patients. We will present a case of paraspinal CS in an avid weightlifter and discuss diagnostic and treatment options surrounding this syndrome.

Study Design: Case Report

Patient Sample: This is a report of a single patient who presented to Duke University Medical Center.

Methods: We report the case of a 29 year old male with paraspinal compartment syndrome who was treated with fasciotomies. This was considered an IRB exempt study by our IRB as such informed consent was not obtained by the patient prior to publication.

Results: This patients had resolution of symptoms after surgical intervention which continued through follow up.

Conclusion: Paraspinal compartment syndrome can be effectively treated with surgical fasciotomy.

Case Report

A 29-year-old male who is an avid weightlifter, presented to the Duke University Medical Center (DUMC) Emergency Department as a transfer from an outside hospital. The patient completed a strenuous deadlift workout the day prior to presentation at the outside hospital. He subsequently went to sleep with soreness in his back and when he awoke, he noticed increasing levels of pain in his back and a dark brown color to his urine. The patient had a previous history of rhabdomyolysis from physical activity and he believed that his symptoms were consistent with his previous experience. Therefore, he presented to an outside hospital

where the diagnosis of rhabdomyolysis was confirmed via elevated ck at outside hospital. Treatment in the form of aggressive hydration and pain control was initiated. The patient's physical exam was notable for tense paraspinal muscles and back pain which was worse with movement. Despite initiation of the aforementioned treatment, the patient's pain and exam did not improve. The outside hospital provider was concerned this patient's diagnosis of rhabdomyolysis was a sequelae of CS of the paraspinal muscles and resultant muscle necrosis. As a result, the patient was then transferred to DUMC for further evaluation and definitive care.

Upon arrival to DUMC, the patient complained of moderate to severe back pain exacerbated with flexion or extension of the low back.

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Subjectively, the patient also felt his paraspinal musculature was tense with associated numbness over his paraspinal muscles. He denied any changes in bowel or bladder function or weakness in his bilateral lower extremities. Objectively his exam was neurovascularly intact with full strength and normal sensation in bilateral lower extremities. Lab studies were significant for WBC 16.0, CK > 200,000, Cr 1.0.

Imaging in the form of plain radiographs and an MRI were obtained for further evaluation of this patient. Plain films showed no acute fractures or dislocations within the lumbar spine. MRI demonstrated edema within the paraspinal muscles bilaterally from T8 to the sacrum with greater involvement on the left compared to the right, but no signs of ligamentous damage or instability.

Given the concern for CS, paraspinal muscle compartment pressures were subsequently measured with the Stryker Intra-compartmental (STIC) pressure monitoring system and revealed the intercompartmental pressure of left and right paraspinal compartments to be 98 and 95 mmHG respectively with a diastolic blood pressure of 67. Using these values we are able to determine the Delta p which is represented by the equation; Diastolic Blood pressure minus Compartment pressure equals delta p ($DBP-CP=\Delta P$). For any value of delta p less than 30 a diagnosis of compartment syndrome can be made[3]. Our patient had delta p values of -31 and -28 respectively, both less than 30 therefore signifying an active compartment syndrome in our patient.

Bilateral paraspinal compartment syndrome was diagnosed in this patient based on compartment pressure measurements and clinical exam and he was subsequently taken urgently to the operating room for bilateral paraspinal fasciotomies.

In the operating room the patient was placed prone on a Jackson table. An approximately 6 cm incisions was centered over the paraspinal musculature bilaterally each being approximately 3 cm from midline. These incisions started approximately at L4 and extending cranially to approximately T12. Dissection was taken down to the fascia throughout the length of the skin incision and the fascia was incised only to the extent of the skin incision. Once incised, there was immediate bulging of the paraspinal musculature through the fascial opening. Portions of the muscle were dusky-colored initially but they returned to normal appearing red color once the pressure was released and the operative case progressed. At the conclusion of the procedure the fascia was not repaired. The skin was too taught to close primarily, therefore a wound vac was placed rather than attempting primary closure at the time of the index procedure. On hospital day (HD) 2, the patient returned to the OR and underwent closure of the left paraspinal incision (the fascia was not repaired) and reapplication of wound vac of right paraspinal incision which remained too swollen to close primarily. The patient returned to the OR twice more (HD4, 8) and the right incision was subsequently closed on HD 8 with the assistance of plastic surgery. The patient remained neurovascularly intact throughout his hospitalization and his pain continued to improve during his stay. His labs were stable just prior to discharge WBC 9.4, H/H 14.6/43.8, CK 2,725 down from >200,000 at admission. On HD 9 he was subsequently discharged from the hospital. The patient followed up in clinic for a wound check and suture removal 17 days after hospital discharge, he was well with only minimal tightness in his lower back. His wound was healing well and there were no signs on infection or breakdown. He was then advised that further follow up or physical therapy would be on an as needed basis.

Discussion

Acute paraspinal compartment syndrome is characterized by an increase in pressure in the erector spinae muscles (multifidus, longissimus, and iliocostalis) within the thoracolumbar fascia. This compartment is bordered by anterior layer of thoracolumbar fascia ventrally attaching to the transverse processes, the dorsal aspect of the thoracolumbar fascia merges medially on the spinous process. Caudally the fascia attaches to the iliac crest and sacrum. The anatomy of the compartment makes this

Table 1
Paraspinal Compartment Syndrome Classification[5].

Classification	Description
Type I	Acute Lumbar Compartment syndrome
Subtype A	Atraumatic
Subtype B	Direct trauma to paraspinal muscles
Subtype C	Secondary to non-spinal surgery
Type II	Chronic Exertional Lumbar Paraspinal syndrome

area susceptible to compartment syndrome [5]. As previously stated, the resting pressure within the paraspinal space ranges from levels of 3 to 7.95 mmHg. This pressure can transiently rise to 25 mmHg when exercising. While this rise is generally transient, it is interesting to note paraspinal CS has been reported with pressure levels between 14.7–150 mmHg [2,5].

The pathophysiology of acute paraspinal CS can be broadly categorized as acute and chronic. The acute form can further be stratified into subtypes A,B, and C based on etiology (Table 1) [5]. The most common of these is Type I, Subtype A, which is “Atraumatic acute compartment syndrome”, secondary to activities such as weightlifting. This was the etiology of our patient presented above. As Cross-Fit (and weightlifting in general) has grown in popularity in the recent years, the majority of spinal compartment syndrome cases reported have been from this population [5]. In a literature review of 21 articles and 23 cases of paraspinal compartment syndrome, 52% of the cases involved weightlifting, 13% involved skiing, and 17% involved a non-spinal injury[2]. Out of these, 22/23 of the patients were male. These patients had an exertion-related compartment syndrome, by which the increase in intramuscular pressure from intense exercise caused compression, leading to venous stasis and subsequent tissue injury. Our patient, therefore, is consistent with the reported demographics[2].

Clinically, patients typically present with consistent severe back pain exacerbated by passive or active movement of the trunk. This is typically accompanied by swelling and tenseness of the affected muscles, erythema, tenderness, and possibly a sensory deficit of the overlying skin [2]. This sensory deficit is due to loss of function of the dorsal primary rami that cross through this segment [6]. Vital signs are generally unremarkable although a patient may have a mild fever or tachycardia due to acute phase reactants.

Laboratory investigations can give insight into paraspinal CS by highlighting common sequelae. These include an elevated CK, elevated creatinine, or myoglobinuria which are indications of muscle breakdown and acute kidney injury. Literature typically shows an elevation of CK above 5,000 in patients with paraspinal CS. Our patient with a presenting CK of >200,000 is consistent with these known findings. However, our patient did not have accompanied acute kidney injury (AKI) as his creatinine was 1.0 on admission. When patients do present with an AKI they should be prophylactically treated with IV fluids and urine alkalization [2].

Diagnosis of compartment syndrome does not always require imaging and treatment should not be delayed in cases where a clinical diagnosis can be made or there exist elevated compartment pressures. In cases where there is uncertainty, both T2-weighted MRI and CT scans have been shown to have utility in ruling out other acute causes of severe back pain [2]. Furthermore, there are characteristic findings of CS on advanced imaging. On CT enlargement of the paraspinal muscles is noted, representing the increased levels of fluid present in the compartment [7]. This swelling is also noted on MRI, with an additional finding of increased signal intensity on T2 weighted images [7]. Gadolinium contrast can also be used to highlight the damage in the paraspinal musculature but should be used sparingly in patients with kidney injury [6]. Our patient received a plain film which ruled out acute fractures and dislocations and an MRI which demonstrated paraspinal musculature edema bilaterally.

Generally, the treatment of acute paraspinal compartment syndrome is surgical fasciotomy, which rapidly relieves the pressure to prevent ischemic injury. In the literature the majority of cases reported have been treated with open fasciotomy. Patients treated with surgery reported good functionality and little to no residual sequelae [2,5]. In cases of acute paraspinal CS treated conservatively, patients typically went on to recover and return to activity within 4–6 months, but had chronic back pain with exertional activities [5,7].

Unlike CS of the lower extremity, optimal timing of paraspinal fasciotomy has not been explored in the literature. Lower extremity CS fasciotomies should ideally be performed within 6 h of diagnosis of CS, but ultimately no more than 12 h [7,8]. Our patient underwent bilateral paraspinal fasciotomy upon transfer to our facility. The patient was transferred to our facility and taken to the OR within 6 h of initial concern for compartment syndrome at the outside hospital. With this case, the muscles were initially dusky but quickly regained color and contractility with the fasciotomy. The patients' CK values gradually decreased from >200,000 on admission to approximately 2,700 on discharge.

Our patient reported progressive improvements in symptomatology and laboratory values appropriate and in line with other patients that have been presented in the literature. Unfortunately we were unable to reach this patient to evaluate his long term recovery and return to sport.

Conclusion

Acute lumbar paraspinal compartment syndrome is a relatively rare diagnosis but one of which orthopaedic surgeons and other emergency providers should be aware. A high index of suspicion and appropriate timely action are necessary when patients present with the clinical symptoms, lab values, and history concerning for acute CS. Once the diagnosis is made expeditious treatment should be undertaken for optimal patient outcomes.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Patient Informed Consent Statement

The authors declare that informed patient consent was taken from all the patients.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.xnsj.2020.100033.

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