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Case Reports and Series

Acute Compartment Syndrome of the Foot due to Infection after Local Hydrocortisone Injection: A Case Report

Sampat Dumbre Patil, D(Ortho), DNB(Ortho), MNAMS [1],
Vaishali Dumbre Patil, MBBS, DMRE [2], Sachin Abane, MBBS, D(Ortho) [3],
Rohit Luthra, D(Ortho), DNB(Ortho) [4], Abhijit Ranaware, D(Ortho), DNB(Ortho) [4]

[1] *Director and Head, Orthopedic Department, Noble Hospital, Hadapsar, Pune, Maharashtra, India*
[2] *Research Officer, Noble Hospital, Hadapsar, Pune, Maharashtra, India*
[3] *Consultant Orthopaedic Surgeon, Orthopedic Department, Abane Hospital, Hadapsar, Pune, Maharashtra, India*
[4] *Consultant Orthopaedic Surgeon, Orthopedic Department, Noble Hospital, Hadapsar, Pune, Maharashtra, India*

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ABSTRACT

High-energy trauma associated with calcaneal fracture or Lisfranc fracture dislocation and midfoot crushing injuries are known causes of compartment syndrome in the foot. Suppurative infection in the deep osseofascial compartments can also cause compartment syndrome. We describe the case of a 29-year-old female who had developed a suppurative local infection that resulted in acute compartment syndrome after receiving a local hydrocortisone injection for plantar fasciitis. We diagnosed the compartment syndrome, and fasciotomy was promptly undertaken. After more than 2 years of follow-up, she had a satisfactory functional outcome without substantial morbidity. To our knowledge, no other report in the English-language studies has described compartment syndrome due to abscess formation after a local injection of hydrocortisone. The aim of our report was to highlight this rare, but serious, complication of a routine outpatient clinical procedure.

Compartment syndrome is the clinical entity that results from increased pressure within a myofascial compartment. Acute compartment syndrome of the foot has generally been associated with high-energy trauma involving fracture of the calcaneus, Lisfranc joint fracture-dislocation, and mid- and hindfoot crushing injuries. Infection with abscess formation deep to the deep fascia is also a generally known cause of compartment syndrome. When present, the timely diagnosis and a prompt fasciotomy will help to avoid the morbid consequences of untreated acute compartment syndrome.

To adequately treat compartment syndrome of the foot, knowledge of the anatomy of the different myofascial compartments of the plantar vault is important. Kamel and Sakla (1) divided the foot into 4 compartments: medial, lateral, central, and interosseous. They are separated by fascial layers. Manoli and Weber (2) in 1990 further investigated the compartments in a cadaver dye injection study. Their study revealed the presence of 9 compartments in the foot (Table). The medial, lateral, and superficial compartments run along the entire length of the foot. Five compartments are present within the forefoot; they are the adductor and the 4 interosseous muscles. The ninth is the calcaneal compartment, which also communicates with the deep posterior compartment of the leg. The possible presence of a tenth dorsal compartment, containing the extensor digitorum brevis, has also been suggested by some investigators (3).

Untreated compartment syndrome can result in significant morbidity owing to weakness, contracture, deformity, motor paralysis, and sensory neuropathy (1). Timely surgical decompression of the foot using fasciotomy is the most effective method to prevent functional morbidity (4). In 1988, Myerson (5) described the rationale for systematic decompression of pedal fascial compartments in a cadaver study and emphasized the effectiveness of using dorsal and medial fasciotomy incisions.

We report a case of acute compartment syndrome of the foot due to infection secondary to local hydrocortisone (LHC) injection for the treatment of plantar fasciitis. The compartment syndrome was successfully treated by fasciotomy. The purpose of reporting the present case was to demonstrate a rare, but possible, complication of LHC injection and to emphasize the importance of a prompt diagnosis and timely fasciotomy to decrease the morbidity due to compartment syndrome.

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Address correspondence to: Sampat Dumbre Patil, D(Ortho), DNB(Ortho), MNAMS, Director and Head, Orthopedic Department, Noble Hospital, Hadapsar, Pune-411013, Maharashtra, India.
E-mail address: sampatdumbre@gmail.com (S. Dumbre Patil).

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Table
Foot anatomy of different compartments of foot

	Compartment	Muscle Contents	Neurovascular Structures
A	Full length–3		
1	Medial	Flexor hallucis brevis Abductor hallucis	
2	Lateral	Abductor digiti quinti Flexor digiti minimi	
3	Superficial	Flexor digitorum brevis Lumbricals–4 Flexor digitorum longus tendons	With or without medial plantar nerve
B	Forefoot–5		
1	Interosseous–4	Interossei	
2	Adductor	Adductor	
C	Calcaneal	Quadratus plantae	Posterior tibial nerve, artery, vein Lateral plantar nerve, artery, vein With or without medial plantar nerve

Case Report

A 29-year-old female who had been experiencing pain localized to the plantar aspect of her right heel for approximately 3 months had been diagnosed with plantar fasciitis by her family physician. She had undergone an LHC injection in the proximal plantar fascia in August 2011. Radiographs of the heel were not taken by the family physician before injection. She had no history of trauma localized to her symptomatic heel. After the injection, her plantar heel pain had persisted, and she had been administered analgesic medication (aceclofenac, 100 mg twice a day for 5 days, in tablet form) and allowed to continue to walk on the painful heel to her tolerance. The patient's right foot pain progressively worsened, and 12 days after the corticosteroid injection, she presented to our practice with a complaint of severe right foot pain and swelling. Our initial examination showed her entire right foot to be tensely swollen without erythema (Fig. 1). Palpation of the foot revealed a mildly increased skin temperature compared with her contralateral foot and exquisite pain localized to the plantar vault and the dorsal interosseous spaces. However, her maximum tenderness was localized to the inferomedial aspect of the right heel, where she had received the corticosteroid injection. She was unable to actively move her toes, and any passive movements of the toes and ankle, in particular, plantar flexion, caused severe pain. She had a loss of superficial touch sensation and 2-point discrimination over the entire sole of the right foot. The posterior tibial arterial pulse was palpable, although the dorsalis pedis arterial pulse was absent. Systemically, the patient was slightly febrile (oral temperature 38°C), with tachycardia (pulse 102 beats/min). Her left brachial blood pressure was 110/70 mm Hg. On the basis of the clinical findings, in particular, the tense swelling, loss of cutaneous sensation, and severe pain to any stretching of the pedal tissues, we diagnosed acute compartment syndrome affecting her right foot. Moreover, because of the history of the right heel injection, that the pain was localized to the injection site, and her low-grade fever, we thought it likely that she had a deep (deep to deep muscle fascia) abscess in her right foot. Because of these findings, we decided to surgically inspect the tissues and decompress the pedal compartments by immediate surgery. We did not delay the decision to operate to obtain intracompartmental pressure measurements (the equipment for which was not readily available at that point). Preoperative anteroposterior and lateral radiographs of the right foot and ankle were taken, with normal findings, except for the increased soft tissue density and volume. No gas was seen on the radiographs. No evidence was seen of subcutaneous emphysema. The blood laboratory investigations showed only an increased leukocyte count (white blood cell count 12.5 × 10^3, 80% polymorphonuclear neutrophils). Emergency surgical fasciotomy was undertaken within 4 hours of admission to our hospital.

Fig. 1. (*A* and *B*) Clinical photographs of the foot when the patient was taken for fasciotomy. Note the tense swelling of the foot.

Operative Procedure

After establishing spinal anesthesia, with the patient placed supine on the operating table and without the use of a tourniquet or vasoconstrictor, a 5-cm medial incision was made on the right foot, beginning 2 cm posterior to the medial malleolus and extending to the junction of the medial and plantar surfaces of the hindfoot, distal to the proximal attachment of the plantar fascia to the calcaneus (Fig. 2). The incision was deepened in the anatomic layers, and no purulence was encountered in the subcutaneous fat and superficial fascia. However, when the deep fascia over the abductor hallucis was incised, frank drainage of thick, amber pus was noted (Fig. 2). The dissection included sectioning of the laciniate ligament over the neurovascular bundle in the tarsal tunnel to ensure decompression of the posterior tibial artery and veins and nerve trunks at that level. The abductor hallucis muscle was friable but not necrotic, and a pyogenic collection was present in the muscle belly. Blunt and sharp dissection was used to explore the limits of the abscess as it entered the plantar vault and to debride the grossly infected soft tissue (Fig. 3). The medial band of the plantar fascia was excised. A second longitudinal medial incision, 4 cm long, was then made, extending from 1 cm plantar to the tuberosity of the navicular to the midshaft level of the first metatarsal, along the dorsal margin of the abductor hallucis (Fig. 3). Layer dissection through this incision to the periosteum of the first metatarsal did not reveal any purulent drainage of frank necrosis. Thus, our aim with this incision was additional decompression of the medial compartmental pressure. Thereafter, 2 dorsal longitudinal incisions were made (Fig. 3), such that the first of these was placed over the second metatarsal and the second was placed over the fourth metatarsal. These were then deepened in the anatomic layers to the

Fig. 2. Medial fasciotomy incisions. (*A*) An oblique medial incision was used. No pus was drained from the subcutaneous tissue. (*B*) On deep dissection, the fascia over the abductor hallucis was opened to drain the frank pus.

Fig. 3. Medial and dorsal fasciotomy incisions. (*A*) Two medial incisions were used. Through the oblique medial incision, the posterior neurovascular bundle was decompressed. The longitudinal medial incision was used to decompress the other deep compartments. (*B*) Two dorsal incisions were used to decompress the interossei compartments.

periosteum of the respective metatarsals, decompressing the interosseous compartments of the foot. Again, no evidence was found of purulence or necrosis in the dorsum of the foot or the interosseous compartments. After inspection, decompression, and debridement, the tissues in all of the right foot wounds were thoroughly washed with saline and then packed open. Specimens were submitted for microbiologic culture and sensitivity analyses and for histopathologic study.

Postoperative Care

Postoperatively, the patient was admitted to the hospital for 5 days. She had a significant decrease in pain and the active and passive movement of the toes had improved remarkably, within 1 day of surgery. Broad-spectrum injectable antibiotic amoxycillin, 1 g, combined with clavulanic acid, 0.2 g, was administered intravenously twice a day for 3 days, at which time, the culture and sensitivity results yielded methicillin-sensitive *Staphylococcus aureus* organisms. Thus, in addition to the antibiotic noted earlier, injection Amikacin 500 mg was given intravenously twice a day for an additional 7 days. Histopathologic studies showed no evidence of necrosis, tuberculosis, or malignancy, although the tissues contained many polymorphonuclear neutrophils. The patient was discharged from the hospital on the fifth postoperative day and followed up in the outpatient clinic for regular dressing changes. By 6 weeks postoperatively, the dorsal wounds and the distal medial wound had healed well by secondary intention, although the oblique heel wound had required an additional debridement at 3 weeks postoperatively and had not fully healed until 8 weeks after the initial operation. We followed up the patient periodically for more than 2 years after the emergency right foot surgery, during which she progressed well with asymptomatic pedal scars (Fig. 4). The superficial touch sensation and 2-point discrimination had improved during the 2-year period and were fully intact and symmetric compared with her contralateral left foot. By our last evaluation, she was able to ambulate barefoot or with shoes, without any right foot pain. The only sequela of the infection and compartment syndrome was mild (10° plantar flexion) contracture of the right second toe (Fig. 5). However, she was able to perform all her desired activities without difficulty.

Discussion

Iatrogenic causes of compartment syndrome related to injections have been previously reported in published studies and appear to be most prevalent in the upper extremity. Compartment syndrome

Fig. 4. Clinical images at 2 years of follow-up. (*A* and *B*) Clinical photographs showing healing of the dorsal and medial incisions.

Fig. 5. Flexion contracture of the second toe. (*A* and *B*) Clinical photographs at 2 years of follow-up showing flexion contracture of the second toe.

localized to the forearm due to extravasation of contrast medium during computed tomography (6–9) and after intravenous phenytoin administration (10) has been described. In these cases, the timely diagnosis and fasciotomy saved each patient's forearm, further emphasizing the importance of the rapid appreciation of the condition and definitive treatment. Yet another report (11) described a case of acute compartment syndrome after intra-articular corticosteroid injection in the wrist in an immunocompromised patient. Compartment syndrome of the forearm has also been described in association with pressurized therapeutic infusion in a 74-year-old female under general anesthesia (12). Furthermore, Yang et al (13) described a rare case of abdominal compartment syndrome after injection sclerotherapy for the treatment of symptomatic hemorrhoids.

To our knowledge, compartment syndrome in the foot from an iatrogenic cause, such as LHC injection, has not been reported in the English-language medical literature. We have reported a rare case of foot infection with abscess formation due to LHC injection that resulted in acute compartment syndrome. We did not measure the pedal compartment pressures in the present case, because the diagnosis of acute compartment syndrome was determined by the clinical findings and history, and because we did not have the specific equipment required to measure the intracompartmental pressures readily available. Finally, our aim was to alleviate the abscess and compartment pressures as soon as possible once the clinical diagnosis had been made. The main elements of our clinical diagnosis included the history of the corticosteroid injection at the site of the suspected abscess, the presence of severe foot pain that seemed out of proportion to the clinical appearance of the foot and her medical history and that was aggravated by flexion of the ankle (stretch), the indurated swelling of the foot, and the loss of sensations in the involved foot. Moreover, the persistence of flexion contracture of the patient's second toe long after resolution of the infection and wound healing supported the diagnosis of acute compartment syndrome secondary to the abscess.

In the present case, the timely diagnosis and prompt fasciotomy helped to decrease the morbidity resulting from the compartment syndrome in the foot. Classically, 1 medial and 2 dorsal incisions have been reported to decompress the compartments of the foot. We have used the same approach; however, because of the particular need in the present patient to drain an abscess near the attachment of the plantar fascia to the calcaneus, we used 2 medial incisions. After more than 2 years of clinical follow-up of the patient, she had only mild flexion contracture of her right second toe.

In conclusion, acute compartment syndrome is a rare, but possible, complication of infection due to an LHC injection. An LHC injection is a common outpatient clinical procedure used by many practicing family physicians, rheumatologists, and orthopedic and podiatric surgeons for plantar fasciitis. Adequate aseptic precautions and proper injection technique are required to minimize the risk of this unusual complication. The management of this case has also shown that the morbidity due to pedal compartment

syndrome can be avoided or decreased by timely diagnosis and intervention.

References

1. Kamel R, Sakla FB. Anatomical compartments of the sole of the human foot. Anat Rec 140:57–60, 1961.
2. Manoli A II, Weber TG. Fasciotomy of the foot: an anatomical study with special reference to release of the calcaneal compartment. Foot Ankle Int 10:267–275, 1990.
3. Matsen FA III. Compartmental syndrome: a unified concept. Clin Orthop 113:8–14, 1975.
4. Fulkerson E, Razi A, Tejwani N. Review: acute compartment syndrome of the foot. Foot Ankle Int 24:180–187, 2003.
5. Myerson MS. Experimental decompression of the fascial compartments of the foot—the basis for fasciotomy in acute compartment syndromes. Foot Ankle Int 8:308–314, 1988.
6. Hawi N, Citak M, Liodakis E, Petri M, Haasper C, Krettek C, Meller R. Development of compartment syndrome after intravenous administration of an X-ray contrast medium: recommendations on acute therapy regimens. Unfallchirurg Epub 2013 May 9 [in German].
7. D'Asero G, Tati E, Petrocelli M, Brinci L, Palla L, Cerulli P, Cervelli V. Compartment syndrome of the hand with acute bullous eruption due to extravasation of computed tomography contrast material. Eur Rev Med Pharmacol Sci 14:643–646, 2010.
8. Ensat F, Babl M, Spies M. Acute compartment syndrome of the forearm after paravasation of contrast medium: case report. Radiologe 50:272–276, 2010.
9. Selek H, Ozer H, Aygencel G, Turanli S. Compartment syndrome in the hand due to extravasation of contrast material. Arch Orthop Trauma Surg 127:425–427, 2007.
10. Warnecke IC, Raute-Kreinsen U, Schirmer S, Kretschmer F, Fansa H. Purple glove syndrome—a case report. Handchir Mikrochir Plast Chir 42:260–262, 2010.
11. Konieczny MR, Müller EJ, Gaggl A, Bürger KH. Defect coverage with myo-fasciocutaneous free flaps: consequence of corticosteroid infiltration of the wrist in a patient on immunosuppressive therapy. Unfallchirurg 116:367–370, 2013.
12. Sung CY, Chung RK, Ra YS, Lee HS, Lee GY. Impending compartment syndrome of the forearm and hand after a pressurized infusion in a patient under general anesthesia—a case report. Korean J Anesthesiol 60:60–63, 2011.
13. Yang P, Wang YJ, Li F, Sun JB. Hemorrhoid sclerotherapy with the complication of abdominal compartment syndrome: report of a case. Chin Med J (Engl) 24:1919–1920, 2011.