CASE REPORT

Non-traumatic compartment syndrome secondary to deep vein thrombosis and anticoagulation

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SUMMARY

We describe an unusual case of non-traumatic compartment syndrome in three compartments of the left lower limb in a 57-year-old male inpatient. He had recently been started on anticoagulation therapy for multiple pulmonary emboli and deep vein thrombosis of the left posterior tibial and peroneal veins. Three of the four osteofascial compartments had pressures above 70 mm Hg, hence four compartment fasciotomies were performed. Postoperatively, intravenous heparin therapy was started resulting in a significant blood loss, but he had no neurovascular deficit. At reoperation, for primary wound closure, his tissues looked healthy. Non-traumatic causes of acute compartment syndrome, including deep venous thrombosis and anticoagulation, are considered.

BACKGROUND

Compartment syndrome requires prompt identification and treatment in order to prevent irreversible neuromuscular damage, Volkmann's ischaemic contracture, rhabdomyolysis, acute kidney injury, infection and death.¹ This condition is usually related to trauma, with mostly young men at risk.² Deep vein thrombosis (DVT) as a cause for compartment syndrome is unusual. However, there are reported cases associated with extensive venous thrombosis haematoma formation and as an early or delayed complication post inferior vena cava (IVC) filter placement.^{3–5}

Our case is, therefore, the first reported case of non-traumatic compartment syndrome due to the combination of a non-extensive DVT without specific haematoma formation and anticoagulation management.

This case highlights an unusual presentation of compartment syndrome with a 'rash' as the first presenting feature and prolonged symptomatology over 7 days, resulting in all salient features prior to operative management. Compartment syndrome should be kept as a differential diagnosis for lower limb pain, especially in an anticoagulated patient, even if there is no history of trauma or the features are atypical. This syndrome can be managed effectively with fasciotomies but delay can result in catastrophic sequelae.

CASE PRESENTATION

A 57-year-old man with a history of chronic obstructive pulmonary disease (COPD), atrial fibrillation and hypothyroidism presented to the emergency department with worsening shortness of breath, cough, increased sputum production and fever. His drug history was aspirin, quinine,

ramipril, carbocisteine, simvastatin, levothyroxine, diltiazem, budesonide and formoterol, tiotropium, and salbutamol inhalers. Pulse oximetry recorded his saturations as 86% on air which rose to 90% with an oxygen flow of 3 L/minute. A provisional diagnosis of an infective exacerbation of COPD was made; he was admitted to a medical ward and started on oral coamoxiclav, prednisolone and regular inhalers. Three days ago, he presented to the ambulatory care unit with a swollen left ankle; Doppler ultrasound had demonstrated DVTs within the posterior tibial and peroneal vein. As per hospital protocol, he was managed as an outpatient with fragmin 18 000 units and warfarin 10 mg for the first 2 days and 5 mg on the third day. On admission, 3 days after starting warfarin, his International Normalised Ratio (INR) was 1.5; however, this peaked at 5.3 on day 6 of admission and had stayed above 3 for six consecutive days.

The day after admission a CT pulmonary angiography (CTPA) was performed given his shortness of breath and recent diagnosis DVTs. This showed multiple non-occlusive bilateral pulmonary emboli affecting all lobes with features of pulmonary artery hypertension and severe emphysematous changes with small bilateral pleural effusions.

Four days after the admission, the patient noticed a 'rash' on his left ankle; there was red-purple skin discoloration over this region with ill-defined edges that was macular in nature and blanched when pressure was applied. He also had erythematous areas over his torso and back. Initially, this was felt to be a drug reaction and the decision was made to continue the current treatment and observe. Over the next 6 days (day 5–10 postadmission), he developed an increasing pain within his left foot and ankle and the skin changes became more pronounced over this area but had settled over the torso and back; benzyl-penicillin and flucloxacillin were started to treat a presumed cellulitis. On day 10, an ultrasound scan and orthopaedic review were requested. At this stage, there was erythema extending from the level of the left ankle to the mid-calf, which was tender and firm to touch figures 1 and 2. Pain was worse on dorsiflexion of the foot but not made worse by extension of the hallux. He developed paraesthesia across the distribution of the deep peroneal nerve but retained strong peripheral pulses.

INVESTIGATIONS

Ultrasonography showed generalised subcutaneous and muscular oedema; however, no haematoma or focal lesion was identified.

Intraoperatively compartmental pressures were measured using the wick-catheter technique; three

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Figure 1 Lateral aspect of the left ankle and calf demonstrating skin changes.

of the four osteofascial compartments had pressures above 70 mm Hg.

DIFFERENTIAL DIAGNOSIS

The differentials were progression of deep venous thrombosis, cellulitis, thrombophlebitis, haematoma and compartment syndrome.

TREATMENT

Preoperatively he received human prothrombin complex (Octaplex) as his INR was 2.9.

The patient underwent four compartment fasciotomies as per British Orthopaedic Association guidance.⁶ Intraoperatively, the subcutaneous tissues were oedematous and muscles were under severe tension. There was moderate bleeding between superficial and deep compartments, resulting in 600 mL of blood loss but there was no overt sign of necrosis or infection and his tissues were not debrided. The wounds were left open at index

Figure 2 Medial aspect of the left foot and ankle demonstrating skin changes.

surgery; 2 days later, he was taken to theatre; his tissues looked healthy and primary wound closure was performed.

OUTCOME AND FOLLOW-UP

Postoperatively, he was managed on the high dependency unit and under the advice of haematology was kept on intravenous heparin therapy. He continued bleeding from the open fasciotomy wounds, resulting in a drop in haemoglobin of 2.4 g/dL (from 9.2 to 6.8) requiring transfusion of three units of packed red blood cells. Postfasciotomy, his paraesthesia had improved and he did not have any neurovascular deficit.

DISCUSSION

Compartment syndrome is characterised by pain out of proportion to the clinical situation, pain and weakness on passive stretch of the compartment, hypoesthesia and tense boundaries.⁷ Although our patient developed these features, they were not initially present. Fracture of a long bone is the most common aetiological precipitant but non-long bone fractures and soft tissue injury can also result in compartment syndrome, especially if the patient is on anticoagulation therapy or has an underlying bleeding disorder.² Non-traumatic cases such as this are rare but have been associated with diabetes,^{8–12} haemophilia,¹³ disseminated intravascular coagulation,^{14 15} arteritis,¹⁶ atypical localised infections,¹⁷ DVTs,¹⁸ thrombolysis^{19–23} and anticoagulation.^{3 24–34}

DVTs as a single pathological entity do not cause compartment syndrome except in the case of extensive thrombosis such as phlegmasia cerulea dolens – where venous return is via collateral vessels only and phlegmasia alba dolens – where there is total venous return occlusion.⁴ The treatment of DVTs with an IVC filter has been associated with compartment syndrome,⁵ and in one case non-extensive DVT treated with anticoagulation resulted in compartment syndrome but there was a preceding trauma.³⁵ Differentiating between DVT and haematoma as a cause of limb pain and swelling is crucial as anticoagulation will potentiate bleeding, thereby increasing intracompartmental pressures.³⁶ Our patient did not have an extensive DVT, nor an IVC filter and on ultrasound there was no evidence of haematoma.

Anticoagulants have been associated with the subsequent development of compartment syndrome although this is usually related to minor trauma.^{3 24–30} To the authors' knowledge, there are three reported cases of heparin-induced spontaneous compartment syndrome: one patient was on heparin for a left ventricular assist device,³¹ one due to a large bleed from the profunda artery³² and one 12 days after a fracture.³³ There are two reported cases of warfarin-induced spontaneous compartment syndrome: one secondary to large haematoma formation in a patient who was receiving warfarin for multiple pulmonary emboli³ and the other associated with excessive warfarin therapy due to prescription error, with an INR of 8 at presentation.³⁴

Combination of the DVT and overanticoagulation is the likely mechanism for raised intracompartmental pressures in this patient. In vivo drug–drug interactions may have contributed to the prolonged rise in INR. Looking at the medications our patient was taking, warfarin is associated with an increased bleeding risk when combined with aspirin due to a decreased platelet aggregation,³⁷ simvastatin due to CYP3A4 inhibition³⁸ and coamoxiclav via CYP4S0 and decreasing vitamin K-dependent clotting factors.^{39 40}

This case, along with others, highlights the importance of considering compartment syndrome as a differential diagnosis in a patient with a painful limb, especially if they are over-anticoagulated. Warfarin therapy is vital in the management of thromboembolic disorders but consideration must be given to potential interactions as other medications can potentiate bleeding tendencies. Prompt fasciotomies prevent further tissue ischaemia and must be considered in atypical cases.

Learning points

- Compartment syndromes can occur in the absence of injury especially in those receiving anticoagulation therapy.
- Compartment syndrome should be kept as a differential in an atypical presentation, with slower onset of symptoms, where other diagnoses cannot be identified, in the presence of worsening pain without major septic signs.
- Anticoagulation needs careful monitoring in those with potential drug–drug interactions.
- It is possible that, in this case, there was a synergistic effect between venous thrombosis, warfarin therapy and warfarin–drug interactions, contributing to the development of compartment syndrome.
- Fasciotomies should be performed promptly as any delay in treatment not only causes longer than necessary pain and distress for the patient but may result in unacceptable sequelae.

Contributors SD identified and managed the case; he also revised the manuscript and is the guarantor. PAN read the literature, drafted and revised the manuscript.

Competing interests None.

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