CASE REPORT

Propofol extravasation: a rare cause of compartment syndrome

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Accepted 16 April 2015

SUMMARY

We detail a rare cause of forearm compartment syndrome that occurred in an 18-year-old patient who presented with a Glasgow Coma Scale of 13/15 after a mixed drug overdose and subsequently required intubation. She suffered extravasation of her propofol infusion, which resulted in intrinsic compression within her forearm muscle compartments. Fortunately, the diagnosis of compartment syndrome was made swiftly and the patient was taken to theatre within 3 h where she underwent an emergency forearm fasciotomy. She made an uneventful recovery and at follow-up her wounds had healed well with no associated morbidity or loss of function. The learning points of this study highlight the importance of thoroughly understanding the signs and symptoms of compartment syndrome while maintaining a high index of suspicion. In addition to a thorough history and examination, consideration of the potential underlying causes allows for a swifter diagnosis and a quicker transition to theatre.

BACKGROUND

Compartment syndrome is a pathological condition caused by increased pressure within a closed fascial compartment, which may cause ischaemia, and result in functional loss of muscle and nerve tissue.¹ There are various causes of compartment syndrome and many studies have concluded that fractures are the commonest; for example, they accounted for 69% of cases in a study by McQueen *et al.*² Acute compartment syndrome, which is the focus of this report, is often secondary to trauma; the pressure rise occurs from bleeding or inflammation. However, chronic compartment syndrome occurs when excessive exercise results in increased pressure within an enclosed fascial compartment in a susceptible individual.^{1 3}

Other important causes of acute compartment syndrome include intramuscular haematoma, intravenous injections, casts, ischaemic reperfusion following injury, prolonged limb compression, crush injuries and burns.^{4–6} Compartment syndrome is classically diagnosed clinically, on history and examination, with surgeons maintaining a high index of suspicion.⁷ In the early stages of the condition, symptoms include pain out of proportion to the injury, which worsens on passive stretch, despite adequate and increasing analgesia such as opioids; signs include a firm and visibly swollen myofascial compartment.¹ As the condition progresses, the affected limb may later exhibit pallor, paraesthesia, cold extremities, an absence of distal pulses or paralysis.¹ Obtaining compartment

pressures may also be of benefit but this should not delay time to treatment.

The treatment of choice is immediate decompression of affected compartments via fasciotomy. The wound is conventionally left open until pressures are relieved, with a re-exploration at 48 h.⁷ Options for closure then include healing by secondary intention, delayed primary closure, slow dermal apposition or skin grafting.⁸ Delay to treatment can result in irreversible damage to nerves and muscles, with loss of function secondary to pathological processes such as contractures. A review of the literature by Duckworth *et al.*⁹ revealed that time to fasciotomy did correlate with patient outcome and that performing surgery within 6–12 h was critical in clinical and in experimental studies. Therefore, once a diagnosis of compartment syndrome has been performed, patients should proceed to immediate fasciotomy.

This case report highlights how a serious condition such as a compartment syndrome can occur unexpectedly and secondary to relatively rare causes such as extravasation of intravenous drugs. In addition to performing a proficient history and examination, it is vital to maintain a high index of suspicion while being familiar with the potential underlying causes. Furthermore, the non-cytotoxic nature of propofol may allow extravasation to go unnoticed until there are clinical signs and symptoms of compartment syndrome.

CASE PRESENTATION

An 18-year-old female patient with no significant medical history was transferred to the emergency department by ambulance after collapsing outside a nightclub. She had allegedly consumed alcohol, 3,4-methylenedioxy-methamphetamine and a liquid morphine preparation.

On arrival, her Glasgow Coma Scale (GCS) score was initially 13/15 but she soon became agitated. When her GCS dropped rapidly to 6/15 and she became unable to maintain a patent airway, she underwent a rapid sequence induction and intubation. For sedation, she was given 14 mL (140 mg) of intravenous propofol via a cannula in her right antecubital fossa.

She was transferred to the intensive treatment unit for monitoring, where she continued to receive a propofol infusion prior to her eventual extubation 9 h later. In that time period, she received a total of 341 mL (3410 mg) of intravenous propofol. On regaining consciousness, she reported of increasing pain over several hours in her right forearm and antecubital fossa, despite

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To cite: Kalraiya AJ, Madanipour S, Colaco H, *et al.* *BMJ Case Rep* Published online: [please include Day Month Year] doi:10.1136/bcr-2015-209360

cessation of intravenous infusions and removal of the intravenous cannula on that side.

On examination of her right upper limb, she had tenderness throughout the forearm and elbow, particularly over distal biceps, common extensor and flexor-pronator muscle masses. There was no localised induration or necrosis at the site of intravenous cannulation. Pain was increased on passive elbow extension, wrist flexion and finger extension, and had not been adequately controlled despite receiving 1 g of paracetamol and 100 mg tramadol regularly in addition to two boluses of 3 mg intravenous morphine. Motor and sensory function of all peripheral nerves was intact, capillary refill time was less than 2 s, and radial and ulnar artery pulses were present.

DIFFERENTIAL DIAGNOSIS

Forearm compartment syndrome was clinically suspected, and initially it was felt this may have occurred secondary to lying on the limb on the pavement outside the nightclub. However, there was no prolonged period of unconsciousness witnessed and no rise in creatine kinase during admission. Extravasation was considered but at that stage was lower on the list of differentials. Cellulitis was also considered, but the clinical findings of increasing pain on passive stretch of the involved muscle compartments were more in keeping with compartment syndrome. Furthermore, with no evidence of swelling or deformity on admission, there was a low suspicion of fracture on this occasion. A swift diagnosis of compartment syndrome was therefore performed, and a better prognosis was indicated by the fact there had been no progression to late signs, such as paralysis.

TREATMENT

After the clinical diagnosis was performed, the patient was transferred urgently to the operating theatre within 3 h of initial referral to the on-call orthopaedic team. She underwent forearm fasciotomy via a curvilinear incision, which allows decompression of superficial as well as deep anterior compartments in addition to the mobile wad (figure 1). This extensile approach was used to incorporate decompression of the carpal tunnel, access to the distal biceps muscle mass, exposure of median as well as ulnar nerves and to avoid postoperative joint contractures.

Intraoperative findings revealed tight but healthy anterior muscle compartments with evidence of extensive propofol

extravasation deep to the fascia. The subcutaneous adipose tissue was oedematous and bathed in propofol, which may have contributed to extrinsic compression of the muscle compartments. However, there was no evidence of inflammatory tissue reaction or necrosis and no debridement was required. It was therefore clinically diagnosed by the operating surgeons that the compartment syndrome was secondary to extravasation of propofol. This also explained why attempts to keep the patient sedated required large doses of the drug. She had actually been agitated and combative prior to her eventual extubation.

After adequate release of the deep fascia, transverse carpal ligament and lacertus fibrosus, a gentle milking technique was used to reduce the residual volume of propofol within the subcutaneous adipose tissue and the wound was irrigated with 3 L of normal saline. The palmar skin overlying the median nerve was approximated with interrupted 2-0 nylon sutures to protect the median nerve, and further temporary tacking sutures were used. The exposed muscle was dressed with Mepitel, saline-soaked blue gauze, wool and crepe. After 48 h of elevation, the patient returned to the operating theatre for a second look and tension-free closure of the wound with interrupted 3-0 nylon sutures. She had no neurovascular deficit postoperatively.

OUTCOME AND FOLLOW-UP

Postoperatively the patient made an uncomplicated recovery on the ward and was discharged the following day. The incision healed well with no evidence of infection, and sutures were removed after 2 weeks. At this point, range of elbow flexion was 10–120° with full pain-free range of wrist movement, and the patient was referred for a course of physiotherapy. By 3 weeks, she had regained almost full range of pain-free elbow movement (figure 2). There was no evidence of short-term complications related to the compartment syndrome or to the operative intervention.

DISCUSSION

Complications related to inadvertent extravasation of intravenously administered agents have been well documented in the literature. In 2014, Le *et al*¹⁰ performed a study that compiled a list of 232 documented cases of extravasation involving 37 different types of non-cytotoxic agents. Propofol was not in the top 10 most frequent agents reported in this literature and hence our case study reports a rare agent for extravasation, and an even rarer cause of compartment syndrome.

There are reports in the literature of extravasated intravenous medications causing compartment syndrome. For example, in

Figure 1 Intraoperative images of a right forearm fasciotomy to decompress a compartment syndrome, with milky white propofol still visible in the soft tissues despite a thorough washout.

Figure 2 Postoperative images at 3 weeks after the wound closure showing a fully healed scar with no signs of infection.

2014, Yurdakul *et al*¹¹ reported a case of right hand compartment syndrome secondary to extravasation of contrast material prior to a computed tomographic (CT) scan.

LeBlanc *et al*¹² and Basak *et al*¹³ both reported incidents of propofol extravasation in patients who had required intubation. In both these cases, soft tissue necrosis occurred and in one case, surgical debridement was required. However, neither of these patients required a fasciotomy for compartment syndrome. Fortunately, in our case, the soft tissues were healthy at operations and had obviously not been affected by either the compartment syndrome or by chemical reaction to the agent itself.

Overall, this case report highlights the importance of maintaining a high index of suspicion for compartment syndrome and of considering all possible underlying causes when no obvious trauma has occurred. In this study, an immediate refer-

ral to the on-call Orthopaedic team, in addition to a high index of suspicion from all clinicians involved, meant a swift diagnosis was performed. This helped to reduce possible delays in taking the patient to theatre. Performing a fasciotomy within 3 h contributed to a positive uncomplicated outcome for a young patient.

Competing interests None declared.

Patient consent Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

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Learning points

- ▶ This case study reiterates the importance of having a thorough understanding of the signs and symptoms of compartment syndrome, while maintaining a high clinical index of suspicion, in order to make a clinical diagnosis.
- ▶ This particular case highlights the fact that it is also vital to study the history and consider possible rarer causes, such as extravasation, as this may lead to a swifter diagnosis and thereby appropriate treatment.
- ▶ Swift treatment of compartment syndrome is vital to prevent long-term complications such as nerve or tissue damage, including contractures and loss of limb function.
- ▶ Propofol is a non-vesicant agent and therefore any suspicion of extravasation requires early and regular clinical examination, and a low threshold for surgical review.

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