Deltoid compartment syndrome as a complication of lateral decubitus positioning for contralateral elbow surgery in an anabolic steroid abuser

Julian D Wijesuriya, Paul D Cowling, Christopher Izod
and David JC Burton

Abstract

Compartment syndrome as a result of patient positioning for surgery is a rare but serious complication. Compartment syndrome as a result of anabolic steroid use is more rare. We present a unique case of compartment syndrome related to anabolic steroid use and patient positioning for complex distal humerus fracture fixation and also provide a review of the literature related to this topic.

Keywords

Compartment syndrome, lateral decubitus, steroid abuse, surgical positioning

Date received: 11th November 2013; accepted: 10th March 2014

Introduction

Compartment syndrome as a result of patient positioning for surgery is a rare but serious complication more commonly noted following urological, colorectal or gynaecological procedures,^{1–3} although it has been reported in the orthopaedic literature.^{4,5}

Deltoid compartment syndrome is also uncommon,^{6,7} with only one report linking operative positioning to deltoid compartment syndrome.⁸

Compartment syndrome as a result of anabolic steroid use is more rare.^{9–13} To our knowledge, the case described here is the first case of deltoid compartment syndrome related to a combination of anabolic steroid use and patient positioning during orthopaedic surgery.

Case report

A 20-year-old right-hand dominant electrician fell from a ladder at a height of 12 feet onto his right side. He sustained an intra-articular fracture of the right distal humerus (AO 13-C3) (Figure 1) and a stable undisplaced fracture of his right distal fibula. There were no injuries to the opposite limb.

He underwent olecranon osteotomy and open reduction internal fixation of his right distal humerus fracture 5 days following injury (Figure 2).

The patient had no significant previous medical history and was assessed by the anaesthetist as ASA Class 1. The patient had a body mass index of 30 kg/m². Awake supraclavicular brachial plexus block was noted to be technically difficult as a result of the increased muscle mass and a large number of veins in proximity to the brachial plexus.

The patient was positioned in the left lateral decubitus position on a modern padded fracture table (Eschmann MR Manual Table; Eschmann, Lancing, UK) with pelvic supports and the right arm free over an L-shaped bar without tourniquet. His left forearm was held, flexed at the elbow, with a padded support,

Department of Orthopaedics and Trauma, Darlington Memorial Hospital, Darlington, UK

Corresponding author:

P. D. Cowling, c/o Mr Burton's secretary, Department of Trauma and Orthopaedics, Darlington Memorial Hospital, Hollyhurst Road, Darlington DL23HX, UK.
Email: cowling@doctors.net.uk

Figure 1. Pre-operative anteroposterior and lateral elbow X-rays.

Figure 2. Postoperative lateral and anteroposterior elbow X-rays.

such that the hand was adjacent to the face. As a result of the comminuted, intra-articular fracture pattern and the large size of the patient's triceps, exposure and fixation was technically demanding and time consuming; the recorded surgical time was 4.5 hours. A length of approximately 10 cm of the wound over the triceps was left open as a result of triceps muscle bulk and swelling.

After approximately 2 hours of surgery, the patient developed a gradual rise in heart rate to 125 beats/minute and hypertension relative to his baseline blood pressure.

The patient and equipment were examined to try and rule out obvious causes. No anaesthetic cause was found. The patient's positioning on the theatre table was rechecked and no compression to the eyes or peripheral nerves was found. The visible blood loss at the

time was not excessive and, clinically, the patient was warm and well perfused. The precise cause of this tachycardia remained unclear.

On awakening, after a total 6 hours of anaesthesia, his tachycardia and hypertension increased (heart rate 160 beats/minute; systolic blood pressure 160 mmHg) and he became profoundly sweaty. A further 10 mg of morphine had been administered prior to extubation; however, the patient immediately complained of excruciating pain from his left shoulder, which he had been lying on during surgery. Clinical examination revealed a grossly swollen, erythematous exquisitely tender deltoid region. Passive abduction of the arm was especially painful, and active abduction was impossible because of the pain. Examination of the elbow and wrist were unremarkable, and sensation was intact throughout

the arm and hand, with a palpable radial pulse. Compartment syndrome was suspected on clinical grounds and this was confirmed by a middle deltoid compartment pressure of 85 mmHg, as measured by an intra-compartmental pressure monitor (Stryker; Kalamazoo, MI, USA). Because this was found to be sufficiently high to warrant fasciotomy, the pressures in the anterior and posterior deltoid compartments were not measured. An X-ray confirmed that there was no fracture or dislocation to the left shoulder.

The patient was immediately transferred back to theatre for deltoid fasciotomy. Through a lateral deltoid incision, the fascia and epimysium of all three deltoid compartments (anterior, middle and posterior) were incised along the line of the fibres. All three compartments were under high tension and muscle herniated out from within the compartment in each case. The muscle was oedematous though viable in all three compartments. The skin and fascial incisions were left open and lightly dressed.

There was a marked improvement in cardiovascular parameters following decompression of the fascial compartment (heart rate falling from 130 to 90 beats/minute and systolic blood pressure falling from 120 mmHg to 90 mmHg).

Postoperatively, the patient was transferred to the intensive care unit and was kept sedated and ventilated. He remained cardiovascularly stable, requiring no inotropic support, whereas, from a renal perspective, he had visible myoglobinuria with a good urine output, and a modest postoperative rise in urea (from 5.6 mmol/L to 8.7 mmol/L) and creatinine (from 87 µmol/L to 113 µmol/L), although his postoperative serum potassium was 6.7 mmol/L. This was managed with calcium gluconate and an insulin-dextrose infusion. Overnight, his metabolic acidosis improved, although creatinine kinase levels rose from an initial postoperative value of 5668 units/L to a peak at 18300 units/L at 10 hours post fasciotomy.

He was extubated without complication the following morning but remained as a patient on the high-dependency unit for analgesia and monitoring for 5 days, during which time the fasciotomy wound was closed. All blood parameters returned to normal within 48 hours.

The patient subsequently admitted to systematic abuse of injectable anabolic steroids to enhance his physique for a forthcoming holiday.

He was then transferred to a plastic surgery facility for split skin grafting of the triceps wound associated with the fracture fixation, which could not be closed, primarily as a result of tension. At 6-month follow-up, he has a healed fasciotomy wound with normal shoulder function and he is back to work as an electrician.

Discussion

Compartment syndrome is a rare occurrence in the upper limb, a fact attributed to a more compliant fascia¹⁴ and also because the compartments freely communicate with the shoulder girdle, allowing further distribution of oedema and therefore pressure.¹⁵

Deltoid compartment syndrome is therefore extremely rare, with few cases being documented. One case reported blunt trauma to the triceps, resulting in both triceps and deltoid compartment syndrome requiring fasciotomy.⁷ This was considered to be a result of extravasation of oedema from the posterior arm compartment into the adjacent deltoid compartment. Another report describes two intravenous drug addicts who suffered deltoid compartment syndrome as a result of compression in a prolonged obtunded position, rather than intra-compartmental injection of heroin.⁸

The only previous report of deltoid compartment syndrome related to operative positioning⁹ describes a tall well-built man undergoing 8 hours of orthopaedic surgery in the right lateral decubitus position. He developed deltoid compartment syndrome of the right shoulder requiring fasciotomy. This case, however, did not have the added factor of anabolic steroid abuse, with the attendant rapid muscle growth that this case involves.

Reports have documented compartment syndrome following low velocity trauma normally unassociated with such complications, describing the increased pressure as being 'accelerated' in poly-trauma patients abusing anabolic steroids.^{10,12,13} It has been suggested that anabolic steroid users are more susceptible to compartment syndrome as a result of rapid muscle expansion without concomitant fascial sheath expansion.¹²

The use of recreational anabolic steroids has increased in recent years, with approximately 27,000 16–24-year-olds admitting to their use in 2010.¹⁶ This increasing prevalence was noted in North-East England when 43% of new attendees on a needle exchange scheme were anabolic steroid users.¹⁷ Anabolic steroids are freely available online, with little regulation of the quality or quantity.¹⁸ Their use is no longer limited to elite athletes and is now also accessible to regular gym-attending members of the public, with one study finding that up to 15.2% of men who regularly attended the gym in London in 2000 had used anabolic steroids within the previous 12 months.¹⁹

Given this increased use, cases of unusual compartment syndrome may become more common. Anaesthetic and surgical teams must have a high index of suspicion with regard to anabolic steroid use in highly muscular patients of all ages because this can influence the peri-operative care provided by both teams.

Patients should be directly questioned during pre-assessment and special care should be taken with regard to patient positioning for surgery. Extra precautions regarding padding and positioning may need to be made, over and above the normal, in patients who may have taken anabolic steroids. Anaesthetic and surgical procedures may be technically difficult and more time consuming as a result of muscle bulk and increased vascularity and so allowances should be made for this: if the patient is likely to be positioned in the lateral decubitus position for a long period, consideration of another position could be made (e.g. prone), although this may place pressure on the pectoral and quadriceps compartments.

Acknowledgements

This paper is not based on a previous communication to a society or meeting.

Funding

No funding was sought or required for publication.

References

1. Akhavan S, Gainsburg DM and Stock JA. Complications associated with patient positioning in urologic surgery. *Urology* 2010; 76: 1309–1316.
2. Rao MM and Jayne D. Lower limb compartment syndrome following laparoscopic colorectal surgery: a review. *Colorectal Dis* 2011; 13: 494–499.
3. Arnim DU, Zotter M, Koch H, Pristauz G and Tamussino K. Well-leg compartment syndrome after surgery for gynecologic cancer. *J Gynecol Surg* 2010; 26: 261–262.
4. Anglen J and Banovetz J. Compartment syndrome in the well leg resulting from fracture table positioning. *Clin Orthop Rel Res* 1994; 301: 239–242.
5. Cascio BM, Buchowski JM and Frassica FJ. Well-limb compartment syndrome after prolonged lateral decubitus positioning: a report of two cases. *J Bone Joint Surg Am* 2004; 86: 2038–2040.
6. Mubarak SJ, Owen CA, Hargens AR, Garetto LP and Akeson WH. Acute compartment syndromes: diagnosis and treatment with the aid of the wick catheter. *J Bone Joint Surg Am* 1978; 60: 1091–1095.
7. Diminick M, Shapiro G and Cornell C. Acute compartment syndrome of the triceps and deltoid. *J Orthop Trauma* 1999; 13: 225–227.
8. Rohde RS and Goitz RJ. Deltoid compartment syndrome: a result of operative positioning. *J Shoulder Elbow Surg* 2006; 15: 383–385.
9. Farkash U, Shabshin N and Pritsch P. Rhabdomyolysis of the deltoid muscle in a bodybuilder using anabolic-androgenic steroids: a case report. *J Athl Train* 2009; 44: 98–100.
10. Erturan G, Davies N, Williams H and Deo S. Bilateral simultaneous traumatic upper arm compartment syndromes associated with anabolic steroids. *J Emerg Med* 2013; 44: 89–91.
11. Adamson R, Rambaran C and D-Cruz DP. Anabolic steroid-induced rhabdomyolysis. *Hosp Med* 2005; 66: 362.
12. Bahia H, Platt A, Hart NB and Baguley P. Anabolic steroid accelerated multicompartiment syndrome following trauma. *Br J Sports Med* 2000; 34: 308–309.
13. Winternitz WA Jr, Methany JA and Wear LC. Acute compartment syndrome of the thigh on sports related injuries not associated with femoral fractures. *Am J Sports Med* 1992; 20: 476–477.
14. Ridings P and Gault D. Compartment syndrome of the upper arm. *Orthopaedics* 1994; 17: 1144–1147.
15. Doyle JR. Anatomy of the upper extremity muscle compartments. *Hand Clin* 1998; 14: 343–364.
16. Hoare J and Moon D. *Drug misuse declared: findings from the 2009–10 British Crime Survey*. London: Home Office, 2010.
17. Dawson RT. Drugs in sport – the role of the physician. *J Endocrinol* 2001; 170: 55–81.
18. Corrado FG, Lombardo S and Consentino M. Selling androgenic anabolic steroids by the pound: identification and analysis of popular websites on the internet. *Scand J Med Sci Sports* 2011; 21: e247–e259.
19. Elsharkawy AM, McPherson S, Masson S, Burt AD, Dawson T and Hudson M. Cholestasis secondary to anabolic steroid use in young men. *BMJ* 2012; 344: e468.