Deltoid Compartment Syndrome: A Rare Complication after Humeral Intraosseous Access

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CASE PRESENTATION

A 67-year-old female with an extensive psychiatric history and past medical history notable for heparin-induced thrombocytopenia that resulted in a left below-knee amputation and right foot amputation presented emergently to the intensive care unit from a psychiatric hospital due to hypoxic respiratory failure and hypotension necessitating bilateral humeral intraosseous (IO) access for resuscitation. A central line was placed and the IO access was removed within 24 hours. She was resuscitated and transferred to the floor 8 days later in stable condition except for difficulty managing her anticoagulation.

Five days after arriving on the floor, the patient developed progressive worsening pain and swelling in the left deltoit region at the site where IO access was obtained. Clinical examination demonstrated firmness and tenderness on palpation of the deltoit compartment, with diminished shoulder extension and external rotation (Fig. 1). Laboratory findings showed a supratherapeutic international normalized ratio of 2.7 and elevated white blood cell count of 20. Initial conservative management with warm compresses failed and a decision to bring the patient to the operating room was made after confirmation of elevated deltoit compartment pressures using a Stryker needle: anterior, middle, and posterior compartments were 38, 98, and 24 mm Hg, respectively. Incisions over the anterolateral and posterolateral aspects of the shoulder were utilized to expose all 3 deltoit compartments (Fig. 2). The fascia over the muscle was incised and muscle appeared viable. At the inferior margin of the anterior deltoit, a hematoma was noted and explored to the level of the humerus (Fig. 3). The organized clot, measuring 5 × 3 × 2 cm, was evacuated and the surrounding deeper muscles were debrided to healthy bleeding tissue. The incisions were packed, left open, and the patient left the operating room in a stable condition.

Immediately after the procedure, the patient noted pain relief and improvement in range of motion of the shoulder. Unfortunately, 1 week later, the patient developed a pericardial effusion due to viral pericarditis resulting in acute cardiac tamponade. Given her multiple ongoing medical issues and tenuous condition, closure of her fasciotomy wounds was deferred and were allowed to heal by secondary intention with routine wound care.

DISCUSSION

The deltoit compartment is an uncommon location for development of compartment syndrome, a limb-threatening and common problem that has been described...
as having multiple etiologies such as trauma, prolonged re-
cumbence, orthopedic procedures, and exercise.\textsuperscript{1–5} Whereas lower extremity compartment syndrome after IO access is well described, this case represents the first documented incidence of upper extremity compartment syndrome as a complication of IO access.

IO access is used because it is a rapid and reliable way to achieve intravascular volume repletion in critically ill patients in comparison to central and peripheral intrave-
nous access.\textsuperscript{6,7} However, complications although rare can be devastating such as extravasation of infused agents, osteomyelitis, and compartment syndrome.\textsuperscript{8,9} Whereas the traditional site of IO access has been the proximal anterior tibia, the proximal humerus has also emerged as a desirable site due to decreased pain, rapid fluid delivery, and proximity to the heart.\textsuperscript{10} However, first attempt success rate, time to access, and most importantly subsequent dislodgement have been shown to be significantly higher when cannulating the humerus compared with the tibia.\textsuperscript{11,12} In this case, the threshold to obtain humeral access was lower given the patient had a left below-knee amputation and right foot amputation. Nonetheless our case report demonstrates that complications seen in lower extremity IO access can also occur in the upper extremi-
ties. Taking this into account, along with difficulty of access compared with the tibia, humeral access should only be considered as a second-line option or if lower extremity access is contraindicated.

This case is also unique because despite timely removal of IO access from the humerus, the patient developed a delayed compartment syndrome. Current evidence sug-
gests that IO access should ideally be used as a bridge for 4–6 hours with a max of 24 hours until intravenous access can be reliably obtained to prevent common associ-
ated complications.\textsuperscript{9,11} In this case, the patient appeared to have a central line placed and IO access removed within 24 hours of the initial resuscitation. Furthermore, the first clinical signs of compartment syndrome developed 8 days after IO access discontinuation. Our experience, there-
fore, suggests that in the case of upper extremity IO ac-
cess, prolonged vigilance after removal of the device may be necessary to prevent devastating delayed complications.

With respect to presentation, this patient showed clas-
cic signs associated with compartment syndrome despite the unusual location. Furthermore, as with other well-
described cases of deltoid compartment syndrome, the diagnosis was made via physical examination and elevated compartment pressures.\textsuperscript{13} Prompt clinical diagnosis, fasci-
otomy, and evacuation of the hematoma avoided irrevers-
able muscle ischemia necessitating gross resection that has been documented in the literature.\textsuperscript{13}

Another interesting point this case raises is that al-
though lower extremity compartment syndrome after IO access is well documented in the literature, it is mostly in the pediatric population.\textsuperscript{8} In fact, most literature discussing complications after IO access is in children and therefore the safety of IO access in adults may be overstated. Further research and increased discussion of outcomes af-
ter IO access in the adult population is necessary to better characterize the true risks associated with this procedure.
To conclude, we present a case report of an atypical complication of IO access to the humerus not previously discussed. Deltoid compartment syndrome is extremely rare and not well documented in the literature. This case highlights the importance of prompt removal of IO access and subsequent vigilant monitoring to prevent this limb-threatening complication. Our experience supports humeral IO access only as a second-line option. Furthermore, the authors encourage increased reporting and research of complications after IO access in the adult population.

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