
CASE REPORT**Acute compartment syndrome due to delayed tourniquet release in distal forearm osteosynthesis: A case report**

T. M. Ridzuan¹, I. M. A. Ramdhan¹, I. P. Faris^{1*}

¹Department of Orthopaedics, Faculty of Medicine and Health Sciences, Universiti Malaysia Sarawak

Abstract

Compartment syndrome is a known complication in trauma. Commonly it occurs immediately after trauma and involves lower limbs especially in tibial fractures. However, it can also happen after internal fixation and less commonly in upper limb fractures post-surgery. This is a case of compartment syndrome of the forearm developed after open reduction and plating of distal shaft of radius and ulna secondary to hematoma collection. The use of tourniquet intra-operatively that was deflated after skin closure masked the bleeding from small arteries. Fasciotomy performed and plate was left in situ without subsequent major complication.

Keywords: Compartment Syndrome, Forearm Fractures, Plating Radius Ulna, Tourniquet

Introduction

Acute compartment syndrome is a limb threatening surgical emergency that can be caused by accumulation of blood and transudates within a closed compartment. The risk of developing this condition is less than 1% in patients with distal radius fractures and about 4-5% in those with tibial diaphyseal fractures [1]. Compartment syndrome following internal fixation of upper limb is not common, and carries a significant risk if not identified early. Rodgers *et al.*, reported a case of compartment syndrome following chronic monteggia surgical fixation [2]. Though rarely seen, compartment syndrome after open reduction and internal fixation is a devastating condition that needs to be diagnosed early to limit or prevent further damage. We report a case of acute compartment syndrome that developed after open reduction and plating in distal forearm fractures. In our case torniquet was used and was only deflated after skin closure.

Case Report

A 15-year-old teenager sustained injury to his left forearm after a fall. On examination, his distal left forearm was deformed. The swelling was not tense and neurovascular assessment was non-remarkable. The radiograph of the forearm showed fracture of distal one-third radius and ulna (Fig. 1). The fracture was temporarily held with cast and surgery was done 3 days later.

Under general anesthesia, open reduction and plating of radius and ulna were performed using modified Henry and posterior approach, respectively. Both fractures were reduced and stabilized with dynamic compression plate (Fig. 1). Fascia was left unrepaired. Subcutaneous layer was sutured followed by the skin. No surgical drain inserted. Total tourniquet time was 2 hours 10 minutes and was deflated after wound closure.

Six hours after surgery patient complained of pain and tightness over dressing site at the surgical wound. Thus, the bandage was reapplied but

loosely and analgesic was given. Patient felt more comfortable and the symptoms relieved. However, patient developed pain and numbness on the following day. After opening up the bandage and dressing pad on the operated area, there were multiple blisters over the volar surgical incision with tense volar compartment (Fig. 2). There was reduced sensation over median nerve distribution and the passive stretch test was positive for the volar compartment of forearm. Clinical diagnosis of compartment syndrome was made and patient underwent urgent fasciotomy of forearm. Intra-operatively, there were blister formation along the surgical incision. The forearm was not

significantly swollen. However, there was significant immediate muscle bulging over anterior compartments of forearm with presence of hematoma. The posterior compartment was soft. The muscles appeared viable and healthy after fasciotomy, and no active bleeding was seen. The radial artery was noted to be intact and median nerve also appeared healthy and viable. The fasciotomy wounds were left open with the implants remained inside unexposed. Post operatively, patient reported reduced numbness and pain. The wounds were treated via secondary wound healing without additional surgery and there was no implant-related infection.



Figure 1 (a): Plain radiograph of left forearm demonstrates fracture of distal one-third radius and ulna.

Figure 1 (b): Plain radiograph immediately after surgery. Both fractures were reduced and fixed with narrow dynamic compression plates



Figures 2 (a) and (b): Wound inspection shows multiple blisters over surgical wound with swollen wrist and forearm.

Figure 2 (c): The wound condition after fasciotomy appears healthy. The implants used were not exposed. The wounds healed well with secondary intention.

Discussion

Shaft fractures of radius and ulna in teenage population are treated with plating as it provides anatomical reduction and allow early mobilization. The standard approaches used for this surgery are anterior (Henry) and dorsal approach, for radius and ulna respectively, which enable visualization of fracture and proper plate positioning. Tourniquet use is valuable in providing clear surgical field for easy identification of structures and optimum working field. However it is not without complications. Post-operative compartment syndrome may result from several factors including prolonged tourniquet time, surgical positioning, hematoma and tight bandaging or casting [3].

Early identification of symptoms and intervention are essential to limit the consequences related to compartment syndrome. Pain out of proportion to injury and increasing analgesic requirements should raise the suspicion of a developing compartment syndrome. Furthermore, paraesthesia may occur as an early symptom in acute compartment syndrome, representing a potentially reversible state because peripheral nerves are more sensitive to ischemia than muscle. The irreversible ischemic changes begin approximately 8 hours after the onset of ischemia [4].

Clinical test and assessment are important and could be done via passive stretch test and palpation

of the compartment. Typically, it would have a tense swelling over the affected compartment. The objective way of determining compartment syndrome would be by measuring the compartment pressure [4]. Absolute pressure can be measured directly and considered significant when the pressure is more than 30mmHg. However, this pressure is not very accurate as multiple factors can contribute to developing compartment syndrome such as muscle bulk and blood pressure of the patient. Hence another method is used called delta pressure. It is the diastolic blood pressure minus the pressure of the compartment. It is considered significant when the Delta pressure is less than 30mmHg [5]. Nevertheless, this value needs to be considered in conjunction with clinical suspicion.

In this case patient developed worsening pain and paraesthesia with blisters at the surgical site after surgery. The diagnosis of acute compartment syndrome was made clinically and fasciotomy was performed. Subsequently patient's condition was better with reduction in pain and paraesthesia. During the fixation surgery, tourniquet was used but only deflated after wound closure. Even though there is no consensus on timing of tourniquet deflation, Himel *et al.* reported less hematoma formation if the tourniquet was deflated and hemostasis achieved prior to wound closure [6]. Bleeding from small capillaries could be missed during surgery and potentially cause significant hematoma collection which may lead to compartment syndrome if left unrecognized. The deflation of tourniquet could lead to increase in operative time, but it is an important step to avoid greater perils [7]. The other option is to insert a surgical drain before tourniquet deflation and wound closure to reduce hematoma accumu-

lation and intra-compartmental pressure post-operatively.

After fasciotomy, the implants were left under the overlying muscle and were not exposed. There was no major complication such as bone infection or implant-related infection and wound was dressed regularly and healed well. Implant with open fasciotomy wounds has been accepted and showed good outcome [8].

Retrospectively to minimize complications, forearm fractures could be fixed using Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO). This technique could avoid extensive soft tissue dissection and periosteal stripping, and minimize infection and skin flap necrosis [9]. For forearm injuries, MIPPO technique is an option for ulna fractures due to its subcutaneous location. In order to prevent surgical site infections and post-surgical compartment syndrome, the surgery should be performed within an acceptable duration by an experienced surgeon. Jindal *et al.* mentioned that surgical site infections commonly happen in surgeries performed for more than two hours and under emergency procedures [10]. Surgical site infection is a known cause of morbidity, prolonged hospital stay and increase in medical expenses [10]. In our case, we suggested a larger skin incision to accommodate plate insertion. Furthermore, less vigorous soft tissue retraction and more precise surgical incision approach could have reduced the incidence of neurovascular structure injuries such as median nerve neuropathy that happened in our case.

Conclusion

In conclusion, acute compartment syndrome could happen after plating surgery in close fracture of distal forearm fracture. The use of tourniquet is

helpful to minimize intraoperative bleeding and ease the surgery. However, if it is not deflated before surgical skin closure there would be multiple bleeding from small arteries that could contribute to hematoma formation and subsequently cause acute compartment syndrome as illustrated in this case. Thus, we recommend surgeons to deflate the tourniquet and check the bleeding before skin closure or insert the surgical drain.

Furthermore, the plate could be kept in the compartment after fasciotomy, if it is not exposed with healthy surrounding soft tissues. We also recommend use of surgical drain, acceptable length of surgical incision and less forceful soft tissue retraction. Use of MIPPO technique is also encouraged in indicated cases provided it is being performed by an experienced surgeon.

References

1. Ganeshan RM, Mamoowala N, Ward M, Sochart D. Acute compartment syndrome risk in fracture fixation with regional blocks. *BMJ Case Rep* 2015; 2015:bcr2015210499.
2. Rodgers WB, Waters PM, Hall JE. Chronic Monteggia lesions in children. Complications and results of reconstruction. *J Bone Joint Surg Am* 1996;78(9): 1322-1329.
3. Dugdale TW, Schutzer SF, Deafenbaugh MK, Bartosh RA. Compartment syndrome complicating use of the hemi-lithotomy position during femoral nailing. A report of two cases. *J Bone Joint Surg Am* 1989; 71(10):1556-1557.
4. Mubarak SJ, Hargens AR. Acute compartment syndromes. *Surg Clin North Am* 1983;63(3):539-565.
5. Janzing HM, Broos PL. Routine monitoring of compartment pressure in patients with tibial fractures: Beware of overtreatment! *Injury* 2001;32(5):415-421.
6. Himel HN, Ahmad M, Parmett SR, Strauss HW, May JW. Effect of the timing of tourniquet release on postoperative hematoma formation: an experimental animal study. *Plast Reconstr Surg* 1989;83(4):692-697.
7. Wolfe, Hotchkiss, Pederson, Kozin. Green's Operative Hand Surgery. 6th edition. Philadelphia: Churchill Livingstone; 2010: 15.
8. Sharma N, Singh V, Agrawal A, Bhargava R. Proximal tibial fractures with impending compartment syndrome managed by fasciotomy and internal fixation: A retrospective analysis of 15 cases. *Indian J Orthop* 2015;49(5):502-509.
9. Helfet DL, Suk M. Minimally invasive percutaneous plate osteosynthesis of fractures of the distal tibia. *J Krishna Inst Med Sci Univ* 2004; 3(1):120-124.
10. Jindal R, Swarnkar M. Outcomes are local: a cross sectional patient specific study of risk factors for surgical site infections in major abdominal surgeries. *J Krishna Inst Med Sci Univ* 2020; 9(1):43-50.

*Author for Correspondence:

Dr. I. P Faris, Department of Orthopaedic, Faculty of Medicine and Health Sciences, Universiti Malaysia Sarawak Email: prahasta_82@yahoo.com
Cell: +60136021706

How to cite this article:

Ridzuan TH, Ramdhan IMA, Faris IP. Acute compartment syndrome due to delayed tourniquet release in distal forearm osteosynthesis: A case report. *J Krishna Inst Med Sci Univ* 2022; 11(4):87-91

Submitted: 25-June-2022 Accepted: 01-Sep-2022 Published: 01-Oct-2022