ABSTRACT

Introduction: Acute compartment syndrome is a condition in which increased pressure in the tight fascia space reduces capillary perfusion below the level required for tissue viability. Very few cases of acute compartment syndrome associated with dialysis have been reported. It can lead to severe damage to the tissues of the arm.

Case Illustration: A 47-year-old woman with end-stage renal failure presented to the emergency room with swelling and pain in the right upper extremity and had lasted for a day. Three days before admission, the patient underwent right brachiocephalic arteriovenous (AV) fistula surgery. Physical Examination showed a blackish bruise at the fossa cubiti, radial and ulnar artery were not palpable, but there is trill at AV fistula. Decreased motoric strength, reduced hand sensation and decreased capillary return in fingers.

Keywords: arteriovenous fistula, AV Fistula, Compartment Syndrome, End Stage Renal Failure, Fasciotomy, Haemodialysis.


INTRODUCTION

Acute compartment syndrome is a condition in which increased pressure in the tight fascia space reduces capillary perfusion below the level required for tissue viability. It can occur with any increase in interstitial pressure in the osseous-fascial space. Tissue perfusion is proportional to the difference between capillary perfusion pressure (CPP) and interstitial fluid pressure. Very few cases of acute compartment syndrome associated with dialysis have been reported. It can lead to severe damage to the tissues of the upper extremities and can quickly get worse, leading to strictures and tissue loss.

CASE ILLUSTRATION

A 47-year-old woman with end-stage renal failure presented to our emergency room with rapidly developed swelling of the right arm. The complaint was accompanied by pain in the whole right upper extremity that had persisted for one day. Three days before admission, the patient underwent right brachiocephalic AV Fistula surgery and was successfully constructed for hemodialysis in which the end of the 4-mm diameter vein was anastomosed to the side of 4-mm diameter artery with interrupted 7-0 polypropylene sutures. One day after surgery, the patient was discharged without any complaints.

Physical examination showed a blackish bruise at the fossa cubiti which was painful with a visual analogue scale at 7-9 (Figure 1). Radial and ulnar artery was not palpable, but there was a palpable thrill around the AV fistule site. Decreased motoric strength, reduced hand sensitivity response, and decreased capillary return time in fingers distal to the troubled site were also found. Oxygen blood saturation of the right fingers could not be read. Diagnosis of acute compartment syndrome was made. The patient was immediately taken to the operating room for decompression surgery. Emergency compartment fasciotomy was performed. After fasciotomy, necrotomy was performed. Furthermore, brachiocephalic AV fistula was ligated. Postoperative evaluation obtained good radial and ulnar artery. Six months after the surgery, the wound was fully healed and no sign of neuromuscular or vascular deficit.

Conclusion: Compartment syndrome is a possible complication after AV fistula formation that can have disastrous consequences. However, it can be effectively treated if detected and treated early. Prognosis of compartment syndrome after fasciotomy depends on how quickly the condition is diagnosed and treated.

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Figure 1. A swelling and blackish bruise appeared at right forearm.

Figure 2. A successful fasciotomy, necrotomy, and ligation of the brachiocephalic AV fistula.

Figure 3. The wound was fully healed after six months.

was performed. A longitudinal incision was started at the anterior of the palm, extended up the forearm crossing the elbow and continued longitudinally up the upper arm, ending near axilla line (Figure 2). The muscle tissue throughout the arm and forearm appeared diffusely oedematous and congested. There was no bleeding or hematoma formed. The volar forearm and upper arm muscles expanded on release. After fasciotomy, necrotomy was performed to remove excess necrosis tissue around brachiocephalic AV fistula and the brachiocephalic AV fistula was ligated. The wound was left open and wet-dressed.

Postoperative evaluation was carried out, a good radial and ulnar artery was obtained with Oxygen blood saturation of the right extremity was 95-100%. The patient underwent routine wound care and debridement twice. Six months after the surgery, the wound was fully healed and there was no sign of neuromuscular or vascular deficit of the patient's right upper arm, forearm or hand (Figure 3).

DISCUSSION

Acute compartment syndrome is still a clinical diagnosis that includes pain on passive stretching, rapid advancement over a short period of time, paraesthesia, pallor, pulselessness, and paralysis. One of the most sensitive diagnostic approaches are out of proportion with the apparent damage and paraesthesia with loss of 2-points discrimination test.\(^4\)

Compartment syndrome can be caused by many pathologies, including specific consequences, such as: (1) Reduction of the volume in the compartment, which could occur due to many causes including for example sustained localized external pressure, thermal injuries, burn eschar or closure of fascial defects; (2) increased compartment content due to hemorrhage, vascular injury, bleeding diathesis or anticoagulation; (3) External pressure and/or compression.\(^5,6\)

Those issues may happen independently or in combination, which is adequate to cause occlusion of the small vessels. The occlusion rapidly leads to muscle and nerve ischemic. In the event that compartment pressure is not relieved in time, it comes about in muscle damage with contracture and nerve damage.\(^5,6\)

Vascular access-associated compartment syndrome is reported rarely in hemodialysis patients. In this case, the patient underwent hemodialysis and was accessed in form of AV fistula. AV fistula is defined as an autogenous anastomosis between artery and vein to make hemodialysis access easier and increasing the venous flow to the dialysis machine. Histologically, the structure of the veins and arteries are different, the
tunica boundaries are not clear and also in the tunica media, the muscle tissue and elastic tissue are lacking so that the veins cannot withstand high pressure. The inability of the veins to withstand high pressure causes histological changes in the veins where the tunica intima hyperplasia will occur. Hyperplasia itself occurs due to an inflammatory response which increases oxidative stress, thus the activation of the leukocyte then causes the release of the myeloperoxidase triggered by turbulent blood flow resulting in proliferation of the venous endothelium so it makes central vein stenosis.7,8

Progressive stenosis slows venous return leading to local oedema and swelling of the arm. Continuous arterial flow and inadequate collateral circulation further increase compartment pressure and reduce venous return. Eventually, microcirculation is impaired and tissue ischemia develops, with typical skin changes and clinical symptoms of compartment syndrome. The combination of these pathophysiological features and our results highlight the possibility of severe venous hypertension progressing to the acute compartment.8,9

The normal tissue compartment pressure is close to 0 mmHg in conditions without contraction and rises with muscle contraction with an average of 0-8 mmHg. If the pressure becomes more than 30 mmHg, the small blood vessels will be compressed, causing a decrease in the flow of nutrients. Other than by measuring intra-compartment pressure, it can also measure the difference between diastolic blood pressure and intra-compartment pressure. If the result is less than 30 mmHg then it is considered an emergency because the area has become a compartment syndrome.8,10

Fasciotomy is the treatment of choice for the acute compartment syndrome. Rapid intervention is crucial for tissue recovery and rehabilitation. Ischemic tolerance of muscle tissue without irreversible damage is 4-6 hours and skin changes will be seen after 12 hours. Irreversible damage of nerve tissue is after 12 hours.5,6

The compartment syndrome prognosis after fasciotomy depends on how quickly the condition is diagnosed and treated. Fasciotomy performed within six hours results in practically complete return of limb function. After 6 hours, there may be residual nerve damage. Data indicates that only two-thirds of patients have normal limb function after the completion of fasciotomy within 12 hours. The limb will need to be amputated in extremely delayed situations.11

CONCLUSION
Compartment syndrome is a possible complication after AV fistula formation that can have disastrous consequences. However, it can be effectively treated if detected and treated early.

CONFLICT OF INTEREST
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ETHICAL CONSIDERATION
The patient had received signed written informed consent regarding publication of medical data in medical journal with confidentiality to personal information.

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