Iatrogenic Subclavian Arteriovenous Fistula: Rare Complication of Plate Osteosynthesis of Clavicle Fracture

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abstract

Iatrogenic subclavian arteriovenous fistula is rare and has not been reported as a complication of plate osteosynthesis of clavicle fracture. This article describes the first case of iatrogenic subclavian arteriovenous fistula caused by plate osteosynthesis.

A 36-year-old man sustained a right middle clavicle fracture in an injury and underwent open reduction and internal fixation with clavicular compression plate 3 days later in a local hospital. On the second postoperative day, a pulsatile mass and thrill were detected at the right supraclavicular region. The patient was discharged 3 days postoperatively with no extra inspection. Three months later, he was admitted to our institution because the mass was getting bigger and weakness was felt in his right upper limb. Digital subtraction angiography confirmed a subclavian arteriovenous fistula. Vascular surgeons treated the patient successfully using endovascular techniques. The subclavian arteriovenous fistula was eliminated with a fully expanded stent graft, and the plate was removed simultaneously. The result was satisfactory, and the postoperative course was uneventful.

This case demonstrated that subclavian arteriovenous fistula could be an iatrogenic complication of screw-and-plate osteosynthesis of clavicle fracture. The operative manipulation in the process of fracture reduction and hole drilling should be meticulous, and the screw length must be accurate. Orthopedic surgeons should be aware of this uncommon complication with plate osteosynthesis of clavicle fracture. We recommend using an endovascular surgical technique for treatment of this complication.

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Arteriovenous fistula can be congenital or acquired. Acquired arteriovenous fistula are traumatic or iatrogenic as a result of penetrating injuries that cause perforation in an artery and a vein, which are usually surrounded by a firm sheath, such as the femoral, carotid, or subclavian sheath, resulting in a communication between the artery and the vein. Arteriovenous fistula in the upper limbs are usually well tolerated, as shown by the time-honored arteriovenous fistula established for hemodialysis.

Iatrogenic subclavian arteriovenous fistula most commonly occurs in catheterization and can cause heart failure and be limb-threatening.1,2 Although many complications have been reported with screw-and-plate osteosynthesis of clavicle fracture, subclavian artery injury caused by a screw is rare. To our knowledge, iatrogenic subclavian arteriovenous fistula with plate osteosynthesis of a clavicle fracture has not been reported in the literature. This article describes a case of subclavian arteriovenous fistula as a complication of plate osteosynthesis of clavicle fracture.

**CASE REPORT**

A 36-year-old man presented with a slowly growing pulsatile mass in the supraclavicular fossa and weakness in his right upper limb of 3 months’ duration, which began after open reduction and internal fixation with a clavicular compression plate of his right clavicle fracture in another hospital. At admission, an obvious pulsatile mass, thrill, and continuous murmur were detected. He had palpable but weakened right brachial, radial, and ulnar pulses compared with the contralateral side. Radiographs revealed union of the right clavicle fracture (Figure 1). Digital subtraction angiography of the subclavian artery was performed, and subclavian arteriovenous fistula was confirmed. The arteriovenous fistula was located at tip of the most medial screw (Figure 2).

Because of the intimate relation between the screw and the subclavian artery, we treated the AVF with endovascular techniques and remove the implant simultaneously with a vascular surgeon consultant. The guide wire was inserted through the right femoral artery to the subclavian artery, and a balloon was sent to the position proximal to the arteriovenous fistula (Figure 3). Blood fluid was blocked through the dilated balloon to avoid massive hemorrhage while the screw was pulled out. A stent was placed across the lesion after the removing the plate and screws. Follow-up angiography demonstrated a successful exclusion of the subclavian arteriovenous fistula with a fully expanded stent graft (Figure 4). The pulsatile mass disappeared, and the radial pulse got stronger immediately.

Color Doppler scanning revealed a patent stent, with flow maintained along the venous and arterial segments of the covered stent. The postoperative course was uneventful.

**DISCUSSION**

Acquired subclavian arteriovenous fistula, which can be traumatic or iatrogenic, is rare because these vessels are protected by the overlying bony, surrounding muscular structures and sheath. In most series, penetrating trauma is the cause of this lesion. Gobin et al3 reported a case of posttraumatic subclavian arteriovenous fistula and subclavian thrombosis after a right clavicle fracture. Farhat et al4 reported a case of iatrogenic subclavian arteriovenous fistula as a complication of percutaneous subclavian vein puncture. Hess et al5 reported a case of iatrogenic subclavian arteriovenous fistula as a rare complication of implantable cardioverter–defibrillator implantation.

Plate osteosynthesis for displaced clavicle fracture is currently popular and has had good results, but several possible serious complications exist, including brachial plexus injury and subclavian artery injury.6 When subclavian artery injury is diagnosed, a thorough neurological evaluation should be included because of the proximity of the brachial plexus to the vessel. No neurological symptoms were recorded in our case.
Subclavian artery injury caused by a screw is rare. Johnson and Thursby\(^7\) reported a case of subclavian artery injury caused by a longer screw in a clavicular compression plate. Shackford and Connolly\(^8\) reported a case of a patient who developed limb-threatening ischemia as a consequence of a pseudoaneurysm that resulted from screw erosion of the subclavian artery. Ischemia of the upper extremity is usually absent with this lesion due to extensive collateral circulation of the extremity is usually absent with this lesion. Limb-threatening ischemia in Shackford and Connolly’s\(^8\) case was due to thrombosis formation in the brachial, ulnar, and digital arteries. In 1 series, 20% of patients had decreased or absent pulses.\(^2\) Our patient had decreased but palpable pulses.

To our knowledge, we have described the first case of iatrogenic subclavian arteriovenous fistula with screw-and-plate osteosynthesis as a complication of clavicle fracture fixation. Three possible risk factors relating to intraoperative surgical techniques exist that may endanger the subclavian vessels. First, the subclavian vessels are located directly behind the middle of the clavicle, the vessels could be injured by the drill bit when it goes inferiorly while hole drilling. Therefore, the protection sleeve is recommended to avoid the drill going too deep to avoid injuring the vessels. Third, even a slightly longer screw can damage the subclavian vessels. In our case, angiography showed that the arteriovenous fistula was located at the tip of the most medial screw (Figure 2). Screw length accuracy is crucial.

In our study, arteriovenous fistula was treated by endovascular surgical techniques, which have been recommended by several authors.\(^10,11\) With balloon-assisted selective occlusion of the subclavian artery, implant removal is much safer and prevents the possibility of massive hemorrhage. The use of endovascular stent grafts reduces the need for surgical dissection and the risk of injuring the surrounding structures, such as the vagus nerve, recurrent laryngeal nerve, phrenic nerve, and innominate vein.\(^12\) It is a cost-effective treatment that reduces patient discomfort, morbidity, blood loss, operative time, and the use of difficult maneuvers to expose the injured vessel.\(^13\) Orthopedic surgeons should be aware of arteriovenous fistula with plate osteosynthesis of clavicle fracture and endovascular surgical technique is recommended for treatment of this complication.

**REFERENCES**


