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Case Report

Minor leg trauma and major arterial consequence: Report of a case and review of the literature

Major arteriyel hasarla sonuçlanan minör bacak travması: Olgu sunumu ve literatür taraması

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ABSTRACT

A high-energy, blunt trauma with fracture/dislocation in an extremity can result in intimal dissection or transection of the involved arterial segment, which may either compromise the lumen or lead to morbidities associated with extravasation. However, there are few reports indicating low-energy or minor blunt traumas without fracture/dislocation could result in major artery injuries in a crural region that mostly diagnosed months after the initial traumatic event.

Here we present a case of rapidly expanding hematoma of the calf week after a minor blunt trauma in which hematoma originated from posterior tibial artery injury.

Keywords: Athlete; minor trauma; low-energy; leg; tibial artery; sport; pseudoaneuriysm.

ÖZET

Ekstremitlerde yüksek-enerjili, kırık/dislokasyonların eşlik ettiği kapalı bir travma; ilgili arteriyel segmentlerde kolayca lümen içine hasar vererek yahut ekstravazasyona yol açarak klinik manifestasyonlara yol açabilir. Bununla birlikte, literatürde; kırık/dislokasyonların eşlik etmediği, düşük-enerjili, minör, kapalı travmaların kruris bölgesinde majör arter hasarına yol açabileceğini bildirmiş az miktarda olgu vardır.

Biz burada minör, kapalı bir cruris bölgesi travmasından sonraki hafta içerisinde posterior tibial arter hasarından kaynaklanan ve hızla genişleyen hematomla sonuçlanan bir olguyu takdim ediyor ve ilgili literatür taramamızı ve olgudan edindiğimiz tecrübelerimizi tartışıyoruz.

Anahtar kelimeler: Sporcu; atlet; minör travma; düşük-enerji; bacak, tibal arter; spor; psödoanevrizma

INTRODUCTION

A high-energy, blunt trauma associated with fracture or dislocation in lower extremity can easily result in either a transection of the involved arterial segment that provokes extravasation or a full thickness damage leading to pseudoaneurysm (PsA) formation. In addition, the injury sometimes can only be limited to the intima or media layer that end

up with occlusal manifestations or true aneurysm formation of the involved arterial segment (1-3).

A minor (low-energy, non-penetrating, blunt) trauma of the leg, however, have very rarely been related to the concomitant bone fractures that cause major arterial injuries (4). Furthermore, as commonly encountered in sporting events-associated minor traumas of the leg, such as sprains, blows, kicks or tackles -even if they require high index of suspicion for detection (5) or sometimes are considered as "unexpected (6)"- can indeed involve major arterial injuries in the complete absence of bone disruptions (7-20).

A review of the literature revealed that such vascular pathologies are reported almost exclusively in athletes or amateur players. Swelling after such trauma is not unusual and is usually treated conservatively as the first course of therapy. In addition, vascular damage in these individuals has mostly been detected as the development of PsA, which are usually able to be identified a few weeks after the traumatic event.

Here we present a rapidly expanding hematoma originated from a major leg artery one week after a minor, blunt trauma that occurred during cycling. We also discuss the lessons learned and the important features of the limited number of other similar reported cases.

Case

An eighteen-year-old, male amateur cycler was evaluated in the outpatient setting the day after the accident that occurred during low-speed, relaxed pedaling. He stated that sudden breaking off of the chain caused a blow to his passive, right posterior leg by rapidly rotating contralateral pedal. He suffered moderate pain that improved by ice packs and elevation until his hospital visit. His history was unremarkable for chronic/congenital diseases, tobacco/illicit drug use and bleeding disorders along with the use of anticoagulants. Physical examination revealed diffuse, remarkable swelling in his right calf without any skin discoloration and moderate tenderness on palpation of the calf muscles. He was able to tip-toe with mild pain in his right calf. Pedal pulses were palpable, and there was no neurologic deficit. An X-ray excluded bone fractures or disruptions. Contusion of calf muscle was considered. He was scheduled one week later for a follow-up, along with the leg-ankle splinting and recommendations of elevation, bed rest, ice packs, and non-steroid anti-inflammatory drugs (NSAIDs).

One week later, improvement in swelling and calf pain was, if any, minimal. Yellowish green hue was also noted on the calf skin. A Duplex not only excluded the deep venous thrombosis and confirmed triphasic flow in posterior tibial artery (PTA) and anterior tibial artery (ATA), but also revealed a 69x28mm perivascular hematoma that mostly located beneath the soleus muscle. The hematoma was then thought to be secondary to tear of soleus muscle and a magnetic resonance imaging (MRI) was scheduled for the next day. The same treatment protocol including splinting was carried on for one more day.

The next day, the leg-ankle splint was removed for MRI procedure. The patient left the office with a crutch to ease in ambulation. After completion of imaging, the patient rushed back into the room with extreme anxiety because of a significant swollen right calf and excruciating pain. He also noted that he had mild progressive pain in his right calf before the MRI procedure began and was no longer able to ignore it shortly after he began returning to the office. An acute hematoma diagnosis was made and followed by inpatient clinic admission for further evaluation. The MRI result, by the way, also affirmed 195x70mm former and ongoing hematoma formation and likely partial rupture of gastrocnemius fibers proximally (Figure 1). Although the patient was first observed for 6 hours with the expectation that the expansion of the hematoma might have resulted from advancing calf tear and could limit itself with immobilization, it was then decided to perform an emergent fasciotomy and hematoma evacuation due to an ever-expanding calf size that could lead to compartment syndrome. At this point, the pain was also noticed intolerable despite the intravenous opiate analgesics.

On the operating room table, the right calf diameter was measured 9 centimeters larger than the left (Figure 2, left). After a vertical 6 cm incision over the medial aspect of the posterior calf, the hematoma popped out following the fascial incision (Figure 2, middle). Pulsatile gross bleeding also noted in deeper. Following a thigh tourniquet, the hematoma was evacuated. A small tear (Figure 2, right) detected in PTA was repaired with microsurgical technique. A suction drain was placed, and the incision sutured. The patient was discharged on postoperative third day without any complication. Follow-ups remained uneventful along the next six months.

DISCUSSION

The management of arterial trauma of limbs in any patient is a serious situation, with a potentially high price of amputation to be paid for a bad or late decision even if the sustained trauma seems to be low-energy and lacks skin penetration or bone disruptions (7,8).

Although the most frequent mechanism of vascular injury in blunt traumas of extremities is a fracture/dislocation imposing tension, traction, or a contusion on the adjacent artery (3), vascular injuries without fracture/dislocations may also occur (7-20). The five recognized types of vascular injuries are as follows (1): intimal injuries (flaps, disruptions, or subintimal/ intramural hematomas); complete wall defects with PsA or hemorrhage; complete transections with hemorrhage or occlusion; arteriovenous fistulas; and spasm.

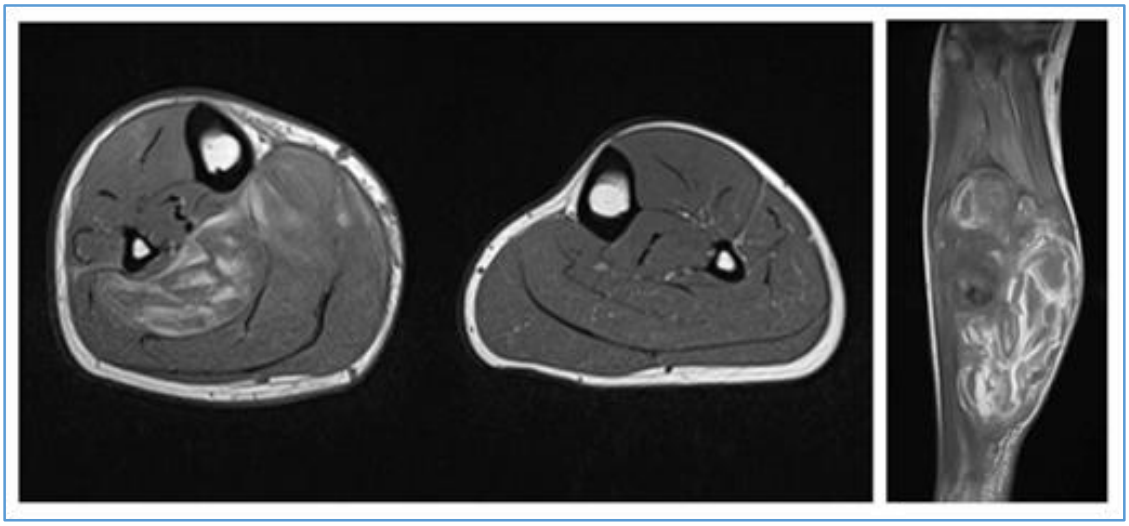

Figure 1: Gadolinium enhanced; T1-weighed MRI shows heterogeneous low to intermediate signal intensity. Heterogeneously mixed intensity signals on the coronal view(right) shows expansion of hematoma in medial, superior, and superficial directions.

Figure 2: View of early hematoma expansion (left above). Calf diameter difference reached 9 cm when the patient was on the operating room table (left below). Hematoma gushing after fascial incision(middle). 3 mm tear on PTA wall (right, arrow).

A comprehensive literature search revealed 17 cases of low-energy, non-penetrating trauma of leg without bone fracture or disruption, but that involve the injury of one of the major arteries of the leg (Table 1). The majority of reported injuries appeared to have a clear relationship with sporting events (14 out of 17). Injury mechanisms were ankle sprains, forced inversion/hyperflexion of the ankle and blows of the shin, ankle and foot. 11 out of 17 vascular injuries were identified as PsA and although the time consumed for the correct diagnosis of these PsAs ranged between 1 day to 8 months, it usually was not sooner than couple of weeks. While partial or complete vascular occlusions were the second common vascular pathology (5 out of 17), one case resulted with complete disruption of ATA that leads to compartment syndrome in hours (13).

Authors emphasized professionalism (P) of the associated sporting event in 8 out of 17 cases. Bandy et al. reported a volleyball player whom they were able to diagnose a pseudoaneurysm in her peroneal artery (PA) after persistent pain for weeks (9). Marron et al. diagnosed a PsA of ATA five days after a forced ankle hyper-plantarflexion injury of a soccer player (14). In this case, a skin ulceration of the swollen area of the ankle not only gave rise to second visit of the patient, but also guided relatively much earlier diagnosis of the PsA. Chougle et al. surgically bypassed a completely occluded PTA of a football player who was diagnosed two months after an ankle

sprain (6). Shalhoub et al. reported three professional football players with ATA occlusion, whom could only be diagnosed after several weeks of the initial injuries (18). The author also discussed the conservative treatment in these vascular injuries. Elens et al. endovascularly coiled a PsA of ATA of a soccer player after weeks of persistent pain (19). And lastly, Aslım diagnosed a complete occlusion of PTA after 3 weeks of ischemic symptoms in a soccer player (20).

Table 1: Reported major arterial injuries following low-energy, non-penetrating, blunt traumas of the leg. Cases above also lacks bone or joint disruptions. ATA, PTA and PA respectively represent anterior tibial, posterior tibial and peroneal arteries (cases involving the branches of any of these arteries were excluded). P: Professionalism in associated sport. PsA: Pseudoaneurysm. *: cases with persistent pain and swelling following the first course of the therapy. N/S: not specified.

Authors	Sport Event involved	Mechanism of injury	Vessel involved	Vessel pathology	Time to diagnosis	Complaint/Finding
Bandy et al.[9]	Volleyball (P)	Ankle inversion sprain	PA	PsA*	26days	Severe pain/increased swelling
Upponi et al.[10]	Football	Forced ankle inversion	PA	PsA*	2w	Persistent pain/swelling
Rooney et al.[11]	N/S	Ankle inversion sprain	ATA	PsA	4w	/Pulsatile mass
Skudder et al.[12]	Taekwondo	Kick to anterior shin	ATA	PsA*	9m	Numbness, tingling, bluish discoloration
	Baseball	Ankle inversion sprain	ATA	PsA	8w	/Ecchymosis, hematoma with expansile pulse
Dhawan et al.[13]	Basketball	Ankle inversion sprain	ATA	Complete disruption	26hours	Increasing pain and swelling/compartment syndrome
Chougle et al.[6]	Football (P)	Kicking the ball with medial aspect of the foot	PTA	Complete* occlusion	8w	Discomfort, pain, numbness, pallor, coldness
Marron et al. [14]	Soccer (P)	Ankle hyperplantar flexion injury	ATA	PsA	5days	Skin ulceration
Christofilopoulos et al.[15]	Skate boarding	Forced ankle inversion	ATA	PsA*	2w	Persistent swelling/tenderness, pulsatile mass and absent pulse distal to the mass
Ramdass et al.[16]	Football	Forced ankle inversion	PA	PsA	2w	/Pulsatile swelling with skin necrosis
Joglar et al.[17]	Low-speed motorcycle accident	N/S	PTA	PsA*	3w	Pain, swelling/edema, tenderness
Shalhoub et al.[18]	Football (P)	Blow to shin	ATA	Partial occlusion	9w	Coldness, pallor
	Football (P)	Kick to anterolateral ankle	ATA	Complete occlusion	8w	Numbness, cramping, pallor/absent pulse
	Football (P)	Kick to anterolateral leg	ATA	Complete occlusion	1day	Pain, coldness
Elens et al.[19]	Soccer (P)	Tackle on right leg	ATA	PsA*	N/S	Persistent pain/tender swelling
	N/S	Ankle inversion sprain	ATA	PsA*	N/S	Persistent swelling
Aslım [20]	Soccer (P)	Kick to medial ankle	PTA	Complete occlusion	3w	pain, numbness/pallor paresthesia, coldness

In our case, a Duplex performed one week after a non-penetrating, low-energy trauma revealed an organizing hematoma in the deep posterior compartment of the right calf, which was intended to treat conservatively until the more precise causative

etiology enlightened by MRI. Presumably, this first hematoma adjacent to PTA had resulted from a leakage through a small PTA own wall tear which limited itself spontaneously. Shortly after removal of the leg-ankle splint and subsequent ambulation, the patient started to experience discomfort in his calf, and he could not ignore the pain anymore following completion of MRI procedure. We consider this rapid process as secondary damage of the previously injured segment of PTA wall where normally at its healing phase and could be expected to develop a PsA later. Thus, ambulation probably had deleterious effects on this injured wall segment that could be targeted to develop PsA, and eventually led to more significant arterial wall tear causing rapidly expanding hematoma. Besides, inflammatory architecture resulted from the initial hematoma and NSAIDs prescribed might have contributed to the secondary tearing process. On the other hand, the MRI also revealed a calf tear which contributes to edema, superficial hematoma and skin discoloration. Even this supports the accuracy of initial diagnosis and treatment, anyhow, obviously this was not entire spectrum of the injury that resulted from the trauma.

Although artery originated hematomas typically present with pulsatile nature, we did not experience this phenomenon, likely due to the initial deep location of the hematoma. We believe that emergent fasciotomy, hematoma evacuation and arterial repair prevented serious complications such as compartment syndrome and late pseudoaneurysm formation. Conservative approach as we applied at first, however, was not a wise choice in a progressively expanding calf hematoma. Unfortunately, this decision was followed mainly by the idea that a major arterial injury was “unexpected” after such a minor trauma, and that this hematoma, possibly caused by ruptured smaller vascular branches or muscle fibers, might be self-limiting with the conservative approach (4).

A PsA of PTA developed following a calf blow during a low-speed motorcycle accident,17 share common features, such as mechanism of injury, persistent pain/swelling and clinical presentation/progression with our case. If the secondary trauma (ambulation) did not cause arterial rupture and subsequent expanding hematoma, our case would have probably also result in PsA development.

Our case also shares important substantial clinical features with the case reported by Young et al., in which a rugby player who was sustained a minor, blunt trauma to his anterior thigh and was initially empirically treated for diffuse anterior thigh swelling due to quadriceps contusion and was eventually underwent fasciotomy for gradually worsening pain and swelling (5). Although an obvious hematoma was not noted following fasciotomy of anterior compartment, a Duplex demonstrated a deep thigh hematoma and related PsA of profunda femoris when the patient re-presented because of sudden increase in pain and swelling ten days after following his hospital discharge. The patient then underwent successful embolization for the bleeding PsA of the profunda femoris. Authors suggested that this re-presentation might be due to rebleed of the PsA which was initially compressed and sealed by the deep perivascular hematoma and as the hematoma liquefied and resorbed local pressure on the artery lessened and led to further bleeding. This theoretical mechanism of rebleed also may have been contributed to our case even if we consider the ambulation as the major factor.

Persistent pain and unimproved swelling after the first course of the treatment (e.g. ice packs, NSAIDs, immobilization) of such minor traumas are noted in the majority of the reported PsA cases (8 out of 11 PsAs, Table 1, *). Therefore, after the first course of treatment, including arterial examination when detailing the investigation of more causative etiology of persistent symptoms (e.g. pain, swelling, unimproved edema) can expedite the diagnosis of PsA. This especially can be crucial in professionals since persistent pain or ischemic symptoms of PsAs may significantly interfere the individual performance and also may require surgery for definitive treatment.

Conclusion

Injury of the major leg artery following a minor sporting trauma should be one of the “expectable” consequences. Major arterial damages in such traumas occurs by mainly three distinct mechanisms: transection, occlusion and PsA formation. A transection can be limb threatening via compartment syndrome and should especially be taken into account when progressive swelling or unexpected reswelling along with the persistent severe pain is noted. A rapidly expanding extremity also warrants prompt exploration of the vascular status. A partial or complete occlusion of an artery can lead to activity-related ischemic symptoms. PsA presents with either painful swelling/mass or ischemic symptoms, both can be sufficiently subtle or nonspecific immediately after the initial trauma and this cause the diagnosis usually to be made weeks to months later. A PsA can be detected earlier with skeptical vascular investigations, especially in cases unresponsive to first course of treatment and with persistent pain and swelling. This early diagnosis may be of utmost importance especially in professionals.

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