



Difficulties in the diagnosis of isolated radial artery injuries: a case report

İzole radial arter yaralanmasında tanı güçlükleri: Olgu sunumu

S. Sinan BILGIN,^{1,2} Oguz CEBESOY,¹ Ismail Hakki GULEC,¹ Ahmet PISKIN³

Ankara University, School of Medicine ¹Department of Orthopaedic Surgery, ² Section of Hand Surgery
³Ondokuz Mayıs University, School of Medicine, Department of Ortopaedic Surgery

Önkoldaki arter yaralanmaları, periferik vasküler travmaların önemli bir kısmını oluşturur. Erken tanı ve tedavi gerek el fonksiyonları açısından, gerekse ekstremitenin yaşamı açısından çok önemlidir. Önkolda arter yaralanmaları sıklıkla cam, bıçak ve ateşli silahlarla meydana gelmektedir ve bu yaralanmalarla birlikte ek yaralanmaların olması tanıyı kolaylaştırır. Fakat, sunduğumuz olguda (50 yaşında erkek hasta) küçük bir çivi parçası yüksek enerjili cisim gibi davranıp başka bir hasar vermeden radial arteri yaralamış; ulnar ve radial arter nabızlarının normal bulunması tanı ve tedaviyi geciktirmiştir. Bu yazıda, tedavisi basit olan yaralanmanın tanısının konmasındaki sorunlar gündeme getirildi.

Anahtar sözcükler: Arter/yaralanma/cerrahi; önkol/kanlanma; önkol yaralanması/komplikasyon/cerrahi; radial arter/yaralanma/cerrahi; yaralanma, delici/komplikasyon.

Arterial injuries of the forearm account for an important fraction of peripheral vascular injuries. Early diagnosis and treatment are important for both function and viability of the extremity. Arterial injuries of the forearm mostly occur as a result of glass or knife cuts and gunshot wounds and the presence of accompanying injuries may facilitate the diagnosis. However, in this case (50-year-old male patient), a piece of nail behaved like a high-energy particle and injured the radial artery without any accompanying lesion. Detection of normal pulses in the radial and ulnar arteries delayed the diagnosis and treatment. This case report aimed to address difficulties in establishing the diagnosis of isolated radial artery injuries.

Key words: Arteries/injuries/surgery; forearm/blood supply; forearm injuries/complications/surgery; radial artery/injuries/surgery; wounds, penetrating/complications.

Forearm vascular injuries are frequently seen in the upper extremity and account for 20% of the vascular injuries.⁽¹⁾ Most of these injuries are caused by cutting and penetrating instruments like glass and knife and the rest can be listed as firearm injuries, iatrogenic injuries and suicidal attempts.⁽¹⁾ For the successful treatment of acute vascular injuries, it is essential to have a thorough knowledge of symptoms and vascular anatomy, the accompanying bone, soft tissue and nerve injuries should be evaluated carefully. The accompanying injuries quicken the diagnosis and treatment, but in some cases like ours, the presenting signs may start innocent and progress to serious complications.

Case report

Fifty years old, right handed male patient presented to our emergency department with complaints of pain and swelling in his left forearm. One day ago, while nailing a piece of wood, the nail head had broken and stuck into his left forearm. Just after the incident, the patient tried to stop the bleeding and dressed his wound. Two hours later, pain and swelling developed and he went to a local hospital. Nothing was done to explore or extract the foreign body, skin was sutured and tetanus prophylaxis and empirical antibiotic treatment was given and a long arm splint was applied. Twelve hours after the initial injury he went

Correspondance to: Dr. S. Sinan Bilgin. Ankara University, School of Medicine, Department of Orthopaedic Surgery, Section of Hand Surgery, 06100 Samanpazarı, Ankara.

Phone: +90 312 - 310 33 33 / 2605 Fax: +90 312 - 311 25 22 e-mail: ssbilgin@hotmail.com

Received: 30.01.2004 **Accepted:** 01.02.2005

to another hospital but no further treatment was given to the patient. Twenty eight hours after the injury he presented to our hospital. His vascular surgery consultation revealed normal ulnar and radial artery pulses with normal extremity circulation and he was referred to our department.

The medical history of the patient was insignificant. He had a sutured wound of 1 cm on the trajectory of the radial artery in the left proximal forearm. There was significant swelling, and tenderness. The swelling had progressed to a more proximal region, to the proximal part of the antecubital fossa and there were no signs of infection. Distal ulnar and radial artery pulses were palpable, nail bed capillary refill was normal. When radial artery was compressed at the wrist there were no changes in ulnar arterial pulse fullness but when the same pressure was applied to the ulnar artery, fullness of the radial artery decreased significantly (Allen's test could not be evaluated exactly because of the swelling in the forearm.), besides the patient had no neurologic deficits. The elbow flexion was normal (although the patient had pain after 90 degrees flexion), but the last 20 degrees of extension was limited due to pain. The wrist range of motion was normal with minimal pain. The foreign body was visible at the two centimeters anterior and 1 cm lateral part of the proximal radius in AP and lateral X-rays (figure 1). Whole blood count was normal.

He was diagnosed to have compartment syndrome but as the etiology was still unclear, the sutures were removed under local anesthesia and the incision was extended (figure 2). The initial diagnosis was an arterial laceration but it was not clear whether there was an accompanying infection. There was a hematoma at the wound site and upon removal of the hematoma, abundant bleeding was started. Compression was

applied and the patient was transferred to the operating room. Exploration showed us that upon piercing skin, subcutaneous tissue and brachioradialis muscle, the nail head had lacerated about 80% of the radial artery. The foreign body could not be found. The cut ends of the radial artery were resected and the artery was anastomosed using 8.0 prolene. Upon deflation of the tourniquet, the vessel had antegrade filling and no escape from the anastomosis site. A penrose drain was left at the operation site and the wound was sutured. At the first post operative week, the functional examination was normal. There was minimal increase of temperature, mild hyperemia and tenderness. These findings were consistent with infection, so oral antibiotics and anti-inflammatory drug were administered. The signs had improved at the second week. The sutures were removed at the end of third week. The patient had no functional deficits at the end of 4th week. At postoperative 6th month both the functions and examination findings were normal and the patient had no cold intolerance.

Discussion

There are three types of arterial injuries; total laceration, partial laceration and the type of injury in which the vascular integrity is preserved. These injuries are differentiated according to their degree of criticality. Critical injuries end up with necrosis if not treated with arterial reconstruction. Non critical injuries do not end up with necrosis even if no reconstruction is performed.⁽²⁾ The fact that delayed the diagnosis on our case is the non critical nature of the isolated forearm arterial injury and neglecting of the mechanism of injury. A high energy trauma penetrating the forearm fascia is the first sign of a potential arterial injury and until otherwise is proved, it should be approached as an arterial injury.⁽¹⁾ In our

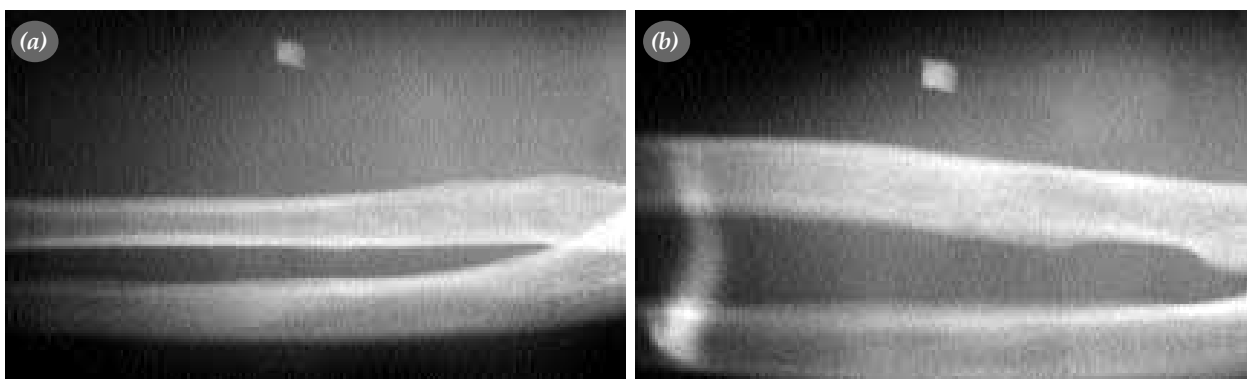


Figure 1. (a, b) The head of the nail can be easily seen closed to the radius in oblique x-rays.

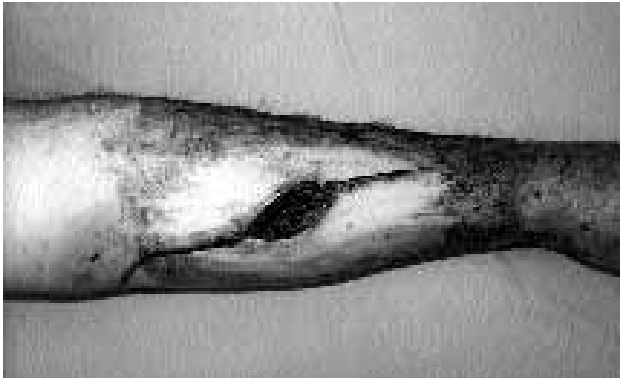


Figure 2. The extended incision on anterior side of the left forearm. The hematoma was evacuated and then tourniquet was applied proximally. The entry point of the head of nail is just in the middle of the incision.

case, the presence of pulses despite the enlargement of the hematoma indicates the second problem during the assessment. This kind of injuries, in the presence of adequate collateral circulation, sympathetic tonus and vasomotor control mechanism may either present as pain, paresthesias and weakness or hematoma, pulsatile bleeding or ischemia. Distal pulses are not reliable as they can be detected in as much as 57% of isolated forearm arterial injuries due to retrograde circulation from the collateral route. Only in 7.6% of these, an acute arterial insufficiency is evident.^(1,2)

Allen's test, Doppler ultrasonography and arteriography have an important role in the establishment of diagnosis. With the suspicion of a radial arterial injury, we also applied Allen's test to our patient but because of the extensive swelling and edema in the forearm, we could not rely on our findings. We diagnosed the patient to have compartment syndrome according to the examination findings but as we could not define the cause, we had to explore the wound site. Even if the probability of an infection causing a compartment syndrome in 28 hours is low, we could not exclude the infection. The drainage of the hematoma, the detection of pulsatile bleeding and so finding the exact cause, enabled us to make an emergent arterial anastomosis as an appropriate treatment for this patient.

There is an indication for reconstruction in all critical arterial injuries. Indications are not as clear in the non critical injuries, but reconstruction is mandatory if there is accompanying neural injury.⁽²⁾ Reconstruction is important in the injuries of both

arteries in the forearm but the indications in isolated injuries are not clear and these cases are treated with ligation or primary anastomosis.^(1,3, and 4) In the case of isolated arterial injuries of the forearm, in the presence of sufficient collateral circulation, ligation does not cause ischemic sequelae in the long term.⁽⁵⁾ The presence of a single artery distal to the elbow is sufficient for functions, if this is the case, ligation especially in large contaminated wounds and in local injuries, is a safe, easy to apply and cheap procedure.^(1,5,6) In forearm arterial injuries although ligation is a simple and easy solution, because of the advances in microsurgical techniques and equipments, if possible, microsurgical repair should be done.⁽¹⁾ The possibility of injury to the remaining artery should be kept in mind as this can cause a significant compromise to the vascular supply of the extremity.⁽¹⁻³⁾ In some cases, insufficiency of palmar arc, reaching up to 20%, may increase the risk of ischemia following single arterial injury and therefore necessitate vascular repair.⁽³⁾ In some cases there is the risk of thrombosis but even in the presence of thrombosis, recannulation of the repaired artery enables the development of collateral circulation and should be done if possible.⁽³⁾

In conclusion as seen in our case, thorough evaluation of the extremity is extremely important even in simple and innocent penetrating injuries. The evaluation should start with obtaining a detailed patient history including the mechanism of injury. In this case presence of an unstoppable bleeding from a small penetration site and the progressing swelling of the extremity were the warning signs. The physical examination findings point to an arterial injury and compartment syndrome. It is important to know that the palpation of distal pulses do not exclude arterial injury. In our experience another point to draw attention is the neglecting of the compartment syndrome in the presence of distal pulses. As seen in this case, the progression to the compartment syndrome can be significant if treatment is delayed but again as in this case if there is a high index of suspicion, the wound site should be explored. The surgeon who does the exploration should also have enough knowledge and capabilities of microsurgical vascular reconstruction. We are against creating an extremity with a single artery by ligation in isolated arterial injuries and think that reconstruction is mandatory in these cases.

References

1. Lee RE, Obeid FN, Horst HM, Bivins BA. Acute penetrating arterial injuries of the forearm. Ligation or repair? *Am Surg* 1985;51:318-24.
2. Evans PJ, Rush DS, Smith BP, Koman LA. Management of vascular disorders in the upper extremity. In: Chapman MW, Szabo RM, editors. *Chapman's orthopaedic surgery*. Vol. 2, 3rd ed. Philadelphia: Lippincott Williams & Wilkins; 2001. p. 1111-45.
3. Gelberman RH, Nunley JA, Koman LA, Gould JS, Hergenroeder PT, MacClean CR, et al. The results of radial and ulnar arterial repair in the forearm. Experience in three medical centers. *J Bone Joint Surg [Am]* 1982;64:383-7.
4. Raskin KB. Acute vascular injuries of the upper extremity. *Hand Clin* 1993;9:115-30.
5. Aftabuddin M, Islam N, Jafar MA, Haque E, Alimuzzaman M. Management of isolated radial or ulnar arteries at the forearm. *J Trauma* 1995;38:149-51.
6. Ballard JL, Bunt TJ, Malone JM. Management of small artery vascular trauma. *Am J Surg* 1992;164:316-9.