

About a case of missed diagnosis of a post-traumatic aneurysm in the ulnar artery

Medical-legal aspects in respect to the professional liability



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Compartment syndrome of the left hand from a late diagnosed post-traumatic ulnar artery pseudoaneurysm. We report the case of 27 years old boy with a tipping and cutting wound on his left wrist, generating an ulnar artery pseudoaneurysm, that was late diagnosed, and therefore complicated by a compartment syndrome in the wrist. Immediately after the trauma the subject went to the emergency room where the severity of the injury was underestimated; in fact, it was sutured and medicated, without further investigation. When he went to the same hospital for the second time, symptoms (pulsatile mass, redness and irritation of the skin) were interpreted as an infectious process and treated in an incongruous way. Then, when he went to another hospital in which imaging studies (ultrasound) were performed, the pseudoaneurysm of the ulnar artery was diagnosed and surgically treated. The delay in diagnosis led to a compartment syndrome that is still appreciable as a sensory-motor deficit of the hand, especially of the fourth and fifth finger. This pseudoaneurysm complication and its debilitating outcomes are known in literature, so the diagnostic delay makes the sanitary staff guilty of the suffered damage.

KEY WORDS: Compartment syndrome, Forensic medical aspects, Post-traumatic ulnar artery pseudoaneurysm

Introduction

By pseudo aneurysm, we mean a hematoma bound in a peri-avventitial fibrous capsule, deriving from the point lesion of an artery, which can cause the compression of its same delimiting structures (vases, tendons and nerves), with the development of a compartment syndrome.

Speaking in haetiopatogenetic terms, we know two kinds of pseudo-aneurysm: the one deriving from a traumatic or iatrogenic lesion and the one depending by the partial or total subsidence of a vascular anastomosis (anastomotic pseudo-aneurysms). Most of the first kind is a consequence of penetrating lesions and/or wounds, even if the literature reports cases deriving from traumas caused by blunt objects ¹. In particular, literature locates the traumas of the hand as the main cause of pseudo-aneurysms in the ulnar artery ². The iatrogenic kind, instead, is a complication of a catheterization, hence it can be found basically into the common femoral artery ³. Among the main risk factors involved into the formation of pseudo-aneurysm, anticoagulant and/or

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antiplatelet therapies, anatomic variation for the vasis (i.e. an high origin of radial or ulnar artery) ⁴, curdling ailments such as haemophilia A ^{5,6}, neurofibromatosis ⁷, Bechet syndrome are included ⁸. From an epidemic point of view, it is not possible have a right estimate of the pseudo-aneurysm prevalence, probably because of the diagnostic delay that often takes place during the identification of the pathology ⁹; this aspect highlights the importance of an opportune diagnosis, that then can be useful for an optimal prognosis. The typical symptomatology of pseudo-aneurysms is characterized by a pulsing mass topped with erythematous skin, pain and paraesthesia; these symptoms can be connected to the compression caused by the haematoma over the surrounding tissues. Furthermore, the same symptoms can appear weeks or months after the initial trauma (exactly the 47% of the cases appear after 30 days from the triggering event) ¹⁰. Among the major complications, beyond the mentioned compartment syndrome ¹¹, thromboembolic episodes, breaking and haemorrhage ¹², neuroaprassia are included ¹³. The therapeutic method doesn't have to be exclusively related to surgery, but it can vary with the case: sometimes the bandaging, the ultrasound-guided manual compression, the ligature, the implant of endovascular prosthesis, the embolization, the intra-aneurysm ultrasound-guided injection of thrombin, the resection followed by anastomosis can be useful ¹⁴.

So, pseudo-aneurysm can be considered a dangerous pathology, that if not diagnosed promptly, it can expose the patient to serious complications, and the healthcare professional to censure because of professional negligence. About the latter, we report the case of a boy affected by pseudo-aneurysm of ulnar artery as consequence of a cutting wound at the left wrist, which was late diagnosed, with relevant consequences.

Case Report

A 27-years-old subject, during his working activity (butcher), got a cutting wound at left wrist, at the level of volar area. At the first-aid, he was dismissed after a shallow medication, suture and a provision of antibiotic therapy for three days. After 6 days, he came back at the same first-aid because of a painful swelling, right leveled with the wound; the swelling was thought to be caused by an infection. In virtue of this, he was dismissed again with the diagnosis "*left wrist erysipelas due to penetrating wound*" and repetition of antibiotic therapy. After three days, the patient started to complaint a strong pain to the whole forearm: therefore, he went to another hospital where the doctors proceeded with an ultrasound exam which resulted in: "*post-traumatic pseudo-aneurysm of ulnar artery (2.5 x 1.1 cm) due to cutting wound*". He was then admitted to the Plastic Surgery Ward, where he underwent to a surgery for "*arterior-*

rhexy". During the operation, the damaged structures could be detected: "*We report the continuous lesion at the level of ulnar artery (80%). The ulnar nerve looks like lightly affected by a cutting lesion at its perineurium, but affected by the hematoma. Relevant hematoma that by now is almost organized, expanding between the muscular bowels of superficial and deep flexor. The superficial flexor muscle seems lightly damaged and disarranged from the hematoma*"; this hematoma was treated as following: "*cut of the ulnar artery involved section (3mm) and, by optical instruments, we perform an arteriorrhaphy*". Then, the patient was dismissed with the diagnosis of "*pseudo-aneurysm of ulnar artery at left forearm*". During the following check-ups, the patient underwent an electromyographic exam that showed a serious neurologic deficit ("*iSAP and response to motor activity not relievable at left ulnar n. Large spontaneous activity at abductor m. of left V finger with no voluntary activity*"). Hence, since the worker received damages as consequence of a presumed wrong conduct of the healthcare professionals, he decided to take legal actions. During the medical-legal check, into the case history it was reported that when the trauma happened, the blood poured out from the lesion like a "gush" and that it was declared also during the very first visit at the ER. During the objective exam it was observed, beyond the scar (lengthwise, 7cm long, at third distal of the volar area of left forearm, on the ulnar side), also the "semi-benedictory" attitude of the hand because of the flexion of phalanx-metacarpus and interphalangeal section of IV and V finger on the left hand, with an evident hypotrophy at hypothenar eminence and Interosseous muscles levels, among the III, IV and V metacarpal ray. It was noted also a sensory-motor deficit with passive extension of the fingers, limited to the IV and part of the V finger, especially at the proximal interphalangeal level. Furthermore the abduction of the fingers was definitely deficit, it was possible but impaired. Especially between the III and IV fingers. Finally, an hypoaesthesia of III and IV finger was detectable.

Discussion and Comments

In the above described case, the pseudo-aneurysm into the ulnar artery formed because of a penetrating cutting wound at the wrist, and it produced the development of a compartment syndrome involving the Guyon canal. The related literature includes among the most frequent complications of a pseudo-aneurysm, the canicular nervous syndromes. In this specific case, a clear compression of the ulnar nerve was found, which run within the Guyon canal; this canal is at ventral level of the wrist, parallel to the carpal tunnel, from which it is divided by a wall thick few millimetres.

The compression of the structures contained within it causes a symptomatology characterized by paraesthesia

and reduction of perception ability of fourth and fifth fingers of the involved hand, with potential functional impotence, especially to execute some special movements. In the most serious cases, the consequence can be the so called “claw hand”, which happens when the nerve can't conduct anymore the impulse to the hand muscles. Who suffers from the Guyon syndrome often reports a normal sensitivity over the hand top and the fingers, since the perceptive branch that arrives to the top of the hand and fingers starts from a point of the ulnar nerve before it enters into the Guyon canal. However, the compartment syndrome, as we said before, doesn't appear immediately after the traumatic event, but after a conspicuous time lapse that permits the creation of pseudo-aneurysm, that is the hematoma which provokes a large lesion, occupying the space between two anatomical structures nearby, penetrating the muscle-tendon plans (with the consequent scar retraction of the single nervous bundle through the spilled blood).

In our case, during the first visit at the first-aid, the healthcare professionals noted the presence of a cutting wound with no functional and/or articular deficits; therefore, they proceeded with suturing and medicating the wound, without performing the diagnostic procedure, but dismissing the patient. In the anamnesis performed by the healthcare professionals, haemorrhage resulted already stopped – this can be conducted to the vasospasm deriving from the lesion, and to the initial thrombosis; on the contrary, there are no references for the peculiar way of the blood “gushing” when the trauma happened. This element, referable to the involvement of an artery, would surely have alarmed the physicians, egging them on performing a diagnostic procedure and in case a suitable therapy to prevent any possible complications typical of these cases. However, the conduct of the healthcare professionals is not sharable since further analysis (even just a further inspection) would have been proper, considering the traumatic nature of the event, caused by a sharp and cutting mean, able to bring in also foreign body, and the high probability of complications like both infections and anatomic-functional problems. Further investigations would have been even more proper if we consider the topographical criteria, more properly, the involved area of the lesion: the volar zone of the wrist, a very superficial passage point of important nervous-vascular and tendon structures. Later, in spite of the analgesic and antibiotic therapies, the pain-dysfunctional symptomatology got worst, forcing the patient to come back at the ER. This time, the healthcare professionals, basing only on the objective exam, noted the presence of a painful swelling at the wrist, right over the sutured wound, and it was connected to an infection caused by germs that possibly resisted to the antibiotics. Actually, the patient was dismissed with a diagnosis of “erysipelas” and the prescription of a new antibiotic therapy. However, the clinical conditions didn't get better, forcing the young man to go to another hospital where

first degree inspections – Doppler ultrasound – diagnosed a “pseudo-aneurysm of ulnar artery”. The subject was then put through a surgical intervention of arteri-orrhaphy.

Just like the previous one, also the conduct of the healthcare professionals during the second visit at the first-aid, is not sharable; not because of the final diagnosis (pseudo-aneurysm of the ulnar artery), but because, considering the painful and dysfunctional symptomatology, they should have had a more prudent and diligent clinical attitude.

Especially the diagnostic procedure should have been supported by clinical-instrumental analysis – ultra-sound exam above all, a first degree control, very easy to carry out, not expensive and quite useful to study the muscle-vascular-tendon structures¹⁶, not invasive, immediately available, with no need of contrast agent or radiations. In fact, in case of penetrating traumatic lesions, as described by the literature, the Doppler ultrasound has a perception from 95% to 100% and a precision of



Fig. 1: Pseudo-aneurysm of ulnar artery.

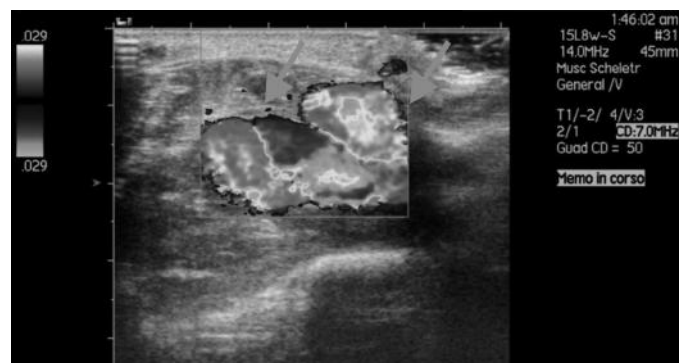


Fig. 2: Ecocolor Doppler pseudo-aneurysm of ulnar artery.

98% than other second degree methods (such as angiography and arteriography)^{17,18} to evaluate traumas of limbs (upper or lower) with possible lesions of tendons, nerves or vases. Talking about the vascular lesions, with an ultrasound exam pseudo-aneurysm are well observable¹⁹, since it allows to distinguish the haematoma and the thrombus that will appear hypoechoic; but you can see also the functionality of the vase, noting a reduction of the velocity into the nervous structures, whose functionality can result altered because of chronic compressions, causing reduction in the density where the compression is and swelling at cranial level. This instrumental research, basically, allows identifying the cause of compression.

Actually, in our case, it's exactly through the ultrasound exam that the diagnosis of pseudo-aneurysm was done, as it can be deduced by the following images (Photo 1 and 2): the red arrow indicates the pseudo-aneurysm, cm 2.36 long, with a diameter of 0.95cm (normal diameter of an ulnar artery = about 3mm); furthermore, it is evident the continuous lesion from which the blood pours out, penetrating the tissues (yellow arrows) with turbulence in the flow that the Doppler showed as very fast (green arrows). A careful reading of literature has also demonstrated the existence of many episodes related to penetrating traumas involving upper limbs; most of these additional cases can be connected to firearm shots in first place, then to cutting lesions and in very few cases to iatrogenic wounds^{20,21}. Altogether, these traumas are related often to vascular lesions, especially of arteries; from here it comes the need of a correct and prompt evaluation aimed to identify potential vascular and/or nervous lesions. Hence, the evaluation must include the exploration of the wound (also to find tissue areas not receptive, including the bottom of the lesion, proceeding then with its cleaning and suturing) and the ultrasound exam²², plus the performing of tetanus injection (if the patient shouldn't have the antibody coverage) and a suitable antibiotic therapy.

Actually, in the reported case, the patient developed a compartment syndrome at the hand because of a post-traumatic pseudo-aneurysm of the ulnar artery, a well-known complication in literature. For this reason, we observe that all the scientific publications, from the oldest²³ to the newest²⁴, always highlight how a traumatic pathology of the wrist and hand can lead to this complication that can get worst causing the breaking of pseudo-aneurysm and the stabilisation of the neurologic deficit. The latter, in our case, was confirmed by the electromiographic test, which attested a relevant nervous dysfunctionality, connectable to the compression of the ulnar nerve.

Conclusions

This study has considered a case of nervous lesion as consequence of a traumatic pseudo-aneurysm of the ulnar artery. Into the specific, it was a cutting wound at volar

zone of left wrist, with a vascular lesion of ulnar artery tangled by a pseudo-aneurysm, with concomitant suffering of ulnar nerve; the latter depended basically from the compression of the nerve by the aneurysm bag, and in part by the direct impact of the cutting mean (exclusively perineurium). The formation of a pseudo-aneurysm after traumas like this is not very frequent; however, it's very important to identify promptly the vascular lesion to perform the right therapies and avoid in this way possible complications. Therefore, it is necessary as first thing, to examine carefully the wound, especially if it is near skin areas that are superficial passages of important nervous-vascular and tendon structures (i.e. the volar area of the wrist). About this, we already said how the lack of active bleeding from the wound does not exclude the presence of a vascular lesion; hence, if anamnesis and symptoms/signs are coherent with a possible vascular lesion it is extremely important to proceed with the diagnostic procedure, especially through the help of instrumental exams, such as ultrasound test and Doppler ultrasound, with the aim to establish the need of a medical and/or surgical operation.

This kind of pseudo-aneurysm, indeed, often are clinically observed after weeks or months from the traumatic event, since the vascular lesion is not identified; from here, it gets clear that in these cases, the healthcare professionals must perform the right diagnostic-instrumental procedure with the aim to find potential vascular lesions. Hence, it's fundamental to suspect a pseudo-aneurysm when we are in front of a warm, pulsing swelling covered with erythematous skin, even after weeks or months from a traumatic event, especially if the medical case happens nearby the wound. What here described wants not only manage at the best the clinical situations, but wants also to reduce the incidence of the medical-legal disagreements related to late diagnosis for such cases. The case we treated, indeed, had medical-legal implications both civilly (money compensation) and penologically (because there was a strong relation between the wrong conduct of the healthcare professionals that treated the patient and the result of the lesion, it means a permanent weakness of the prehensile functionality).

Riassunto

Gli pseudoaneurismi costituiscono una complicanza rara ma prevedibile delle lesioni traumatiche vascolari di diversa natura, determinate sia da ferite penetranti con lesione diretta del vaso sia da traumi contusivi che producono una compressione dei vasi su piani ossei tale da determinare una zona di minor resistenza della parete vasale alla pressione endoluminale che va incontro a rottura. In particolare, per gli pseudoaneurismi dell'arteria ulnare la letteratura riconosce come causa principale i traumi della mano. Gli Autori descrivono il caso clini-

co di uno pseudoaneurisma post-traumatico dell'arteria ulnare a livello del polso conseguente ad una ferita da punta e taglio occorsa durante l'attività lavorativa. A tale diagnosi si è giunti solo tardivamente dopo che la ferita, senza essere stata meglio indagata, è stata suturata e medicata nonché dopo che era stata posta errata diagnosi di erisipela in conseguenza allo sviluppo di una tumefazione dolente e pulsante in prossimità della sutura. Infatti solo in ultima battuta, presso un nosocomio diverso da quello iniziale, i sanitari hanno messo in atto il corretto iter diagnostico ed anche terapeutico, al fine di ridurre il più possibile le complicanze adducibili allo sviluppo di una sindrome compartimentale. Nonostante il corretto approccio chirurgico, l'errata e quindi ritardata diagnosi ha determinato lo sviluppo di un deficit sensitivo-motorio a carico del territorio del nervo ulnare a livello della mano, del IV e del V dito.

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Commento e Commentary

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Per evitare di esprimere a posteriori giudizi basati sulla conoscenza acquisita dell'evoluzione ormai avanzata di un evento traumatico coinvolgente strutture arteriose, tipico e criticabile se si trascura l'evoluzione clinica del processo patologico, vi sono due pilastri comportamentali: una meticolosa visita clinica della regione traumatizzata, completata da un esame neurologico condotto con estremo rigore e metodo, e – al minimo dubbio – un' esplorazione chirurgica del focolaio traumatico fondata su una precisa conoscenza dell'anatomia chirurgica, e dopo una accurata formulazione del modulo di consenso informato. In questo vi dovrà essere l'elenco non solo dei possibili aspetti negativi della sua esecuzione, ma anche delle conseguenze eventualmente negative della sua omissione.

L'uso precoce della diagnostica strumentale conservativa con gli US può essere inutilmente tranquillizzante e non dimostrativa se eseguita nei tempi brevi conseguenti il trauma, mentre quella angiografica deve essere ragionevolmente giustificata dall'esame obiettivo. A rigore anche un esame ecografico con ecocolor-doppler potrebbe essere privo di validità in una rigorosa controversia medico-legale se eseguito troppo precocemente.

Alternativamente uno stringente programma di sorveglianza e controllo nei giorni successivi al trauma può ottenere il risultato di cogliere lo sviluppo di un eventuale pseudoaneurisma traumatico prima che si sviluppi una sindrome compartimentale o una neuroaprassia dei nervi adiacenti. Solo in un secondo tempo, non immediato rispetto all'evento traumatico, le indagini strumentali non invasive perché basate sugli US possono essere in grado di dettare tempestivamente le indicazioni terapeutiche corrette e tempestive.

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To avoid an unfair a posteriori judgments based only on the final knowledge of the negative evolution of a traumatic event involving arterial structures, typical and that has to be criticized if the clinical evolution of the disease process are neglected, there are two pillars of behavior: a meticulous initial clinical examination of the traumatized region, complemented by a neurological examination conducted with the utmost rigor and method, and – at the slightest doubt – a surgical exploration of the injured region based on a precise knowledge of surgical anatomy, and naturally after a careful formulation of the informed consent form.

In it there must be not only the list of the possible negative aspects of its execution, but also the possibly negative consequences of its omission.

The early use of diagnostic conservative imaging with the U.S. can be deceptively soothing and not necessarily demo if done in the short time after the trauma, while the angiography must be made only if reasonably justified. Strictly speaking, even an ultrasound examination with Echo-Doppler might be lacking true validity in a rigorous medical-legal dispute if performed too early.

Alternatively, a strict program of surveillance and control in the days following trauma can obtain the result of catching the early negative development of a possible traumatic pseudoaneurysm before it could develop a compartment syndrome or neuro-apraxia of the adjacent nerves. Only at a later time, not immediately after the traumatic event, the non-invasive imaging techniques because based on the U.S. may be able to dictate timely the proper and correct therapeutic indications.