Radial artery pseudoaneurysm: A rare complication after a single arterial puncture for blood-gas analysis

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Abstract

With a reported incidence of 0.048%, radial artery pseudoaneurysm (PA) is a rare but serious complication of arterial cannulation. We report a case of PA developing after a single puncture of the right radial artery for arterial blood-gas analysis diagnosed by Doppler ultrasound in young male patient. The development of PA after puncture of radial artery for continuous blood pressure monitoring and serial blood-gas analysis has been reported in the past; however, to the best of our knowledge, there is only one case report of development of PA after a single arterial puncture for blood-gas analysis is reported in the past.

Keywords: Doppler ultrasound, pseudoaneurysm, radial artery

Introduction

Pseudoaneurysms (PAs) following arterial injuries are rare occurrences, but they have been described in the literature following vascular access attempts to arterio-venous fistulae, catheterization of arteries, arterial blood-gas (ABG) analysis, and other invasive procedures. Only 22 cases of aneurysm of the radial artery have been reported in the literature till 2006. In PubMed research, there were about nine cases of iatrogenic radial PA reported between 2006 and 2016. The vast majority of cases are due to iatrogenic arterial lesions and their incidence has been increasing because of the higher use of interventional radiological procedures. The reported complications include catheter-related sepsis, thrombosis, peripheral embolization, and PA. PA is caused by disruption of the arterial wall at site of cannulation.

Case Report

A 26-year-old male patient was suffering from chronic kidney disease and was on maintenance hemodialysis twice a week for 6 months. The patient came to the institute for workup of cadaveric renal transplantation before 2 months. His right radial artery was punctured for ABG analysis in ward as a routine workup for sending a patient to dialysis. Special BD 2cc (heparinized) ABG syringe with 23-gauge needle was used for puncture of radial artery. Only one puncture was attempted for collecting the sample. First year resident of Anesthesia Department with experience of about 6 months punctured the radial artery. Compression of about 5 min with bandage was given over the punctured site. After 2 days of procedure, he noticed pulsatile swelling near his right wrist joint over volar aspect without overlying erythema [Figure 1]. The patient...
denied fever or chill. Allen’s test was negative. His hand movement was not restricted. Thrill was palpable over the swelling. Lesion was not painful; hence, the patient was referred to our Radiodiagnosis Department for Doppler ultrasound of his right wrist joint swelling. As the patient had not fever and tenderness over local site, methicillin-resistant *Staphylococcus aureus* test was not done. On ultrasonography, swelling appeared to be cystic in nature measuring about 14 mm × 9 mm in size, communicating with the right radial artery at wrist joint. On color Doppler imaging, it had typical swirling pattern of flow [Figure 2]. Spectral Doppler imaging revealed a classic to and fro waveform confirmed the diagnosis of PA [Figure 3]. There was no evidence of thrombosis within PA, in radial artery or arteries of the right upper limb. Due to smaller size and asymptomatic nature of PA, the patient was not offered any treatment and close follow-up is advised. Size and patency of PA were checked every time, it did not seem to increase in size. The patient was discharged from our institute after completion of his cadaveric transplantation work-up. On follow-up Doppler study, it appeared to be thrombosed after 1 month.

**Discussion**

Trauma to the artery may lead to occlusion of the vessel by thrombosis, arteriovenous fistula formation or PA development. PAs are usually caused by trauma to the artery which leads formation of hematoma between the arterial wall and surrounding parenchyma. Continuous arterial blood creates a cavity which remains in continuity with the normal vessel, which is lined by inflammatory cells and fibroblasts. This false sac’s inner wall is lined with endothelium, and the outer walls are formed of fibrous scar tissue. In contrast to a true aneurysm, which involves dilatation of all layers of the arterial wall, a PA is a false sac, being enclosed without the arterial wall.

The main risk factors for formation of PA are shown in Table 1.[2] Ranganath and Hanumanthaiah described that the site of arterial cannulation placement, timing, and number of catheter site changes made no significant difference in terms of complications. They also described that there is no specific time frame for the formation of PA after radial artery cannulation.[3] Detection of these types of complications may be within hours from the time of insult or occur one to several months afterward.

Most common means of presentation of PA are that of a palpable pulsatile or nonpulsatile expanding mass without compromising distal limb. Pressure applied to the lesion will result in decompression of the blood-filled sac whereas release leads to rapid refill, thereby distinguishing from a solid mass. The presence of pulsations and an audible bruit over the swelling differentiate a PA from simple hematoma. PA has typical appearance on color Doppler ultrasound like presence of expansile pulsatile cystic lesion, turbulent
flow which appears as a classic “yin-yang” sign, and a hematoma with variable echogenicity within it. The variable echogenicity may represent separate episodes of bleeding and rebleeding.[4] Identification of a “to-and-fro” spectral waveform within the neck is considered pathognomonic for a PA. Ultrasonography is a valuable diagnostic tool for the detection of PAs. This modality is portable, readily available, inexpensive, and fast; involves no ionizing radiation or renal toxic contrast material; and is noninvasive. Contrast-enhanced computed tomography (CT) may demonstrate a contrast material – filled sac. However, the entire PA may not fill with contrast material; a low-attenuation area will remain within the PA, a finding that indicates partial thrombosis. Three-dimensional CT angiography and gadolinium-enhanced magnetic resonance (MR) angiography allow visualization of the lesion from all angles and in any projection. MR angiography is a valuable tool in the imaging of PAs in patients with impaired renal function and allergies to CT contrast material. A significant advantage of conventional angiography is its capacity for real-time hemodynamic assessment of a particular vascular bed. The principal disadvantage of angiography as a diagnostic modality is its invasive nature and the increased risk of procedure-related complications. Another limitation of conventional angiography is that it does not help accurately to assess the size of a PA that contains a thrombus.

The natural history of PA is that small PA has tendency to thrombosis spontaneously over the time. Morbidity due to PA may be severe and it is due to distal embolization from microemboli, rupture, and venous compression.[9] Treatment of PA has evolved through the years. The treatment of radial artery aneurysms is still controversial; it is dependent on the etiology, location, presence of thrombi, associated symptoms, and mainly the circulation status collaterally and distally to the lesion. Traditionally, arterial PAs are managed in various ways: observation, compression bandages, ultrasound-guided compression, ultrasound-guided thrombin injection, and surgical repair [Table 2].[6,8]

An accepted approach is to monitor small (<3 cm), stable, asymptomatic PAs as the majority of them will thrombosed within 4 weeks.[8] In one large series of small (<3 cm) PAs, Tournsarkissian et al. reported a rate of spontaneous thrombosis of ~90% at 60 days of follow-up.[9]

An exception may be for very small (<1 cm), stable, asymptomatic PAs, which could be managed conservatively with repeat imaging at 1 week after diagnosis to see if spontaneous thrombosis has occurred. In addition, spontaneous thrombosis of the PA may be less likely in patients who are fully anticoagulated or receiving combination antiplatelet therapy, where active management is preferred.

There are case reports regarding formation of PAs after radial artery cannulation for various procedures. Llácer Pérez et al. reported the incidence of development of PAs in 0.05% cases in cardiac surgery patients after radial artery cannulation in 2006.[9] Other cases of development of radial artery PA are due to hemophilia and postoperated case of radial fracture with plate.[11,12] However, to best of our knowledge, only one case report of formation of PAs after single puncture of radial artery for blood-gas analysis had been reported previously.[13]

In previous reported case, according to their authors, possible cause of developing PA was incorrect compression and/or a too much short time of compression of radial artery after the puncture. Age of that patient was 32 years. His PA size was 3 cm, so the patient was referred for operative management to avoid thromboembolism and risk of rupture. While in our case, size of PA was small; hence, only conservative management in form of restriction of physical activity and close observation was made. Later on, PA was thrombosed spontaneously.

Table 1: Factors associated with the formation of pseudoaneurysm

| Factor                                      |
|---------------------------------------------|
| Antiplatelet agents (often aspirin and clopidogrel) |
| Anticoagulation                             |
| Age >65 (years)                             |
| Obesity                                     |
| Poor postprocedural compression             |
| Simultaneous artery and vein catheterization|
| Hypertension                                |
| Peripheral arterial disease                 |
| Hemodialysis                                |
| Complex interventions                       |
| Low or high puncture sites                  |

**Conclusion**

Radial artery cannulation being a very common procedure in clinical practice for ABG analysis and cardiovascular monitoring, every medical person should be aware of the possibility of incurring arterial injuries, necessitating early diagnosis, and prompt intervention of PAs. The real incidence is unknown, probably because these lesions are seldom reported. This case demonstrates that Doppler ultrasound supplements, careful history-taking, and physical examination in making this difficult diagnosis easily.
Table 2: Treatment of pseudoaneurysm

| Conservative methods | Surgical methods |
|----------------------|------------------|
| **Technique** | **Disadvantage** | **Benefits** |
| 1) Ultrasound-guided compression | Manual compression of the PA with the transducer probe, maintained for 10 min intervals, after which time the PA is rechecked for occlusion. If flow is still present, compression is quickly reestablished for additional 10 min intervals, until occlusion is achieved | Costly in terms of skilled manpower and sophisticated technical equipment | Non-invasive |
| 2) Reapplication of a compression bandage | Reapplication of an occlusive bandage and waiting for spontaneous healing during a wait-and-see period | - | Non-invasive |
| 3) Thrombin injection | The principle of thrombin injection into the PS chamber is based on the fact that thrombin is important in the conversion of fibrinogen to fibrin. Thus, a fibrin clot is formed instantaneously (even in the presence of antiplatelet therapy or anticoagulation therapy) with UGT, whereas it may take up to several hours with USGC | Chances of development of deep venous thrombosis (if the thrombin is inadvertently injected into the vein) | Highly effective |
| 4) Pulse oximeter-guided compression | TR Band is specifically designed to provide pressure by using dual compression balloons in a controlled manner over the radial artery, allowing for adequate venous return and preventing local nerve compression | - | Non-invasive |
| 5) Restriction of physical activity | - | Non-invasive |
| 6) External compression, (Terumo TR Band) | - | Non-invasive |
| **Indications** | **Options** | **Risk** |
| Symptomatic | Proximal and distal ligature of the vessel combined with the aneurysmatic sac resection to revascularization procedures, with termino-terminal primary anastomosis or bypass with venous graft | Requires anesthesia and an incision, an area known to become infected easily after a surgical procedure |
| Expanding | - | - |
| Infection | - | - |
| Prolonged history with large hematomas | - | - |
| Failed conservative management | - | - |

UGT: Ultrasound-guided thrombin; USGC: Ultrasound-guided compression; PA: Pseudoaneurysm

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**Conflicts of interest**

There are no conflicts of interest.

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