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Thoracoacromial artery perforation in subclavian vein catheterization : a rare complication

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Introduction

Percutaneous large vein catheterization is a technique widely used across specialties for hemodynamic monitoring, intravenous drug administration and parental nutrition. The most common sites for deep vein catheterization are internal jugular, subclavian and femoral vein (1). While several randomized clinical trials have demonstrated the superiority of ultrasound guided techniques (2, 3), many clinicians rely on experience and surface landmarks for a blind puncture of the chosen vein. Despite large experience in a vast majority of anesthesiologists, mechanical complications with this procedure occur in up to 5-19 % of cases (4, 5). Mechanical complications are associated with injury to surrounding anatomical structures such as nerves, arteries, veins, pleura and esophagus. Accidental puncture of an artery occurs in about 5 % (6) of cases and is usually not harmful except for a local hematoma. Inadvertent large bore dilatation with introducer sheath is much more morbid (stroke, pseudo-aneurysm, arteriovenous fistula, brachial plexus injury, hematoma with compression on surrounding structures, …), but ensues luckily less frequently (0.1% to 0.8 %) (7).

The subclavian approach has multiple advantages like lower rates of infection and thrombosis and higher comfort for the patient (8). However, its use is associated with more complications than the internal jugular route (9).

One of the main disadvantages is the inability of direct compression on an eventual subclavian artery puncture or perforation (10, 11). Especially in procedures where full heparinization is required, the subclavian approach is not a preferred choice (1).

Case report

An 86-year-old man was planned for elective aortic endoprosthesis for an aortic abdominal infrarenal aneurysm (68 mm) on 10/12/2015. The patient had a history of minor stroke with abducens nerve paralysis and COPD. Other than a Billroth I operation in 1986 for gastric bleeding, the patient denied surgical history or known anomalies in the neck region. Platelet counts and liver function were within normal range. The International Normalized Ratio (INR) was 1.1 (normal range: 0.85-1.15). The electrocardiogram and chest radiograph showed no significant abnormality prior to surgery. After securing peripheral venous access with 18-gauge i.v. cannula in right basilic vein, general anesthesia with propofol induction and sevoflurane maintenance was given by board certified anesthesiologist. Afterwards a 20 gauge arterial cannula was placed in the right radial artery. Patient was placed in Trendelenburg position (15°) and clavicular region prepared aseptically for right subclavian vein catheterization. Using anatomical landmarks the subclavian vein was successfully punctured on first attempt under constant aspiration with the 18-gauge introducer needle and Spring-Wire introduction syringe (Arrow® central venous catheter, Arrow International, Asheboro, NC, USA). Using the Arrow® Transduction probe the puncture was identified as being venous (non-pulsatile, dark red blood). The guide wire (0.81 mm diameter) was advanced without resistance. After tissue dilatation the two-lumen indwelling catheter (7 French, 16 cm) was placed using the Seldinger technique. The guide wire was removed and intact without kinking or buckling. Table was zeroed to start the dissection of the bilateral femoral region and 1.5 ml

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Heparin (7500 IE) was given later to start the endovascular procedure. A Zenith® endoprosthesis with dimensions ZALB 28-84, ipsilateral leg ZSLE 24-56, contralateral leg ZSLE 16-74 was placed. Correct perfusion of both renal arteries was confirmed and type II endoleak noted. Both femoral groins were surgically closed. Surgical blood loss was minimal. Anesthesia was uneventful with normal blood pressure and capnography readings. The central line was only used for intravascular access ; vasopressive agents had not been necessary. After removal of the surgical drapes a hematoma in the right subclavian region became apparent. The patient was transferred to intensive care with pressure padding on this site, with continued general anesthesia (propofol 6 mg/kg/h) and ventilation.

Because this hematoma continued to expand, a CT angiography was performed two hours postoperative, which showed a hyperdense hematoma in the right pectoral region (Fig. 1A) with an arterial contrast extravasation at the inferolateral border of the right clavicle (Fig. 1B, 1C). The interventional radiologist was called for an arterial angiography. Under general anesthesia the right common femoral artery was punctured and a 4 French catheter was advanced using the Seldinger technique after the placement of a 4 French sheath. The right subclavian artery was catheterized and several images with contrast (Iomeron 300) were taken in RAO, LAO and AP orientation. An active arterial contrast extravasation as a sign of an active arterial bleeding from the clavicular branch of the right thoracoacromial artery was seen (Fig. 2). With

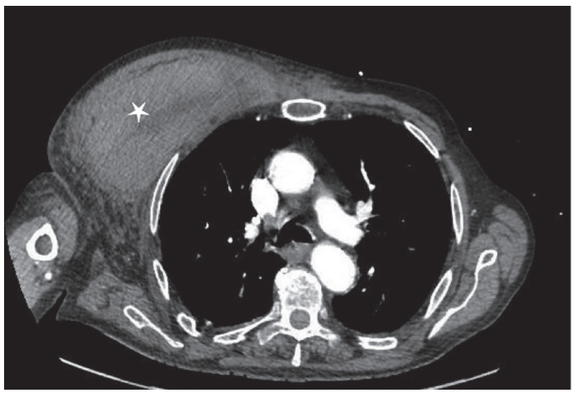

Fig. 1A. — CT angiography of the thorax after the administration of intravenous contrast (arterial phase) showing a hyperdense hematoma in the right pectoral region (white star).

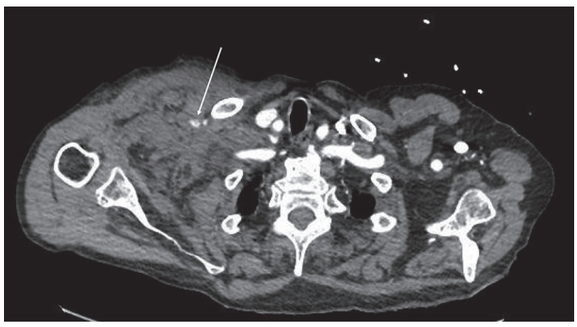

Fig. 1B.— CT angiography of the thorax after the administration of intravenous contrast (arterial phase) showing an arterial contrast extravasation (white arrow) compatible with active arterial bleeding at the inferolateral border of the right clavicle.

Fig. 1C. — CT angiography of the thorax after administration of intravenous contrast (arterial phase) with coronal thin MIP reconstruction showing an arterial contrast extravasation (white arrow) compatible with an active arterial bleeding at the inferolateral border of the right clavicle.

Fig. 2. — DSA angiography of the right subclavian artery showing an arterial contrast extravasation (white arrow) compatible with active arterial bleeding from a little side branch of the right subclavian artery.

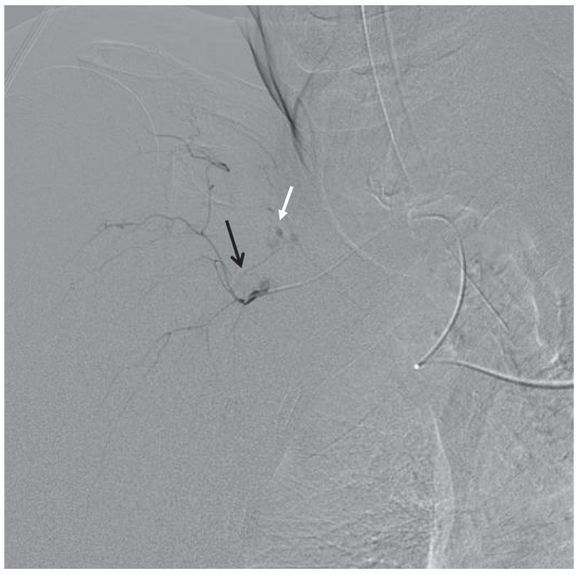

Fig. 3. — Super selective catheterization of the right thoracoacromial artery shows again an arterial contrast extravasation (white arrow) from the clavicular branch (black arrow).

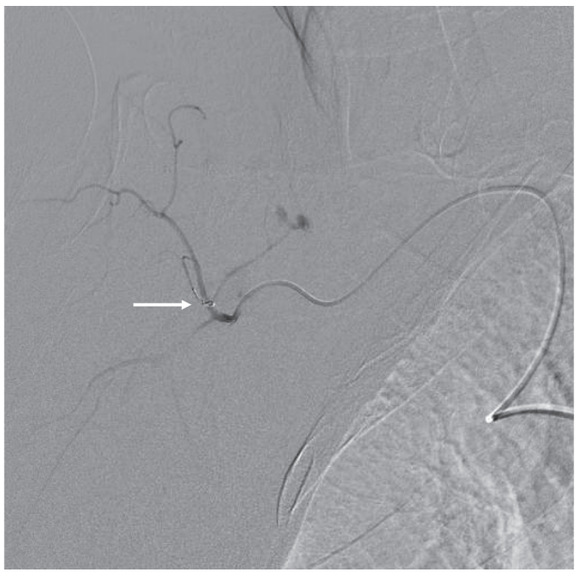

Fig. 4. — Embolization with microcoils (white arrow) was performed in sandwich technique.

the aid of a 2.7 French Progreat microcatheter a super selective catheterization of the right thoracoacromial artery was performed (Fig. 3). Inability to catheterize the tiny clavicular branch super selectively called upon the embolization of this branch in sandwich technique with 3 microcoils (type MCWE-18S-1.2-2-A) (Fig. 4). A control contrast injection could not demonstrate any residual extravasation (Fig. 5). Hemoglobin levels fell from 9.2 g/dL preoperatively to 7.3 g/dL postoperatively. The patient could be extubated in the intensive care

Fig. 5. — Complete occlusion thoraco-acromial artery.

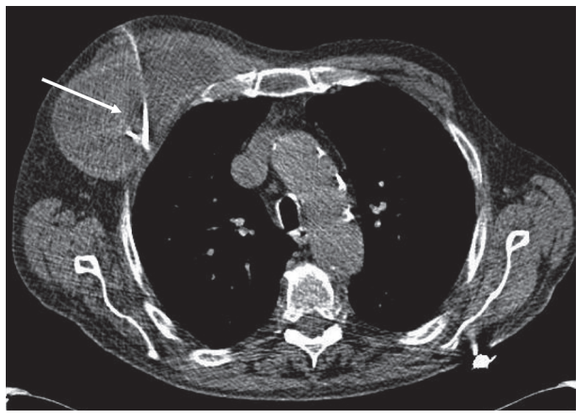

Fig. 6. — Placement of pigtail drainage catheter (white arrow) in liquefied hematoma.

unit (five hours postoperative) and was transferred to the ward on POD3 and later discharged on POD5. Because of an expanding mass in the right subclavian region, the patient presented again on 28/12/2015. CT could not demonstrate any active bleeding but liquefaction of the known hematoma. A pigtail catheter was placed to drain this hematoma with good result (Fig. 6). The patient was discharged after 10 days.

Discussion

Central venous access is commonly performed in the care of the surgical or critically ill patient. Even in the most experienced hands this procedure is not without complications. Accidental arterial puncture occurs in 5% of central lines (6) and is usually without complications. Arterial injury occurs most often in femoral central line insertion and least in the subclavian approach (12). In the case of inadvertent

arterial catheterization, leaving the catheter in place or removing with direct compression, carries separate risks. Accidental arterial puncture is often recognized by bright red pulsatile flow and can most commonly be managed by direct compression (13). Unnoticed arterial puncture is usually so small that it does not pose any significant hemorrhage.

With anatomical landmarks an experienced anesthesiologist usually succeeds in puncturing the vein and inserting the catheter. Puncture and injury of the thoracoacromial artery seldom occurs. It is a small size vessel anatomically located on the way to the subclavian vein in a subclavian vein catheterization procedure. This small artery is probably often unnoticed punctured and therefore seldom described. Utilizing ultrasound could have visualized this small artery on the way to the subclavian vein and thus be dodged.

Another case report of puncture of the thoraco-acromial artery has been published in 2005 (14). In this case the bleeding caused a large hemothorax with urgent successful angiographic embolization. Wicky et al also described an accidental puncture of the thoraco-acromial artery treated with super selective embolization (15). Our case presented a relatively benign hematoma formation outside the thoracic cage with nonetheless enough volume to develop relative anemia.

Ultrasound guidance cannulation of the subclavian vein is effective and can reduce complications (3, 9, 16). Most authors consider it superior to the landmark method and therefore should be the method of choice in critically ill patients (2). We strongly believe that anesthesia practice should be as safe as possible and every non-harmful tool we have therefore has to be used. In particular in patients in whom heparin administration is necessary, ultrasound guided puncture is warranted nowadays. Finally, this case illustrates the successful management of arterial injury by interventional radiology. Because of the semi-urgency of this case, surgery was never considered, as it would also probably necessitate invasive approach with partial rib/clavicle removal. Super selective micro-embolization is a helpful tool in skilled hands, especially for terminal branch injuries. Albeit an expensive technique it avoids the need for post-procedural lifelong antiplatelet therapy like proximally placed stents (17, 18). Proximal embolization of the afferent artery could lead to reinjection via collaterals of the injured artery. Micro-embolization is a highly selective and direct approach to terminal branch injuries.

Conclusion

Subclavian vein access is a safe technique for inserting a central line in critically ill patients. However, inadvertent arterial or venous puncture occurs and this should be minimalized. Therefore we strongly plead for the use of ultrasonography in the modern anesthesiology practice, especially when heparinization is indicated. If an inadvertent arterial puncture would occur, angiography and subsequent endovascular management of actively bleeding vessels are useful diagnostic and therapeutic tools.

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