CASE REPORT – OPEN ACCESS

International Journal of Surgery Case Reports 42 (2018) 269–273

Contents lists available at ScienceDirect

International Journal of Surgery Case Reports

journal homepage: www.casereports.com

Case report: Iatrogenic brachial artery dissection with complete anterograde occlusion during elective arterial line placement

Laurence Weinberg[a,b,*], Diana Abu-Ssaydeh[a], Manfred Spanger[b,c], Patrick Lu[a], Michael H.-G. Li[a]

[a] Department of Anaesthesia, Austin Hospital, Heidelberg, Victoria, 3084, Australia
[b] Department of Surgery, University of Melbourne, Austin Health, Victoria, 8002, Australia
[c] Department of Radiology, Box Hill Hospital, Box Hill, Victoria, 3128, Australia

ARTICLE INFO

Article history:
Received 21 October 2017
Received in revised form
16 December 2017
Accepted 21 December 2017
Available online 27 December 2017

Keywords:
Arterial catheter
Brachial artery
Ischaemia
Anaesthesia
Case report

ABSTRACT

INTRODUCTION: Brachial arterial catheters provide a more accurate reflection of central aortic arterial pressure compared to their radial counterparts. Although brachial arterial line complications are uncommon, we report a case of a rare iatrogenic brachial artery dissection with complete anterograde occlusion from elective arterial line placement.

PRESENTATION OF CASE: A 41-year-old female presented for a right upper and middle lobe resection of a large neuroendocrine lung cancer. A brachial arterial line was inserted for continuous blood pressure monitoring using clinical landmarks. Six hours postoperatively the left hand was noted to be pale, cool and pulseless with complete paraesthesia. Thrombus was initially suspected on computed tomography angiography. Upon return to theatre, extensive dissection of the posterior brachial arterial wall was identified.

CONCLUSION: We review our diagnostic pathway and treatment of this rare complication. Recommendations to minimise the risks of complications from brachial arterial line insertion are also overviewed. We recommend the routine utilization of ultrasound-guided technique and regular post-insertion neurovascular monitoring for the prevention and early recognition of complications from brachial artery catheter insertion.

1. Background

Several studies have concluded that brachial arterial catheters provide a more accurate reflection of central aortic arterial pressure compared to their radial counterparts [1–5]. Although use of brachial artery catheters for continuous haemodynamic monitoring is becoming more common in cardiac and vascular anaesthesia settings, particularly for complex patients, complications of line insertion are relatively uncommon [6–8]. We report a case of a rare iatrogenic brachial artery dissection with complete anterograde occlusion from elective arterial line placement in an academic tertiary referral hospital. We review our diagnostic pathway and treatment of this rare complication. Recommendations to minimise the risks of complications from brachial arterial line insertion are also overviewed.

2. Case presentation

A 41-year-old female caucasian presented for a right upper and middle lobe resection of a neuroendocrine lung cancer. She had no other relevant past medical or family history, and took no medications. The procedure was planned via a hemi-sternotomy surgical incision likely requiring cardiopulmonary bypass (CPB) due to tumour compression of the brachiocephalic and azygos veins, superior vena cava, pulmonary artery and heart (Fig. 1). On arrival to the operating room, a brachial arterial line was inserted by an experienced cardiac anaesthetist for continuous blood pressure monitoring. A 5 mL syringe attached to a 19Gx5.6 cm thin wall short bevel needle with a clear flashback Luer Hub (Argon Medical Devices, Texas, USA) was advanced into the brachial artery using clinical landmarks. Two access passes were required. A 0.028Gx40 cm metal guidewire was then advanced through the needle. There was minor resistance on initial insertion and the wire was withdrawn and reinserted through the needle without further complication. The needle was removed and an 18Gx15 cm Fluoropolymer catheter (Argon Medical Devices, Texas, USA) fed over the guidewire into the artery; the guidewire was removed and the

* Corresponding author at: Department of Anaesthesia, Austin Hospital, Heidelberg, Victoria, 3084, Australia.
E-mail address: Laurence.Weinberg@austin.org.au (L. Weinberg).

https://doi.org/10.1016/j.ijscr.2017.12.034

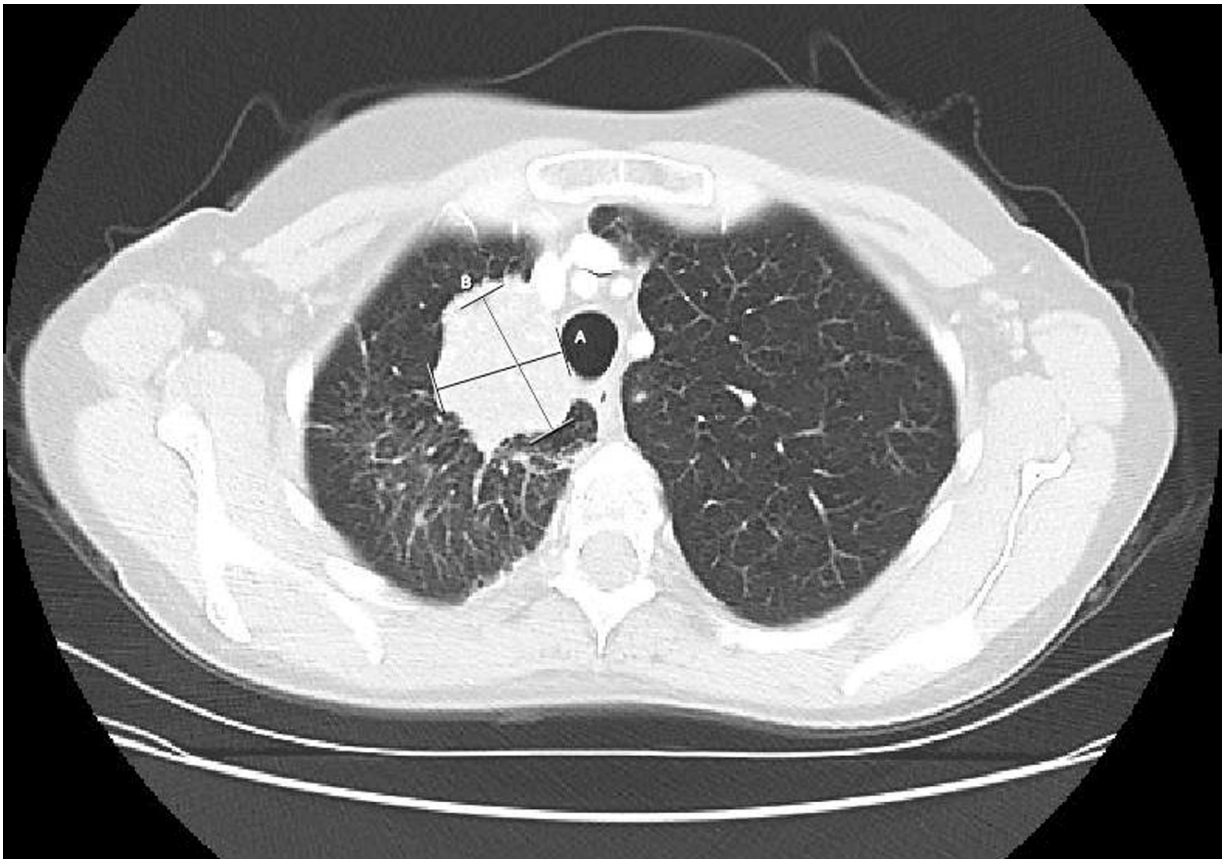

Fig. 1. Principal diagnosis.
Axial computed tomography showing large right sided upper lobe lung tumour with compression of the brachiocephalic and azygos veins, superior vena cava, pulmonary artery and heart.

catheter secured. Surgery and anaesthesia proceeded uneventfully. Immediately postoperatively, the patient was transferred to the intensive care unit for routine monitoring. She was alert and comfortable, with stable haemodynamics. Six hours postoperatively and post intervention, the patient complained of complete paraesthesia of the left hand. On examination, the hand was noted to be pale, cool and pulseless. There was no motor weakness. The arterial catheter was removed, and sensation and warmth returned, but only transiently.

An urgent computed tomography angiogram was performed; arterial phase imaging of the angiogram displayed a thrombus occluding the proximal left brachial artery immediately distal to the profunda brachii branch (Fig. 2). There was opacification of the radial and ulnar arteries on delayed phase imaging indicating collateral flow. The patient was immediately returned to theatre and, under general anaesthesia, the brachial artery was explored at the puncture site and found to be pulseless. Heparin (7000IU) was administered intravenously and a vertical arteriotomy made, revealing a thrombus extending proximally and occluding anterograde flow. Clot embolectomy was unsuccessful. Exploration revealed a small puncture site over the anterior wall of the artery, and large intimal tear of the posterior wall of the brachial artery with extensive dissection. Primary repair of the intimal tear was attempted but failed due to its large size. The artery was then repaired with a cephalic vein interposition graft. Flow was restored with an excellent radial pulse with complete restoration of colour to the hand. Full and open disclosure was provided to the patient. The patient made an uneventful recovery and was followed at 3,6, and 12 months with no further neurology.

3. Discussion

For this case, we chose the brachial artery as the preferred site for continuous haemodynamic monitoring. In the setting of complex surgery and CPB, central-peripheral arterial pressure gradients are well described with unpredictable variances in arterial catheter blood pressure measurements reported [1–4]. Stern et al. reported aortic-radial systolic pressure gradients as great as 32 mmHg post CPB, questioning the reliability of radial artery catheterisation measurements as an accurate source of haemodynamic information [5]. While brachial artery measurements are subject to some pressure gradient, there is less variability, prompting several studies to conclude that brachial arterial catheters provide a more accurate reflection of central aortic arterial pressure compared to their radial counterparts [1]. Although brachial arterial lines are widely used in cardiac and vascular anaesthesia, complications relating to brachial artery catheterisation are fortunately uncommon [3,8–10]. In the largest series to date, the records of 21,597 patients receiving brachial arterial catheters in a university hospital were evaluated [6]. Direct brachial artery catheter related complications were reported in only 41 patients, with an incidence of complications of 0.19% (95% confidence interval 0.14 to 0.26%). The majority of these complications were vascular and no consequent neurologic complications were reported. In another large series of 6185 patients, by Okeson et al., the incidence rate of brachial line complications was 2.0% [7]. Neither of these large series reported dissection, which were findings confirmed in other smaller series of arterial line complications [8,9]. Brachial artery dissection is rare with very few reported cases. In a single case report, Rusza et al. reported brachial

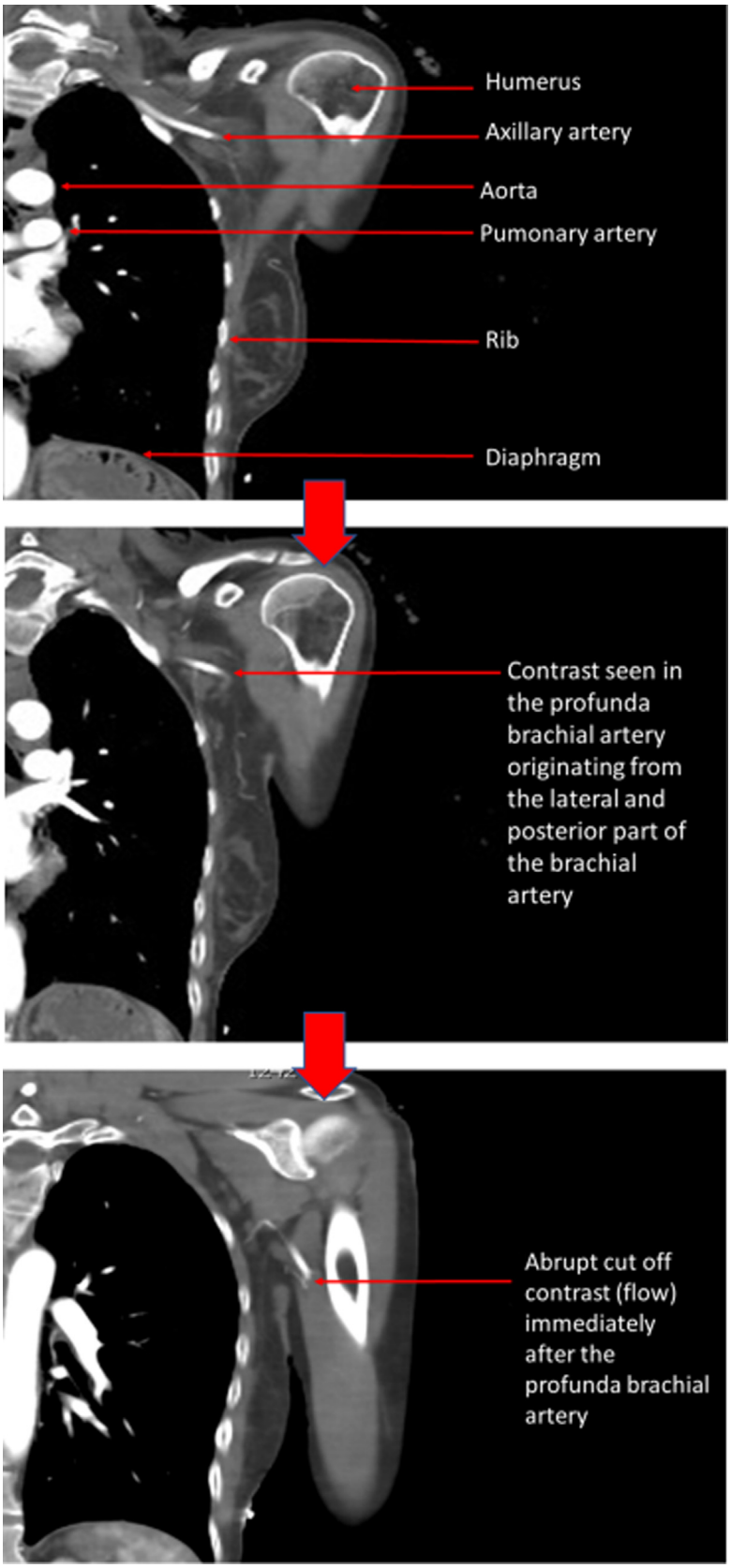

Fig. 2. Radiological findings. Coronal computed tomography demonstrating abrupt cut off of contrast after the profunda brachial artery.

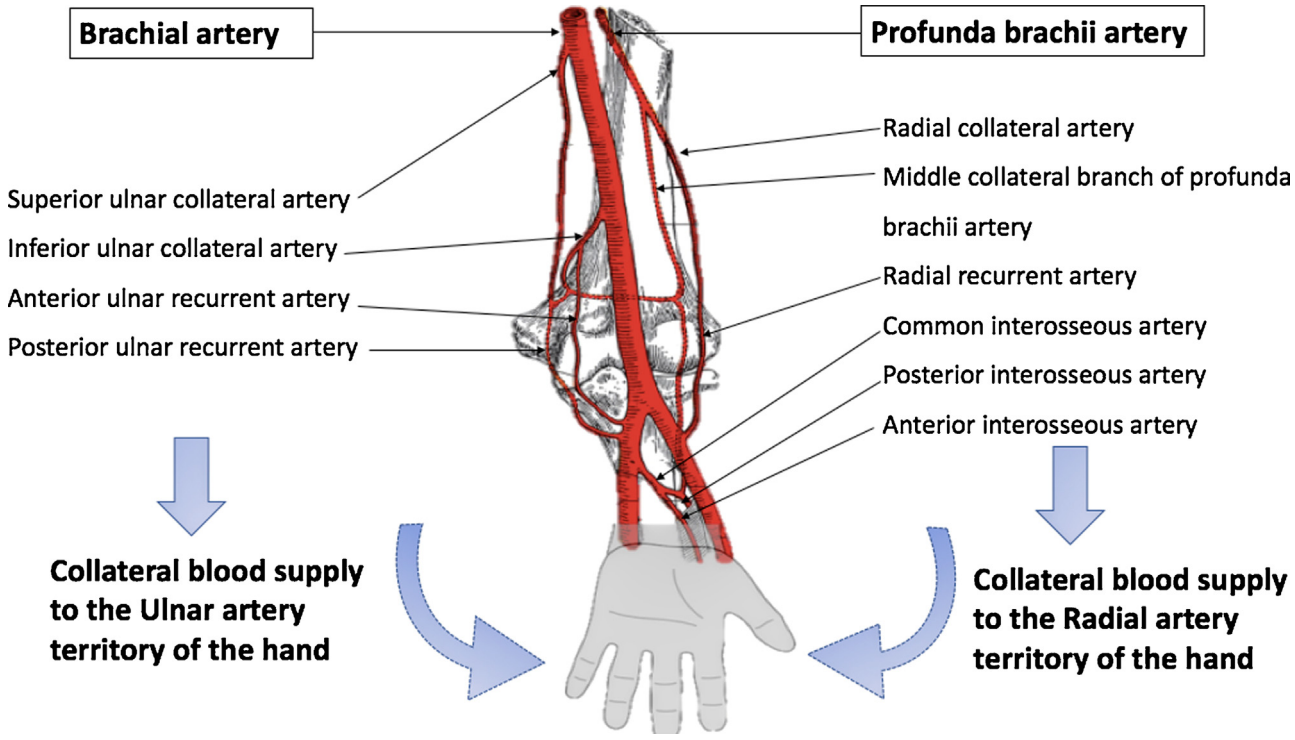

Fig. 3. Upper limb vascular anatomy. Collateral arterial blood supply to the radial and ulnar arteries supplying the hand.

artery dissection extending retrograde into the subclavian artery induced by catheter placement in the context of angiography [10]; however, insertion details were limited.

Comparison with other peripheral sites of arterial cannulation is difficult due to the rarity of complications from arterial line insertion, with complication rates for femoral arterial catheters ranging from a mean incidence of 0.18% for permanent ischaemia to 6.1% for haematomas [11]. However, anatomical differences in collateral supply may predispose the brachial artery to greater risk of permanent ischaemia. The femoral artery has also been shown to be an accurate measure of central aortic pressure, therefore it is a viable alternative to brachial arterial line placement if accurate aortic pressure measurements are required [12].

Our case demonstrated several important clinical lessons. First, although brachial artery dissection is rare, to minimise risk of catheter related complications, we advocate the use of 20G cannula arterial kits for all brachial artery catheter insertions. In the present case, an 18G cannula kit was used, and the larger needle and metal guidewire may have contributed to the severity of the dissection. While studies confirm biological plausibility that rates of arterial occlusion are greater with larger diameter cannulae [13], there are no studies to suggest whether use of a smaller diameter cannula would reduce a rare complication such as dissection. Second, there is increasing recognition that dynamic ultrasonography may reduce risks of line insertion complications compared to a "blind-bedside" procedure. While this has been well-established in practice for central venous cannulation [14], the literature-base regarding the role of ultrasound in reducing complications in adults is scarce. In the absence of specific evidence, we suggest that a reduction in each pass of the cannula may also lead to a reduction in complications. Indeed, ultrasound has been established to reduce number of arterial cannulation attempts [15]. In cardiac catheterization, which much larger diameter catheters are used, the addition of ultrasound has been shown to increase first attempt success rates and decrease complication rates [16,17]. In a paediatric setting, moderate-quality evidence suggests that ultrasound guidance for arterial cannulation improves first and second attempt success rates and decreases the rate of complications as compared with palpation or Doppler auditory assistance [18]. There are clear clinical guidelines advocating the use of real-time ultrasound scanning for central venous catheter placement [19,20]. This recommendation has not yet been integrated into any practice guideline for arterial line insertion in adults. Until further evidence demonstrates otherwise, consensual recognition of the benefits of real-time ultrasonographic guidance and its inclusion into the practice guidelines for brachial artery catheter insertion should be the primary prevention of complications in line placement.

In this case, point of care ultrasonography may have enhanced diagnostic and procedural accuracy by identifying the dissection during needle puncture or guidewire placement. Open surgical exploration clearly identified a posterior brachial artery wall tear, suggestive of an iatrogenic injury from the needle or guidewire at the time of insertion. Using ultrasonography, the short axis (out of plane) view may have allowed the establishment of the appropriate needle angulation at needle insertion; while a long axis view (in-plane) may have provided the depth perception as the needle and guidewire passed through the anterior wall of the brachial vessel. Thirdly, although complications of peripheral arterial catheters are rare, the femoral artery can be considered as an alternative to the brachial artery if more consistent accurate aortic pressures are required. Finally, neurological monitoring should always be performed in the setting of brachial line catheterisation, not only when the catheter is in situ, but after removal, to identify timely assessment and management of catheter complications. As in this case, although there was complete dissection and absence of flow in the brachial artery, progression to motor weakness did not occur, indicating some collateral flow to radial and ulnar arteries (Fig. 3); this further reaffirms the need for detailed sensory neurological hand assessment. This report was written in accordance with the SCARE guidelines for clinical case reporting [21,22].

Conflict of interest

The authors have no conflicts of interest to declare.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethical approval

Austin Health Research Ethics committee has approved this report being submitted for publication. Written informed consent has been obtained directly from the patient and is available upon request from the corresponding author.

Austin Health Research Ethics number: not applicable.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Author contribution

A/Prof Laurence Weinberg: responsible for study concept, data collection, data interpretation, collation of all images and writing of the paper. He is the corresponding author and responsible for patient consent. Dr Manfred Spanger was the radiologist who interpreted the radiological scans. He was responsible for interpretation of all radiological images, data interpretation and writing of the paper. Drs Diana Abu-ssaydeh and Michael Li, and Mr Patrick Lu assisted with the literature review, data collection, interpretation and writing of the paper. All authors were involved in drafting the article. All authors have read the final manuscript and approved it for submission.

Registration of research studies

researchregistry3155.

Guarantor

A/Prof Laurence Weinberg is the guarantor.

Acknowledgement

Nil.

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