Case report

Inadvertent arterial placement of central venous catheter: salvage using endovascular treatment

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Accepted 25 September 2019

SUMMARY

The frequency of placing a central venous catheter (CVC) has increased and it is often performed in emergency situation for venous access. During such an emergency and placing without imaging guidance, sometimes inadvertent placement of CVC in subclavian artery (SCA) can occur. We hereby describe an unusual case of successful endovascular management of inadvertently inserted CVC in SCA by covered stent graft placement along with proper clinical context to manage a case of misplaced venous catheter in left SCA.

BACKGROUND

The central venous catheter (CVC) insertion is a frequent procedure for venous access to administer parenteral fluids, haemodialysis or haemodynamic monitoring before major surgery. In emergency room, this procedure is frequently done by landmark technique without any image guidance, and hence, the chances of misplacement of CVC in adjacent arteries are approximately 3% during jugular and 0.5% during subclavian approach.¹ The American Society of Anaesthesiologists practice guidelines recommend that inadvertent placement of CVC in artery should be left in situ (category B3 evidence) and consultation with vascular surgeon and endovascular interventionist should be sought for surgical or endovascular management because the risk of bleeding, haematoma, pseudoaneurysm or arterio-venous fistula increases if the catheter is simply removed as manual compression of specially subclavian artery (SCA) (situated deep) cannot be done efficiently in adults.² This complication can be identified immediately due to bright red blood, pulsatile flow in intravenous fluid tubing, manometry, blood gas measurement or waveform analysis.² Earlier, open surgery with removal of catheter was the treatment of choice but with increasing technical advances and experience, different endovascular options viz. balloon tamponade, tract embolisation, covered stent and closure devices are available with almost 100% technical success by covered stent placement.^{3–5} This article describes in detail a successfully managed case of inadvertent placement of CVC (via left subclavian vein approach) to SCA by placement of covered stent graft after simultaneous removal of in situ catheter in digital subtraction angiogram suite.

CASE PRESENTATION

A 53-year-old man with known chronic kidney disease for past 8 years maintained on haemodialysis presented in emergency with complains of sudden onset of generalised tonic clonic seizure. The Glasgow Coma Scale was E2V1M5. He had a history of right-side cerebrovascular accident (infarct) 14 years ago. Non-contrast CT of head revealed old infarct without any e/o new onset infarct or cerebral haemorrhage. Laboratory examination revealed hyperkalaemia and low blood sugar. Antikalaemic measures with dextrose infusion was given with plan to put on central venous monitoring. Left subclavian vein was chosen for cannulation and the procedure was done without image guidance. After the CVC placement (using seven French catheter), it was connected to infusion tubing which showed pulsatile regurgitation of bright red blood suggesting accidental arterial cannulation. Chest radiograph and bedside ultrasound was done to localise the position of catheter, confirming its position in midportion of left SCA (medial to costo-clavicular junction). The catheter was left in situ and after consultation with vascular surgeon and endovascular interventionist, consensus was made to manage it by percutaneous covered stent placement.

TREATMENT

Under proper and adequate anaesthetic support, right femoral artery access was obtained by 6F arterial sheath. Selective left SCA angiogram was obtained to localise the entry site of central venous catheter, which was medial to costo-clavicular junction (figure 1A). Angiogram was also taken after injecting contrast through CVC reconfirmed its arterial location without any evidence of contrast extravasation or early venous filling (figure 1B). Left vertebral artery (LVA) was normal. Left SCA was crossed by J-tip 0.035" ordinary exchange guidewire (GW) and selective angiogram showed normal axillary and distal arterial flow in left upper limb. SCA measured 8.2mm in mid part. Subsequently, right femoral artery sheath was upsized by long 9F sheath. To avoid kinking at the bend of SCA (after LVA origin), the stent assembly (9 mm×60 mm Fluency Plus Endovascular Stent Graft, Bard Peripheral Vascular, USA) was taken over extra stiff GW (Linderquist, Cook Medical, USA). Under bony landmark, the position of stent deployment (mid segment at the site of CVC entry) was correctly

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To cite: Shaw M, Chandrashekhara SH, Sharma A, et al. *BMJ Case Rep* 2019;**12**:e231751. doi:10.1136/bcr-2019-231751

Figure 1 Endovascular management of inadvertently inserted central venous catheter (CVC) in left subclavian artery (LSCA). (A) LSCA injection (black arrow) shows the CVC (white arrows) in the artery. (B) Injection through the CVC shows the catheter entry point in the LSCA. (C) The entry point of CVC (white arrow) and position of stent graft (plus sign). (D) The retrieved catheter ex situ.

identified (figure 1C). Next, the venous catheter (figure 1D) was removed percutaneously with sudden jet of pulsatile blood flow through the entry site of left supraclavicular fossa. At same time, the stent graft was deployed and bleeding stopped immediately from entry site of removed venous catheter. Further, 8×40 (mm) balloon (Mustang, Boston Scientific Corporation, USA) was inflated at low pressure for few seconds to completely open the crevices of graft material with sudden deflation.

Post procedural angiogram revealed good antegrade flow through left SCA and LVA with patent stent graft and fluoroscopy shows the final position of the stent (figure 2A,B). No intra procedural complication occurred. New CVC catheter was placed through right internal jugular vein to superior vena cava under ultrasound guidance and patient underwent immediate dialysis. Early postoperative period was uneventful. After 18 hours, the patient was weaned off mechanical ventilation. Chest radiograph revealed no evidence of mediastinal

Figure 2 Post procedure imaging in the same patient. (A) Left subclavian artery injection shows the proper position of deployed patent covered stent (plus sign). (b) Fluoroscopy image showing proper position of deployed stent graft. (c) Chest radiograph after 1 day shows the position of covered stent and confirmed its opened position without any kink or fracture.

haemorrhage with good position of completely opened stent graft (figure 2C). Patient was started on dual antiplatelet drugs.

OUTCOME AND FOLLOW-UP

The outcome of this procedure was successful. At 24 hours follow-up, chest radiograph was within normal limits and patient was discharged. At 1-week follow-up, he did not have any complains in the left upper limb and blood pressure was equal in both the upper limbs.

DISCUSSION

Inadvertent arterial placement of central venous catheters can result in significant morbidity and mortality. The incidence of complication from CVC attempt and placement ranges from 0.4% to 9%. This includes pneumothorax, haemothorax, haematoma, venous thrombosis, pulmonary embolism, air embolism and stroke. Arterial puncture can result in haematoma, pseudoaneurysm, arteriovenous fistula (AVF), dissection, stroke and death.⁴ Inadvertent arterial puncture with a small needle usually has a benign course and occurs in 5% of cases (range between 0% and 11%).⁶ Much more morbid complications from arterial misplacement of large calibre cannula have an incidence of 0.1%–0.8%.⁷ Puncture into anatomically associated arteries includes the carotid, vertebral, subclavian, brachiocephalic, and branch vasculature and can result in strokes, complex pseudoaneurysms, and AVFs. Obtaining imaging facilitates the ability to plan operative treatment, identify anatomic abnormalities, locate the exact arterial entry site, recognise any catheter-related thrombus and distinguish associated pseudoaneurysms or AVFs.

Our case highlights the fact that inadvertently placed CVC should be removed only after making adequate preparation for handling complications such as torrential bleeding. Even in our case, precaution was taken to place stent graft assembly at the site of CVC entry point before removing the CVC. Stent graft was deployed as soon as the external CVC was pulled out. Post stenting angiogram should be taken to rule out residual extravasation. Serial follow-up chest radiograph should be examined for the progressive opacity (residual bleeding) around the deployed stent graft. Selecting appropriately sized stent graft is the key element to avoid these complications. The entire procedure should be performed after intubation due to untoward complications occurring during the procedure. Although covered stents proved to be an effective solution in some cases, local anatomy leads to coverage of branch vasculature, especially in the subclavian circulation. Other endovascular procedures which can be offered for managing these cases include percutaneous closure devices, tract embolisation or gradual downsizing of transarterial catheters. However, safety of vascular closure device is not completely established. Moreover, if it fails, haematoma and residual arterial leakage can occur and the manual compression at this location might be an issue. The gradual downsizing of the catheter was not tried because the hole in the arterial wall has already been created and with downsizing, there is increased chance of periarterial haematoma and leakage which could lead to compression of vital structures lying in this closed space. Open repair is advocated in the setting of large diameter catheters, complex AVFs or pseudoaneurysms, or bleeding risk with significant coagulopathy.⁴

All the CVC line should be placed under imaging guidance even in emergency room to avoid such untoward complications and the current guidelines strongly recommend image guidance in this regard.² Hence, the treating physicians and residents should be well trained in these procedures, which can be safely

performed under imaging guidance. Any untoward complications occurring during the procedure need to be noticed as early as possible and should be discussed with the team comprising of vascular surgeon and interventional radiologist. Endovascular management of such complications avoids morbidity and complications associated with surgical management.

Learning points

- ▶ Inadvertent arterial placement of central venous catheter is relatively rare.
- ▶ It can result in complications such as haematoma, pseudoaneurysm, AVF, dissection, stroke or even death.
- ▶ A high index of suspicion is required for immediate diagnosis and management.
- ▶ Consultation with vascular surgeon and intervention radiologist should be sought to provide optimal management.
- ▶ Endovascular management of such complications may avoid morbidity and complications associated with surgical treatment.

Contributors MS and AS have prepared the manuscript. MS and SHC have prepared and formatted the image. SK performed the procedure, edited and approved the manuscript.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

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