Vascular complications of central venous cannulation – endovascular treatment

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Background

Central venous cannulation is commonly used for obtaining short-term or long-term venous access. The procedures can be performed either using superficial landmarks (blind puncture) or with ultrasound guidance of vein's puncture. The use of ultrasound guided venous catheterization reduced incidence of complications and increased technical success rate of procedure. The complications due to vascular injury (arterial or venous) include bleeding, hematoma, hemothorax, pseudoaneurysm, arteriovenous fistula, stroke, limb ischemia, thrombosis. Treatment options for these iatrogenic vascular traumas are manual compression (pull and hope technique), surgical repair or endovascular techniques (percutaneous closure device, prolonged balloon inflation, stent-graft implantation, embolisation).

Purpose

A retrospective analysis of an endovascular treatment of vascular (arterial and venous) complication during central vein cannulation.

Materials and methods

From November 2003 to January 2018 we treated 21 patients (8 men, 13 women, range 32–90 years, mean 67.8 year) with arterial injury due to cannulation. Attempt to puncture of the subclavian vein was done in 15 cases, jugular jugular vein in three and femoral vein also in 3 cases. The right side was catheterised 15 times, the left side 6 times. The catheter (7–14 F) was inadvertently introduced into the artery in 12 cases (subclavian artery in 10 patients, carotid artery in 2 patients). Eleven of these catheters were left in situ, one dialysis cannula (14 F) was removed by nephrologist who performed cannulation. Arterial laceration with extravasation was seen in four patients, with arterial pseudoaneurysm in another 4 patients. Venous laceration with pseudoaneurysm was in one case. Blind puncture without ultrasound guidance was used in all cases. CT angiography was performed in 9 patients (42.9 %). Following endovascular techniques to stop bleeding were used: sealing with percutaneous closure device in 6 patients, closure device with balloon tamponade in two, closure device and a stent-graft placement in one (in these three patients the extravasation on angiography was detected after using closure device and additional endovascular technique was required), stent-graft placement alone in two, stent-graft placement with embolisation of bleeding arterial branches in one case, embolisation in 6 cases (coils 4x, particles 2x), percutaneous thrombin injection in 3 cases.

Results

Mean follow-up was 38.2 months (range 0.1–78 months). Bleeding cessation was achieved in 95.2 % (20/21). Eleven patients died during follow-up. No relationship between endovascular treatment and death was in 10 cases. Only the patient with unsuccessful manual compression after extraction of dialysis catheter underwent surgical treatment before and after endovascular procedure and died 8 days after endovascular procedure from multiple organ failure due to hemorrhagic shock.

Conclusion

Endovascular management of arterial laceration and catheter misplacement in the artery during central vein cannulation seems to be very effective. Removal and manual compression, especially large bore cannulas (diameter ≥ 7 F) is no more recommended for high rate of failure. Endovascular management offers a less invasive alternative to vascular surgery and it could be considered as first choice of treatment in case when the site of arterial injury is not surgically easily accessible (e.g. subclavian artery).

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Case No 1. 65-year-old man with bilateral pneumonia and acute renal failure. The short term dialysis cannula was misplaced to the left subclavian artery. The arterial cannulation was identified by pulsatile flow from catheter. Angiography through the 12 F dialysis catheter showed patent subclavian artery (Fig. 1A). There was only gentle narrowing (arrow) and no extravasation on final arteriogram after closure using 8 F percutaneous closure device (Angioseal, St Jude Medical, St Paul, MN, USA) (Fig. 1B).

Case No 2. 62-year-old woman with acute renal failure. Difficult insertion of dialysis catheter into the right subclavian vein. She suffered with hypotension and dyspnoea 1 hour after cannulation. She was intubated and CT angiography diagnosed hemothorax (arrowhead) on the right side. There was small pseudoaneurysm of the right internal thoracic artery identified (arrow) (Fig. 2A, B). Angiography confirmed CT findings (Fig. 2C) and the internal thoracic artery was embolised using coils and acrylic glue (Fig. 2D).

Case No 3. 82-year-old man with AV block underwent pacemaker implantation. The procedure was complicated with mediastinal hematoma and CT angiography revealed laceration of the left brachiocephalic vein and contrast media extravasation with pseudoaneurysm (Fig. 3A). Phlebography from the left brachial vein displayed venous pseudoaneurysm (Fig. 3B). Endovascular treatment included embolisation of pseudoaneurysm sac with coils (Fig. 3C). Final phlebography after embolisation (Fig. 3D).

Case No 4. 79-year-old man with end stage renal disease had inadvertent placement of 12 F dialysis cannula into the right subclavian artery (Fig. 4A). The catheter was left in situ and endovascular therapy was indicated. The catheter was pulled from artery during catheterization with wire. Angiography through the catheter inserted from femoral approach showed extravasation contrast media (Fig. 4B) Perforation of the subclavian artery was sealed with balloon-expandable stent-graft implantation (Fig. 4C). There was no extravasation on final angiography (Fig. 4D).