Central venous access devices related complications: Evaluation with multidetector CT

Poster No.: C-0997
Congress: ECR 2010
Type: Educational Exhibit
Topic: Chest
Authors: P. V. Foti, R. Farina, M. Coronella, D. D'Aniello, G. Politi, G. C. Ettorre; Catania/IT
Keywords: central venous access, central catheters, multidetector CT
DOI: 10.1594/ecr2010/C-0997

Learning objectives

To illustrate the imaging findings of complications associated with central venous access devices (CVADs) with emphasis on multidetector CT (MDCT).

Background

CVADs play an important role in modern medical patient management and treatment. CVADs are used to administer chemotherapy, for blood draws, hydration, administration of blood products, total parenteral nutrition, or medications, peripheral access, hemodynamic monitoring. Implanting CVADs is performed in the operating room or during interventional radiology.

Imaging findings OR Procedure details

Before they are used, all CVAD placements should be confirmed by x-ray. For proper placement, the catheter tip should rest in the lower third of the superior vena cava. Right atrium placement can trigger arrhythmias or result in pericardial effusion.

We illustrate the spectrum of imaging findings of the main complications associated with CVADs with emphasis on clinical correlation.

Complications associated with the insertion of CVADs include: pneumothorax (fig. 1 on page 3), cardiac tamponade, arterial rupture or thrombosis (fig. 2 on page 4), hemorrhage, hemothorax, hydrothorax, air embolus, brachial nerve plexus injury, thoracic duct injury, misplacement, infection. Complications during the use of CVADs are: infection or sepsis (fig. 3 on page 5), phlebitis, deep vein thrombosis (fig. 4 on page 6) with risk of pulmonary embolism, chemotherapy extravasation, 180° rotation of an implanted port, catheter occlusion, migration or fracture, fibrin sheath formation. Higher rates of complications are found in patients with CVADs inserted for more than two weeks.

Upper-extremity deep vein thrombosis (DVT) is a clinically relevant complication related to the use of CVADs, it is particularly common in certain at risk population such as patients with acute spinal cord injuries. Factors proposed to influence the development of catheter-related thrombosis include multiple venipunctures, placement technique, use of larger diameter catheters, catheter material, length of use, location of catheter tip (must be in superior vena cava for high flow to dilute infusate), and composition of infusate (total parenteral nutrition may increase endothelial trauma). Upper-extremity DVT has been associated with grave consequences, including fatal pulmonary embolism (PE), septic thrombophlebitis, superior vena cava syndrome, loss of central venous access, and venous gangrene. It may affect the brachial, cephalic, axillary, or subclavian veins. The most common manifestations of upper-extremity DVT are ipsilateral arm swelling, pain, prominent superficial collateral veins, and range-of-motion limitation, thought many events may be subclinical.

Conventional x-ray has a limited role in detecting such conditions. Owing to its widespread availability, short examination time, excellent spatial resolution, cost-effectiveness, cross-sectional imaging, possibility to obtain multiplanar reformations, panesplorant capability, MDCT represents the technique of choice to detect CVADs related complications.

Images for this section:

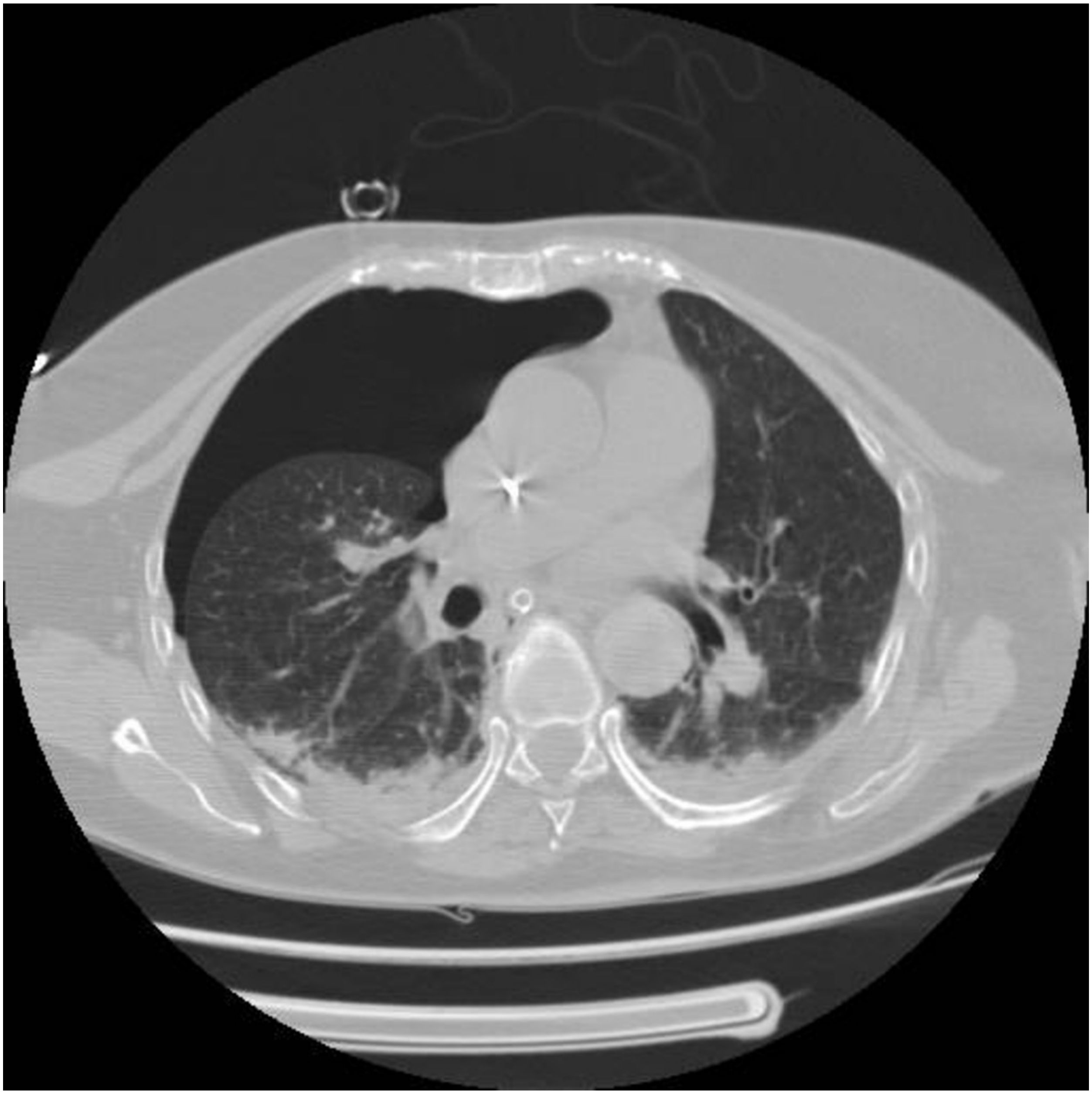

Fig. 1: Fig. 1. Pneumothorax. Large right pneumothorax. Note the central venous catheter in superior vena cava and right lower lobe's posterior basal segment atelectasis.

Fig. 2: Fig. 2. Left axillary artery thrombosis in a paediatric patient. Coronal reformatted MIP image reveals a filling defect, extending for about 1 cm, in the left axillary artery.

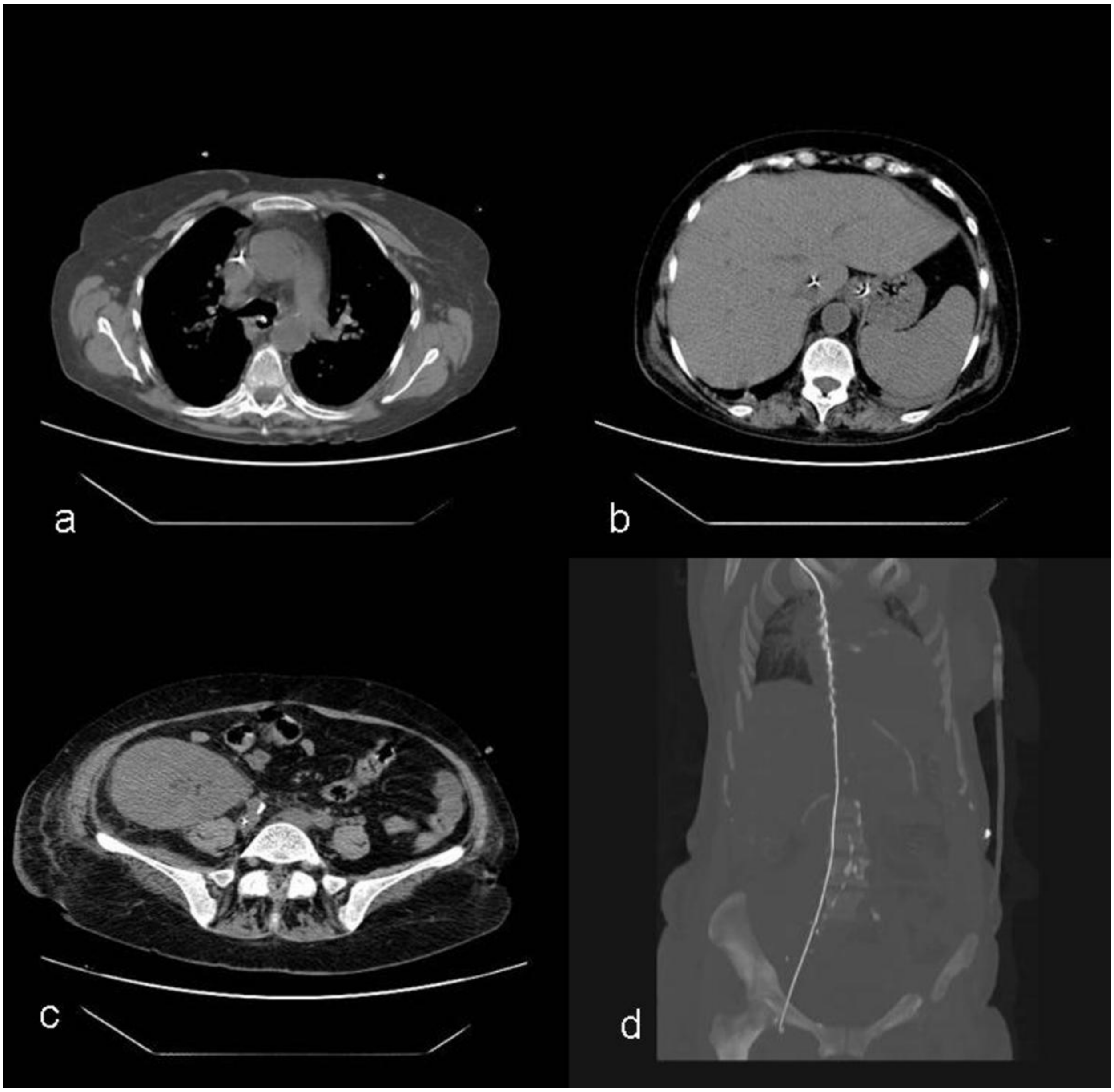

Fig. 3: Fig. 3(A-D). Sepsis. Transplanted kidney patient presenting with sepsis after central venous catheter positioning. (A) CT scan reveals central venous catheter in superior vena cava. (B) CT image shows catheter's guide in intrahepatic vena cava. (C) CT scan shows catheter's guide in right iliac vein. Note the transplanted kidney in right iliac fossa. (D) Coronal reformatted MIP image entirely displays the central venous catheter and its guide.

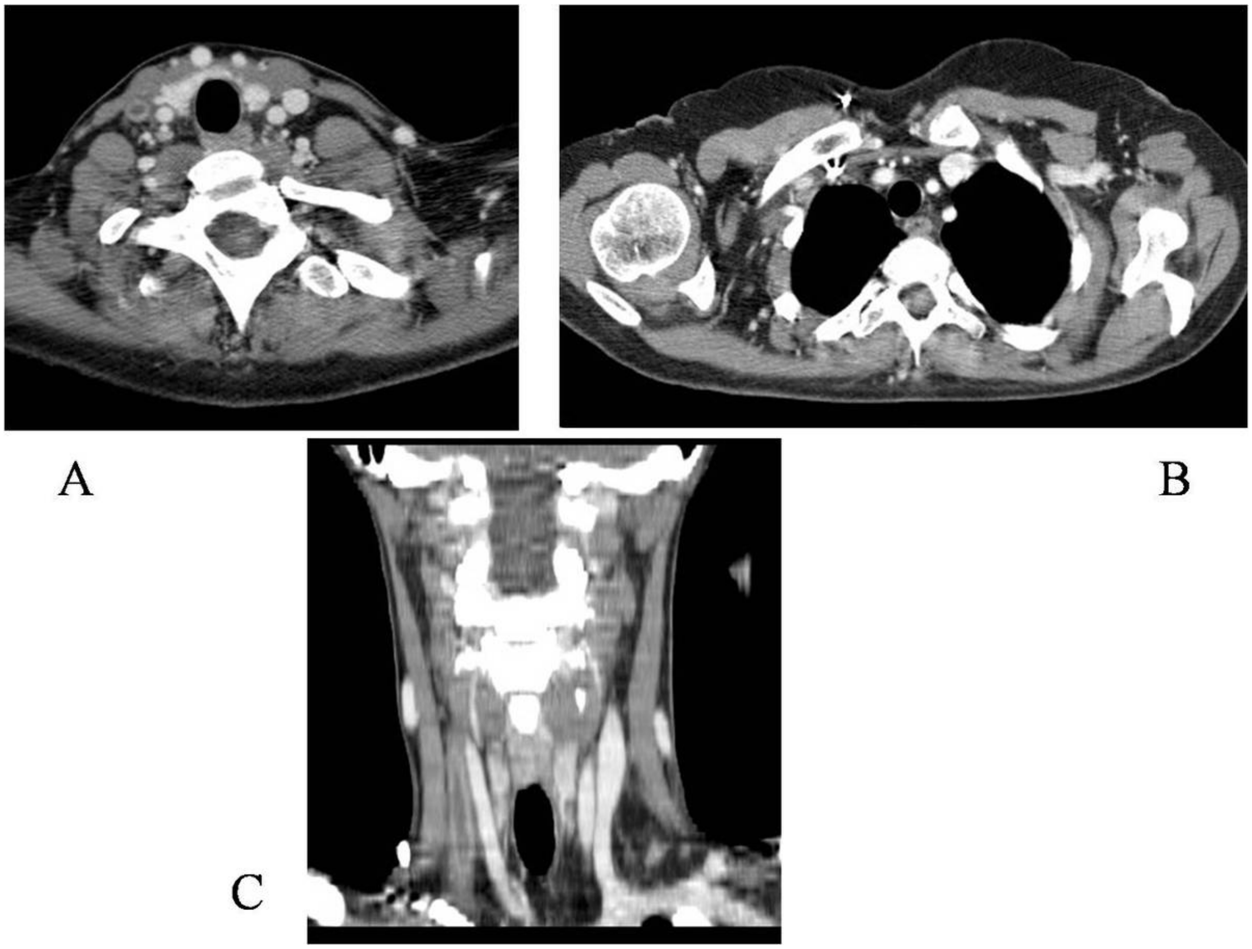

Fig. 4: Fig. 4(A-C). Right internal jugular vein thrombosis in an oncologic patient. (A) CT scan shows a filling defect in the right internal jugular vein. (B) CT image reveals a filling defect in the right brachiocephalic vein. Note the central venous catheter in the right brachiocephalic vein. (C) Coronal reformatted MIP image clearly shows right internal jugular vein thrombosis.

Conclusion

Some precautions should be considered when using CVADs: the smallest available and appropriate diameter catheter should be used; polyurethane or silicone-based catheters should be preferred to those made from polyvinyl chloride or polyethylene; physicians should ensure catheter placement in the superior vena cava before their use to maximally dilute the infusate, especially with more viscous solutions such as total parenteral nutrition. Radiologists must be aware of CVADs related potential complications in order to choose the imaging technique to perform.

Personal Information

University of Catania

Dpt. DOGIRA - Section of Radiological Sciences

Via S. Sofia 95100 Catania, Italy

- Dr. P.V. Foti pietrofoti@hotmail.com

- Dr. R. Farina radfaro@hotmail.com

- Dr. M. Coronella marcofricia@alice.it

- Dr. D. D'Aniello daniellodario@libero.it

- Prof. G. Politi g.politi@unict.it

- Prof. G.C. Ettorre g.ettorre@unict.it

References

1. Arch P. Port navigation: let the journey begin. Clin J Oncol Nurs. 2007 Aug;11(4):485-8.

2. Cowl CT, Weinstock JV, Al-Jurf A, Ephgrave K, Murray JA, Dillon K. Complications and cost associated with parenteral nutrition delivered to hospitalized patients through either subclavian or peripherally-inserted central catheters. Clin Nutr. 2000 Aug;19(4):237-43.
3. Hyman GS, Cardenas DD. Upper-extremity deep vein thrombosis associated with peripherally inserted central catheters in acute spinal cord injury: a report of 2 cases. Arch Phys Med Rehabil. 2002 Sep;83(9):1313-6.