Vascular Complications of Central Venous Line Insertion

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INTRODUCTION

Internal jugular vein cannulation is a common diagnostic and therapeutic procedure. The method for percutaneous cannulation of the internal jugular vein using external landmarks was first described in 1966.1 The incidence of associated complications ranges from 5% to 11%, depending on operator experience (Table).2–9 Early recognition and treatment of these potentially lethal complications is essential and management is illustrated in the following cases.

CASE REPORTS

Case 1

A 43-year-old man underwent elective spinal surgery for L5/S1 spondylolisthesis. Postoperatively, he developed aspiration pneumonitis, which led to adult respiratory distress syndrome and multi-organ failure. He was admitted to the intensive care unit (ICU) for renal and ventilatory support and was also anticoagulated for a coexisting deep vein thrombosis. During his ICU stay, a triple-lumen catheter was inserted into the left internal jugular vein without any obvious problem. However, one day after its removal, a non-pulsatile swelling was noted in the immediate area, extending down to the clavicle. The swelling steadily increased in size. An urgent ultrasound scan of the neck (Figure 1) revealed a 3.3 cm x 2.3 cm x 8 cm heterogeneous mass in the left sternocleidomastoid muscle, with an irregular central anechoic area suggesting necrosis. No colour Doppler signal was detected within the mass, which was in close proximity to, and displacing, the left common carotid artery. Emergency exploration of the left neck was performed under general anaesthesia and the swelling was confirmed to be within the sternomastoid muscle. It was incised longitudinally along the muscle to reveal an intramuscular haematoma that was subsequently evacuated. No extravasation of blood or bleeding outside the muscle belly was noted. Haemostasis was achieved and a drain inserted within the muscle. The wound was closed in layers. Further recovery was uneventful.

Case 2

A 38-year-old man suffered from IgA nephropathy and developed end-stage renal failure. A central venous catheter was inserted into the right internal jugular vein for temporary haemodialysis. Unfortunately, this resulted

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in accidental puncture of the right subclavian artery. The catheter was immediately removed and local pressure applied to the puncture site. Approximately 6 hours later, a thrill was noticed at the site and a continuous ‘machinery murmur’ was heard on auscultation. Doppler ultrasound of the area showed an arteriovenous fistula (AVF) between the right internal jugular vein and the right subclavian artery. An angiogram (Figure 2) confirmed the ultrasonographic findings. Emergency exploration of the right neck was performed and the AVF was ligated. The internal jugular vein was then repaired. The patient made a good recovery. Six months postoperatively, a follow-up angiogram showed no fistula, and the artery and vein showed normal patency.

Case 3

A 33-year-old pregnant woman suffering from cardiomyopathy was admitted for severe pre-eclampsia and acute pulmonary oedema. After resuscitation and stabilization, an emergency Caesarean section under general anaesthesia was performed. During pulmonary artery catheter insertion via the right internal jugular vein, the introducer was accidentally inserted into the right carotid artery. On recognizing the problem, the introducer was immediately removed and firm pressure applied to the puncture site. Seventeen hours later, the patient developed left-sided hemiparesis. Computed tomography showed an area of infarction in her right parietal lobe. During her ongoing care, a continuous ‘machinery murmur’ was noticed in the region of the puncture 5 days later. Doppler ultrasound showed a fistula between the right common carotid artery and the internal jugular vein, with turbulent flow from artery to vein and extensive thrombus formation within the vein. These findings were confirmed angiographically (Figure 3). The right neck was surgically explored and the AVF closed with ligation. Her hemiparesis steadily improved postoperatively.

Case 4

A 29-year-old woman with systemic lupus erythematosus (SLE) developed end-stage renal failure and required temporary haemodialysis. An unsuccessful attempt at right internal jugular vein cannulation was immediately followed by insertion of a right subclavian line. One month later, a pulsatile mass with an associated thrill was noticed in her right neck. Doppler ultrasound of
the area showed a 2.5 cm pseudoaneurysm in the right neck with internal turbulent flow. A false tract was identified from the posterior aspect of the pseudoaneurysm communicating with the proximal portion of the right subclavian artery. A pulsatile waveform was noted in the right internal jugular vein that suggested the presence of an AVF.

Angiography (Figure 4) confirmed a pseudoaneurysm arising from the right thyrocervical trunk, but failed to demonstrate a communication with the internal jugular vein. Exploration of the neck revealed the pseudoaneurysm to be arising from the thyrocervical trunk and a communication with the internal jugular vein was found. The thyrocervical trunk was ligated, the pseudoaneurysm excised and the internal jugular vein was repaired. The patient made a good recovery but, 2 months later, had a cerebrovascular accident. Computed tomography showed a 4-cm, left-sided occipital haematoma. The haemorrhagic stroke was considered to be associated with the SLE-related vasculitis rather than a thromboembolic event arising from the AVF.

**DISCUSSION**

Regular monitoring following insertion or removal of a central line is mandatory for the early recognition and treatment of any associated complications. Intramuscular haematoma of the sternomastoid have not been previously reported in the literature. Differentiating haematoma from AVFs can be difficult, but essential, because small haematoma may resolve spontaneously. Our small series of patients demonstrates the advantage of ultrasonography as an accurate and non-invasive means of investigation. A purely intramuscular haematoma can displace and compress the common carotid artery. Early decompression and drainage is required to avoid the potential risk of stroke and airway impairment.10

AVFs in the neck are uncommon and are mostly due to trauma, surgery, irradiation and post-cannulation in acquired cases. Anticoagulation, use of large-calibre catheters (such as double-lumen central vein catheter for temporary dialysis) and the presence of atherosclerosis are predisposing risk factors.11 AVFs between the carotid artery and the internal jugular vein are a well-known complication of central line insertion via the internal jugular vein12,13 and have also been reported in the neck after penetrating injury.14 Fistulae involving the carotid or vertebral artery carry a risk of thromboembolism that could result in a cerebrovascular accident.15 Presentation is often late and usually as a swelling, thrill or bruit.14 Although several studies have shown that Doppler ultrasound is superior for delineating the lesion, angiography is still considered to be the gold standard in defining the location for surgical treatment.16

Treatment of AVF in the neck is controversial, ranging from close observation, transvenous closure with silicon,11 surgical exploration and ligation17 to endovascular occlusion. All three cases of AVF reported in this paper occurred after difficult cannulation of the internal jugular vein. Difficulty in cannulation should raise a high index of suspicion of potential problems following central line insertion. Any concern should be promptly investigated.
We suggest ultrasound as the first-line investigation. Small haematomata may be safely observed. However, should there be any evidence of enlargement or vascular compression, open exploration is warranted. If cannulation is likely to be difficult, the use of ultrasound-guided techniques of insertion should be considered. Other alternatives include the use of peripheral and superficial entry points for cannulation, transducing intraluminal pressure of the vessel before dilation, abandoning further attempts of cannulation at the same site in case of arterial puncture and application of prolonged pressure to the puncture site.

REFERENCES