Central venous cannulation is an important technique in modern medicine and is used in many disciplines. In anaesthesia and intensive care, it provides a means of measuring the filling pressure of the right atrium, a route for infusion of drugs too potent or too toxic to be administered through peripheral veins and access for pacing wires and pulmonary artery catheters going into and through the right heart. Parenteral nutrition and chemotherapy depend on central venous catheters, and acute renal replacement therapy is usually performed through modified central venous catheters.

There are dangers associated with central venous catheters at all stages of their use. Failure of cannulation, misplaced cannulae, haemorrhage, pneumothorax, air embolism, arrhythmias and damage to other structures are common complications during insertion. Most of these can also occur during use, and thrombosis, embolism, infection and catheter migration are additional complications of continued therapy. Many of the complications can cause rapid death or lead to long-term disability.

Central veins are usually cannulated percutaneously. Many approaches have been described, each with their advocates, each with their special complications and most fatally easy to attempt. If there are many ways to do something, then none is particularly good. This is especially true of percutaneous central venous cannulation. The biggest problem is that percutaneous techniques rely on normal anatomy below the surface landmarks. In most patients this is the case, and that is why most attempts at central venous cannulation are successful. In some patients however, the anatomy is abnormal from the outset. Denys and Uretsky used ultrasound to show that only 91.5% of 200 patients had normal anatomy of their internal jugular vein at the apex of their sternomastoid triangle; 3% had small fixed veins, and 1% had lateral and 2% medial alignment in relation to the carotid artery. In 2.5%, there was complete absence of the internal jugular vein. Attempts to cannulate an absent internal jugular vein will always be unsuccessful and are likely to result in puncture of the carotid artery, subclavian artery or pleura. Rule VI of the cult classic medical novel The House of God states ‘There is no body cavity that cannot be reached by a 14-gauge needle and a good strong arm’. This puts the vertebral artery and intrathecal space at risk during attempts at central venous cannulation.

Even if venous anatomy is originally normal, other factors conspire to complicate cannulation. Obesity produces problems at all sites. Neck deformity and rigidity, previous surgery and goitre are long-standing features that complicate cannulation of the internal jugular vein. To these may be added acute problems, especially hypovolaemia and the inability to lie flat. Haemorrhage can occur rapidly after even a small puncture of an internal jugular vein. It is even more likely to occur after inadvertent carotid artery puncture. At best this complicates later attempts at correct placement of the desired cannulae, but it can be so severe that it results in fatal airway obstruction. Thrombus occurs in the veins of many patients in intensive care units. Attempts to cannulate these veins will be unsuccessful, even when the anatomy is normal.

The use of two-dimensional (B-mode) ultrasound scanning devices enables practitioners to view the anatomy of the target area before cannulation and during the actual act of cannulation. Abnormal anatomy is easily detected. Veins can be distinguished from arteries by gentle compression. If no vein is present at the first site selected, painful, prolonged probing can be postponed and another more suitable site selected. Phasic changes in the size of veins during respiration indicate the most appropriate time to cannulate in those who cannot lie flat. Thrombosed veins are obvious and can be avoided.

Most ultrasound machines can be fitted with an appropriate probe which displays the central veins, and can be used to guide catheter insertion. Small, hand-held, portable scanners, specifically designed for central venous cannulation have many advantages and are easy to use in small anaesthetic rooms, or at the bedside in crowded intensive care units. If the scanner is used purely to check the anatomy before cannulation using a traditional technique, an isopropyl alcohol-based disinfectant spray provides a fast hygienic solution to the problem of acoustic coupling. Most patients with a small or absent internal jugular vein on one side of the neck have a very large vein on the other side. Forewarned, it is easy to select the appropriate side for cannulation. Scanners can also be used during insertion of cannulae. This is an excellent teaching tool, but more elaborate and time-consuming sterile precautions are required, including a plastic sheath to cover the probe. Traditional manoeuvres to increase the size of the vein can be tested and challenged. The needle can be watched indenting and penetrating the vein. The ease with which the vein can be obliterated with excess pressure from the palpat ing finger is simply demonstrated. Haematoma can be observed developing immediately after the accidental withdrawal of a 16-gauge cannula from an internal jugular vein. They push the vein about 3 cm lateral to the artery,
to a point so lateral that it would not be aimed at by a blind observer. The guidewire can be seen going in the correct direction (or be reorientated if it is not). Notched guides can be provided on the ultrasound probe to slide the introducer needle along once the vein has been aligned with a mark on the screen.

The introduction of any new technology, especially in medicine, leads to cries that it is probably dangerous, it will deskill practitioners of the ancient art,9 trainees will no longer learn the old techniques, and eventually no one will be able to perform what used to be everyday tasks. When the British Heart Foundation funded our first SiteRite7 in 1991, mindful of my own fears and the warnings of my colleagues, I resolved to use it for research and teaching, but only teaching of traditional, blind techniques of central venous cannulation. I now find difficulty in maintaining this attitude. Randolph and colleagues10 have used meta-analysis to demonstrate a lower failure rate and a lower complication rate using ultrasound guidance. Hatfield and Bodenham,11 in this issue, describe 100% success using ultrasound guidance as a ‘bale out’ technique after failed attempts at blind central venous cannulation. I have also used it to bale out junior colleagues who I was supervising (and occasionally to bale myself out) to the extent that every elective patient that I have been involved with since then has had a central venous cannula inserted at the initial target site. Maintaining traditional skills has been at some cost. I have supervised seven trainees as they inserted 16-gauge cannulae into carotid arteries and to my horror one 8.5-F introducer sheath. I have spent many hours of theatre time helping trainees climb their learning curves. It would be much simpler for me and safer for my patients to use ultrasound guidance throughout the procedure. I know of three civil actions for damages, currently in hospitals and the plaintiffs are legally aided. Each of the cases is likely to approach £500 000. It will be totally funded from taxation, as the events occurred in NHS hospitals and the plaintiffs are legally aided. Each of the problems would have been far less likely to have occurred if the attempts at cannulation had been performed under direct ultrasound guidance.

Half a millennium ago, the philosopher and theologian Erasmus wrote ‘In regione caecorum rex est lucus’.12 This is usually translated as ‘In the country of the blind, the one-eyed man is king’. Magill13 in 1926 and McIntosh (1943)14 threw light on the larynx, and no anaesthetic room would be complete today without a working laryngoscope. Fibreoptic intubation superseded blind nasal intubation in the 1990s.15 We have not yet reached the point where it is considered by our legal colleagues to be negligent to attempt to insert a central venous cannula without checking the anatomy by ultrasound, but early in the next millennium, I am confident that ultrasound guidance will be a prerequisite before and during central venous cannulation.

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