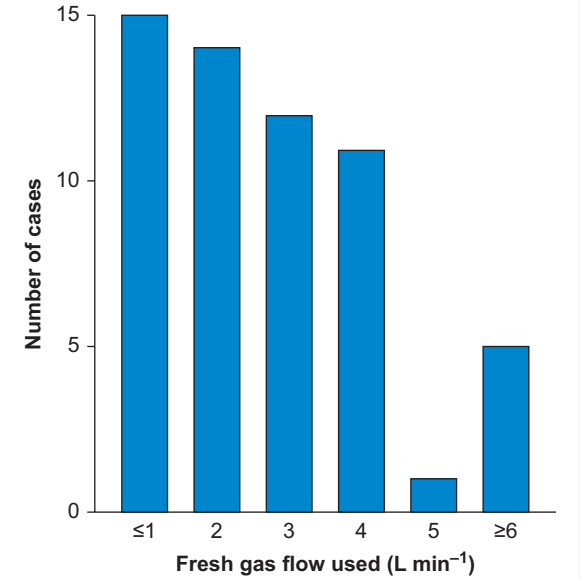

Fig 1. Sprint audit data showing the variation in fresh gas flow rates when using TIVA at our institution.

for routinely-used techniques such as nasal high-flow oxygen (20–60 L min^{-1}) or non-rebreather oxygen masks (15 L min^{-1}).

As much as 5% of the carbon footprint of UK acute care hospitals is attributable to inhaled anaesthetic agents that are potent greenhouse gases, with desflurane and nitrous oxide having the greatest environmental effects, yet little evidence of clinical benefit.[4,10] Our anaesthetic department at Wythenshawe Hospital has already taken steps to address this by removing desflurane vaporisers and nitrous oxide cylinders from our anaesthetic machines and minimising use of inhalation anaesthesia. With most of our general anaesthetics now conducted using TIVA, we are actively seeking 'marginal gains' in sustainable anaesthetic practice. We commend Zhong and colleagues[2] for identifying one such potential gain; it is important to know if, when the carbon intensity of electricity production is accounted for, the potential for environmental gains is actually greater than they have calculated.

Declarations of interest

CS is a former member of the editorial board of *BJA Education*. The authors declare no other competing interests.

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Radial artery catheterisation pressure monitoring with a closed intravascular catheter system and ultrasound-guided dynamic needle tip positioning technique

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Keywords: arterial catheterisation; dynamic needle tip positioning; intravascular catheter; radial artery; ultrasonic guidance

Editor—Radial artery catheterisation is commonly performed in critically ill patients to monitor real-time arterial blood pressure. Traditionally, radial artery catheterisation is achieved by removing the core metal needle to check for arterial blood backflow, advancing the catheter over the needle, and then connecting the catheter to a pressure monitoring system for final confirmation of intra-arterial placement. Blood loss during insertion and needle-stick injury are potential risks associated with this technique.[1] A closed intravascular catheter system was designed to reduce the risks of blood exposure during peripheral venous catheterisation.[2] This technique may have similar advantages during arterial catheterisation. However, the core needle of this closed system cannot be removed to check for blood backflow and the loss of resistance sensation while advancing the catheter over the needle into the arterial lumen cannot be felt because of the high resistance between the catheter and the needle of this closed system. We suggest that this problem can be solved through the use of the ultrasound-guided dynamic needle tip positioning technique.[3] Here, we describe a radial artery catheterisation technique with this closed intravascular catheter system combined with real-time pressure monitoring and the ultrasound-guided dynamic needle tip positioning technique.

The side port of a 20G BD closed intravascular catheter kit (Becton Dickinson Medical Devices Co. Ltd, Jiangsu, People's Republic of China) is connected to a pressurised invasive blood pressure monitoring system before the procedure to minimise blood leakage from the catheter hub and observe intra-catheter pressure continuously (Fig. 1a and b). Radial artery catheterisation is performed using the ultrasound-guided dynamic needle tip positioning technique along with observation of the arterial pressure waveform. First, the wrist is positioned and sterilised. Second, a short-axis out-of-plane view of the radial artery is obtained using a high-frequency linear ultrasonic probe. Third, the needle and the catheter are advanced through the skin at an angle of 30–40° until the hyperechoic needle tip is seen on the ultrasound image. Fourth, the ultrasound probe is moved away from the needle insertion point until the needle tip disappears on the ultrasound image. Fifth, the needle and the catheter are advanced a few millimetres until the needle tip reappears on the ultrasound image (Fig. 1c and d) and the arterial pressure waveform now flattens (Fig. 1d, D1). This stepwise process is repeated until the visualisation of the needle tip in the lumen of the radial artery (Fig. 1e), a dampened arterial pressure waveform on the monitor (Fig. 1e, E1), and blood backflow are seen between the inner wall of the catheter and the needle. Fifth, after lowering the insertion angle, the system is then advanced with the aforementioned dynamic needle tip positioning technique until the entire catheter is in the arterial lumen. Finally, the needle is withdrawn whilst keeping the catheter in the lumen of the radial artery. The observation of a normal arterial pressure waveform (Fig. 1, E2 and E3) indicates successful catheterisation.

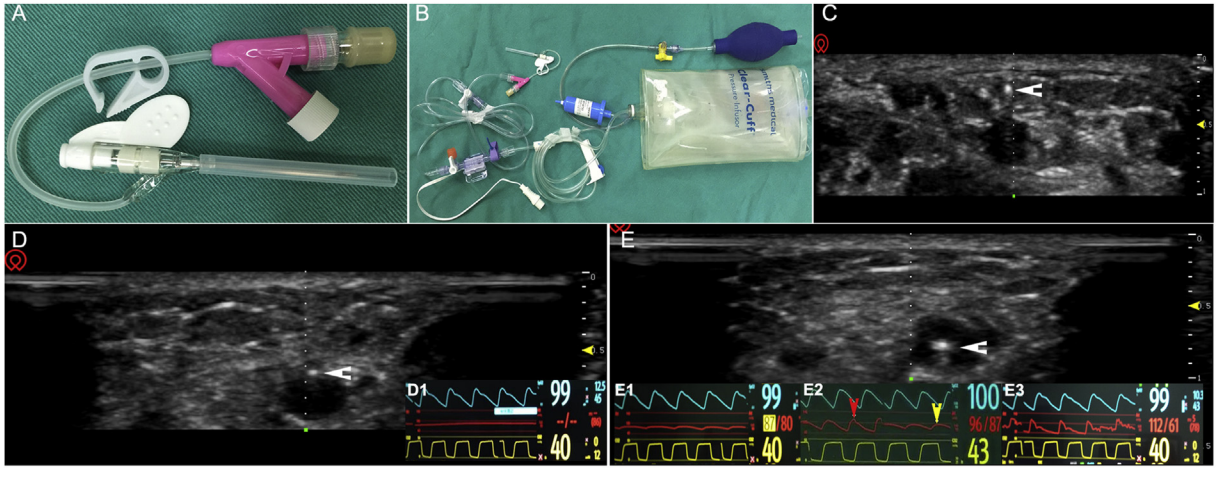

Fig 1. (a) The BD Intima II™ closed intravascular catheter system. (b) The pre-assembled catheter and monitoring system. (c) Ultrasound image with the needle tip in the subcutaneous tissue. (d) Ultrasound image with the needle tip in the arterial wall. D1, pressure waveform with the needle tip in the subcutaneous tissue. (e) Ultrasound image with the needle tip in the arterial lumen. E1, pressure waveform with the needle tip in the arterial lumen; E2, pressure waveform with the needle partially removed from the catheter; E3, pressure waveform after the needle is completely removed from the catheter. White arrow, needle tip; red arrow, pressure waveform before the needle is removed from the catheter; yellow arrow, pressure waveform after the needle is removed from the catheter.

We have found several advantages with this technique. First, the closed catheter system can reduce blood exposure during the procedure. Second, this method improves the success rate of catheterisation with real-time pressure monitoring and ultrasonic visualisation. Third, continuous flush fluid from the pressure monitoring system enhances needle tip echogenicity. Finally, the heparin cap at the end of this closed intravascular catheter system can be used to collect arterial blood samples or to inject heparin to reduce thrombotic risks. In conclusion, we report a novel arterial catheterisation technique with a closed intravascular catheter system, real-time pressure monitoring, and ultrasound-guided dynamic needle tip positioning to reduce blood exposure and improve success.

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Declarations of interest

The authors declare that they have no conflicts of interest.

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Anaesthesia workspace layout and intervertebral disc prolapse

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Keywords: airway management; anaesthesia; back injury; ergonomics; occupational injury; operating room; workplace design

Editor—The association between back injury and some occupations is well recognised. Activities that result in stress upon intervertebral discs are well characterised and include heavy lifting, bending or stooping, twisting and turning, fixed extended postures, and whole-body vibration.[1] All of these result in shearing forces on intervertebral discs and ultimately disc prolapse.

With the exception of whole body vibration, all of the other movements occur frequently throughout during the practise of anaesthesia, and it is surprising that disc prolapse in anaesthetists has not been reported until relatively recently.[2] The largest report on the problem in anaesthetists is a recent Association of Anaesthetists survey in which 24% of respondents reported symptomatic and radiologically proven cervical disc prolapse.[3] Accepting that members with symptoms may have been more likely to respond to the survey, the prevalence seems high in consideration of the incidence in the general population which is reliably 0.5–1% and typically self-limiting in 6–8 weeks.[4] A recent meta-analysis concluded that cervical disc disease was present in ~17% of hospital specialists described as physically active 'Interventionalists'.[5] The relationship between disc problems and occupation was underlined by the fact that hospital specialists whose jobs did not have a physical component exhibited an incidence of disease similar to the general population.

In response to a perceived high prevalence of intervertebral disc prolapse amongst consultants in the Department of Anaesthesia in Sheffield, a recent report analysing the layout of our operating theatres and anaesthetic rooms was carried out. It identified a number of predisposing factors.[6] The standard of seating was aged, variable in design, and of poor quality. Many of our anaesthesia induction areas were too small to work in comfortably without a lot of twisting and turning movements. The placement of display screen equipment was problematic. Many monitors were placed behind the field of view of the anaesthetist when observing the patient, necessitating frequent twisting and turning movements between patient and screen. Writing surfaces and keyboards were not height and angle adjustable and again may not be aligned with display screens. The layout of equipment was lacking in any standardisation with different layouts even in adjacent areas carrying out the same clinical activities. Many of the components of the