phenylephrine or norepinephrine is often requested. Impaired diastolic function and sequential single-lung ventilation with subsequent clipping of the left atrial appendage, leading to decreased atrial natriuretic hormone concentrations, often lead to restricted fluid administration.

During surgery, single-lung ventilation with positioning of the tube by bronchoscopy is mandatory, not only before but also during surgery for surgical ablation. Communication between the surgeon, who might affect pulmonary venous return during ablation, and the anaesthetist is mandatory to avoid hypoxaemia. When changing sides, recruitment manoeuvres with special care of adequate lung re-expansion are important.

Postoperative follow-up involves management of recurrent rhythm problems, oxygenation problems, bleeding, fluid accumulation, and pain.[2] Pain after surgery is often multifactorial (see Fig. 1).

In practice, pain treatment starts before surgery, with paracetamol started before incision, and is continued for 24–48 h. The surgeon infiltrates local anaesthetic before closure at the laparoscopic incision sites. Pain control after awakening is enhanced with either opioid i.v. or an epidural local anaesthetic pump and non-steroidal anti-inflammatory drugs when indicated. Most pain complaints after surgery decrease drastically after thoracic drain removal. In some patients, however, pain persists for another week. Further pain relief is given as usual, with the exception of persistent, refractory pain, which can be treated with paravertebral block.

Declaration of interest

None declared.

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Real-time ultrasound-guided paramedian spinal anaesthesia: evaluation of the efficacy and the success rate of single needle pass

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Editor—The ideal way to provide spinal anaesthesia is via a single needle pass (i.e. a successful dural puncture, with a single skin puncture and no needle redirection). This was recommended by the Second American Society of Regional Anesthesia Consensus on Neuraxial Anesthesia and Anticoagulation.[1] Multiple puncture attempts are associated with a higher chance of complications.[2,3] A paramedian approach has been shown to improve the success rate of spinal anaesthesia, especially in patients who are unable to sit up or those with a degenerative spine condition.[4–6] The use of ultrasound has been suggested to increase the efficacy of spinal anaesthesia.[7]

We conducted a randomized controlled trial comparing the effects of real-time ultrasound guidance *vs* palpation on the efficacy of paramedian spinal anaesthesia. Sixty patients were randomly divided into two groups, a real-time ultrasound-guided group (UG) and a palpation group (PG). The patients ranged from 18 to 75 yr old, with BMI $\leq$30 kg m^{-2}. All patients were positioned laterally with the operation limb at the dependent site. Using aseptic technique, the patients in the UG had their spines scanned using a convex transducer in the paramedian oblique sagittal view (Fig. 1).[8,9] When the preferred lumbar interspace came into view, local anaesthetic was infiltrated, and a spinal needle introducer was inserted in-plane to the ultrasound probe. The angle of introducer was adjusted in real time until it was pointed in between two vertebral laminae (Fig. 2). A 25 gauge Pencan® pencil-point spinal needle (B. Braun Medical Ltd, UK) was inserted. The backflow of cerebrospinal fluid confirmed successful dural puncture. In the PG, the preferred interspace was

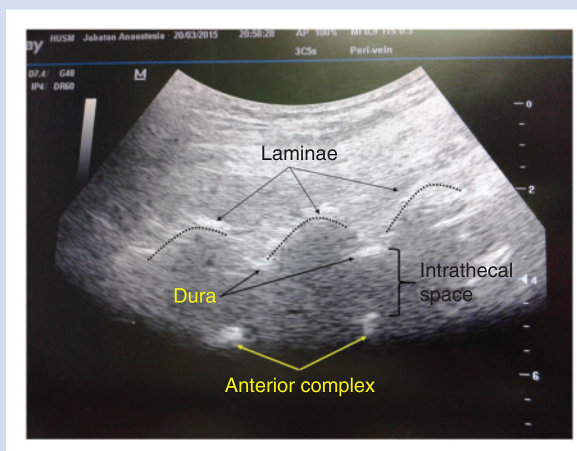

Fig 1 Paramedian oblique sagittal view of the interspinous and intrathecal space.

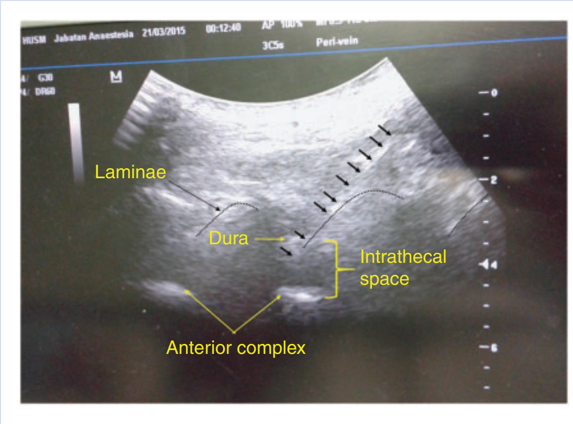

Fig 2 Insertion of an introducer and spinal needle in the paramedian oblique sagittal view (in-plane). The introducer (short black arrows) can be clearly seen, but the spinal needle cannot.

identified by palpation, as described previously.[10] An introducer and spinal needle were inserted 1 cm lateral and inferior to the interspace, angled cephalic and medially. When the lamina was contacted, the needle was walked off in a cephalic direction and gradually advanced into the subarachnoid space until cerebrospinal fluid was obtained. After a skin puncture, the spinal needle could be redirected up to six times before a second skin puncture. We compared the number of attempts, the number of needle passes, and the duration to dural puncture from the time of needle insertion.

Successful first attempts (single skin puncture with or without redirection) were higher in the UG than the PG (87 *vs* 43%, $P<0.001$). Successful single needle passes were also higher in the UG (47 *vs* 20%, $P=0.028$). This was comparable with studies by Conroy and colleagues[11] (30/100 or 30%), Brinkmann and colleagues[12] (7/18 or 39%), and Niazi and colleagues[13] (8/14 or 57%). The mean (SD) time for a successful dural puncture was shorter in the UG [0.69 (1.01) *vs* 1.60 (1.19) min, $P=0.002$]. This was comparable to the study by Conroy and colleagues,[11] which showed a time of 1.2 min (range 0.2–15 min).

Trials on real-time ultrasound-guided spinal anaesthesia are uncommon compared with pre-puncture ultrasound. This could be because of technical difficulties and complexities. The Association of Anaesthetists of Great Britain and Ireland recommends the use of phantom and simulation techniques in its latest vascular access guidelines.[14] The use of a water-based spine phantom[15,16] has helped the operator in ultrasound-guided neuraxial block training. It allows good understanding of sonoanatomy and needle–probe coordination, and is recommended as a teaching tool in ultrasound-guided neuraxial block. With increased experience of the entire anaesthesia team, the procedure becomes faster.

In conclusion, real-time ultrasound guidance improves the success rate of paramedian spinal anaesthesia. It reduces the number of attempts required, improves the success rate of a single needle pass, and shortens the time to dural puncture. Further trials can be done to establish the role of real-time ultrasound-guided neuraxial block among high-risk groups, such as obese and elderly patients.

Declaration of interest

None declared.

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A different use of visual analytic techniques in anaesthetics

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Editor—We are now in a world of big data. In all areas of life, data are collected, stored and interpreted. The potential for big data to improve clinical practice has previously been highlighted.[1] Among other ideas, Simpao and colleagues[1] suggested that analysis tools could reduce the duration of hospital admissions and provide financial savings tools. We have developed a novel way of viewing clinical data and demonstrate an important use for this.

For this work, the University of Queensland Vital Signs Dataset was used, which is freely available online.[2 3] This dataset contains no identifiable patient information. It is a dataset of multiparameter vital signs recorded on 32 patients who underwent surgical procedures under anaesthesia at the Royal Adelaide Hospital in Australia.

We used a sophisticated model-based approach for visualising big data following previous work in the machine learning field.[4] The dynamic changes in vital signs can be thought of as conforming to a linear function such that the observations each second are linked to those of the previous second, which in turn are governed by changes in multiple factors including physiology, pharmacology, and external influences. We focus on a 500-observation subsection from each case, accounting for uncertainties in each of the learned models such that we can visualize patient behaviour for these 32 different cases.

Each case has been collapsed into a single point and mapped onto an Uncertainty Surface (Fig. 1). This is an efficient way of identifying patterns and subsequently analysing anomalous cases. Those with vital signs that are consistently normal in comparison to the rest of the cohort are mapped onto the green area of the Uncertainty Surface. Those patients whose vital signs behave differently during the 500 observations are located

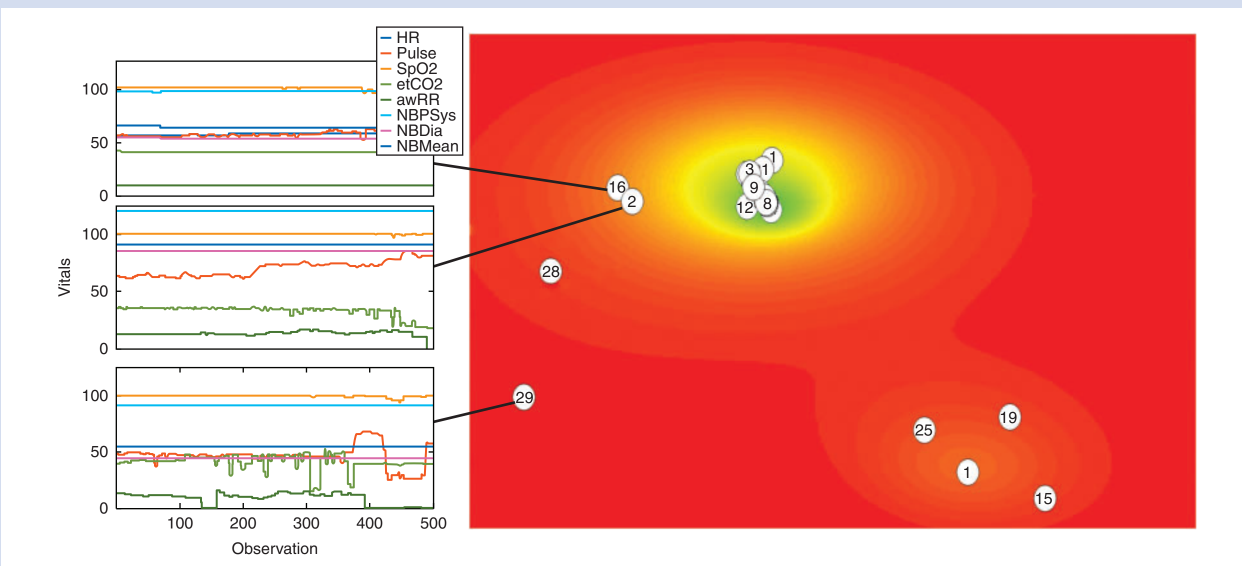

Fig 1 Visual analytic technique based on machine learning principles. Each case is allocated a single two-dimensional point with the number corresponding to the case number. The original vital sign data are included for cases 2, 16, and 29.