Update in
Anaesthesia

Thoracic Paravertebral Block

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Summary
The thoracic paravertebral block was first described in the treatment of chronic pain. More recently, the technique has also been used to provide surgical analgesia for a variety of applications, including thoracic, breast, and general surgery. It is possible to provide analgesia lasting into the postoperative period, and certain procedures may be performed without the need for general anaesthesia.

INDICATIONS

Thoracic paravertebral block (PVB) can afford considerable analgesia for a range of surgical operations where the afferent input from the chest wall is largely unilateral.

This includes:

- **Thoracic surgery** – thoracotomy, lung resection, pleuradesis etc,
- **Breast surgery** – mastectomy, wide local excision with or without axillary clearance, breast reconstruction and breast augmentation,
- **General surgery** – open cholecystectomy, herniorrhaphy,
- **Trauma** – fractured ribs.

Paravertebral blocks have been used for some time and are well established in thoracic surgery. However, they commonly employ a catheter placed by the surgeon at the time of operation, under direct vision. There has been recent interest in the role paravertebral blocks in the anaesthetic management of other surgical specialties, particularly in breast surgery. Surgical treatment for cancer is common and, although general anaesthesia is not usually a problem, postoperative pain and nausea are common and contribute to delayed recovery. There are a number of randomised trials showing improved analgesia and reduced opiate requirements with PVB compared to general anaesthesia and wound infiltration.[1] It has also been suggested that PVB may reduce the incidence of chronic pain after major breast surgery.[2,3] Other authors have successfully used PVB as an alternative to general anaesthesia, allowing a reduction in recovery intervention and the potential for substantial cost savings.[4,5] Finally, there are also a limited number of individual case reports describing the avoidance of general anaesthesia by employing PVB for anaesthesia in patients with significant co-morbidities. This option facilitates palliative surgery or surgery for patients with severe concurrent disease and is an important consideration.

ANATOMY OF THE PARAVERTEBRAL SPACE

The thoracic paravertebral space is triangular in shape and found adjacent to each vertebral body along the spinal column (Figure 1). The space is defined medially by the vertebral body and the intervertebral disc and foramina, antero-laterally by the pleura and posteriorly by the superior costotransverse ligament, running between adjacent transverse processes. Above and below, the space communicates freely with adjacent levels. The paravertebral space is also in communication with the vertebral foramina. The ventral and dorsal primary rami traverse the space, carrying sensory afferents and form the spinal nerves. In addition, the space contains the sympathetic trunk which communicates with the spinal nerves via the gray and white rami communicantes. Thus local anaesthetics introduced into this space may produce sensory, motor and sympathetic blockade over several dermatomes.

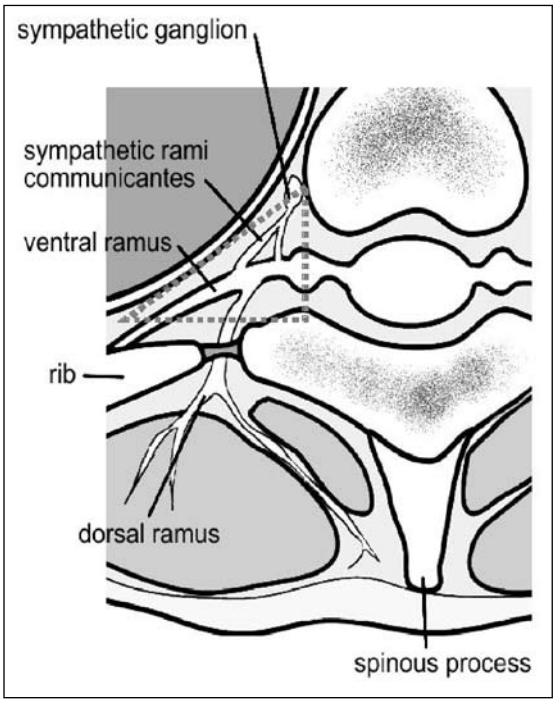

Figure 1. *A sagittal section through the spinal column, demonstrating the contents and position of the paravertebral space (dotted grey line)*

Thoracic PVB produces analgesia by blockade of the sensory input via the ventral and dorsal primary rami of the thoracic spinal nerves. The ventral primary rami afferents carry sensation via the intercostal nerves. The

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anterior and lateral cutaneous branches of the intercostal nerves supply the chest wall anteriorly and laterally.

TECHNIQUE FOR PVB

Obtain consent before starting. It is essential to ensure that full resuscitation facilities are available and that monitoring including ECG, pulse oximetry and blood pressure measurement is in place. Intravenous access should be secured.

Equipment

Skin preparation (e.g. chlorhexadine 2%), skin marker, Tuohy needle (22G), extension tubing, 20ml Leur-lock syringe, 0.5% bupivacaine (Figure 2).

Figure 2. *A 20ml Leur-lock syringe and primed extension tubing connected to a 22G Tuohy needle*

PVB may be performed awake, in which case the sitting position may be preferable, or with the patient anaesthetised in the lateral position. The site of surgery determines the level of PVB as shown in Table 1.

Table 1. *Dermatomal sites for different surgical procedures*

Surgery	Dermatomes	Level of PVB
Thoracotomy	T3 – T9	T3 – T9
Breast surgery	T1 – T6	T1 – T5
Cholecystectomy	T4 – L1	T6 – T12
Inguinal herniorrhaphy	T10 – L2	T10 – L2

Use the scapula and the processus prominens as landmarks. The processus prominens is the most prominent upper thoracic vertebral prominence and is the spinous process of T1. The most inferior palpable part of the scapula lies at the level of T7.

Locate the spinous processes corresponding to the required levels of block and make a mark 2.5cm lateral to each of them (Figure 3). Under aseptic conditions, a skin wheal of local anaesthetic is placed at each mark. If sedation is used, then supplemental oxygen should be administered.

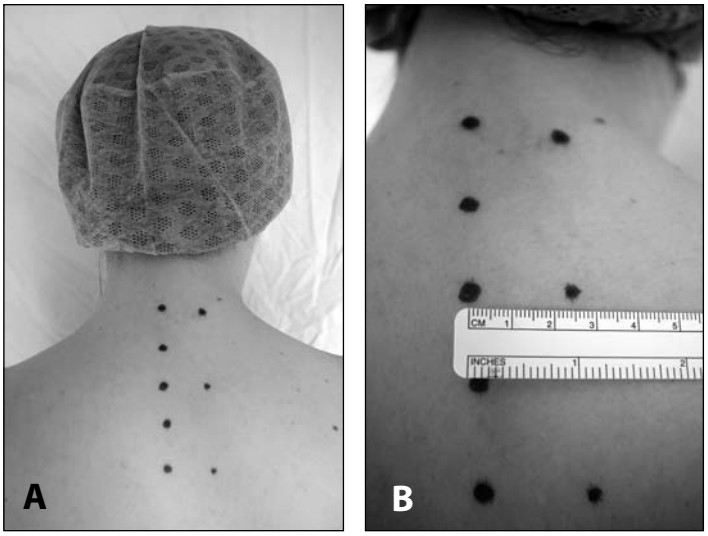

Figure 3. *(A) The spinous processes of T1–T5 are marked. (B) Skin puncture sites 2.5cm lateral to T1, T3 and T5 are also shown*

A 22G Tuohy needle is used, connected to a 20ml syringe by extension tubing. The extension tubing and needle are flushed with local anaesthetic solution prior to insertion. The skin is pierced at the point marked and directed perpendicular to the skin surface. The transverse process is usually contacted at a depth between 2 to 5cm. (Figures 4 and 5). To avoid pushing the needle to far, it can be grasped at a suitable point along its length.

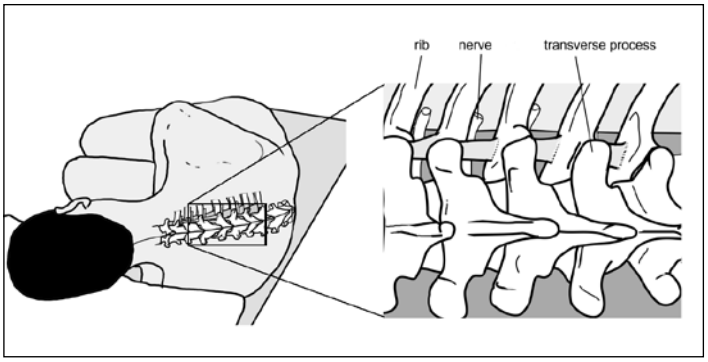

Figure 4. *Patient under general anaesthesia positioned for paravertebral block. The superior costotransverse ligament lies between the transverse process and the rib below*

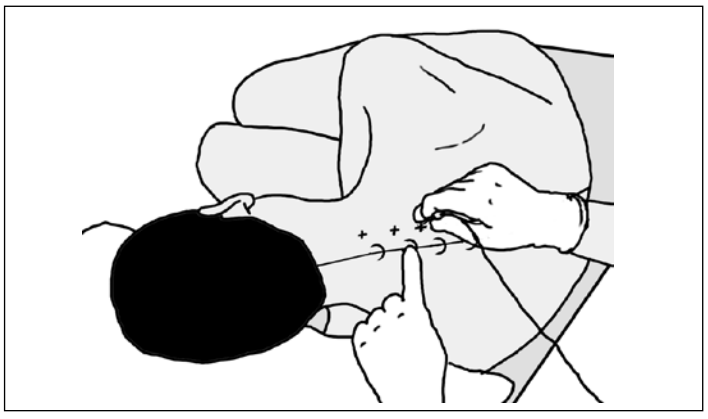

Figure 5. *Showing needle entry 2.5cm lateral to the adjacent spinous process*

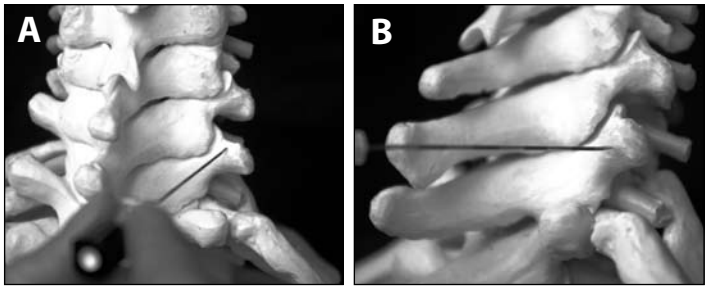

Figure 6. *Showing the needle contacting the spinous process*

If bone is not contacted, the needle should be withdrawn and re-directed superiorly, and if still not successful, inferiorly.

When the needle contacts bone (Figure 6), the depth is noted, the needle is then withdrawn and re-directed inferiorly to 'walk-off' 1cm past the inferior edge of the transverse process (Figure 7). A 'click' can sometimes be felt as the needle passes through the superior costotransverse ligament. It is imperative to locate the transverse process before advancing the needle any further to prevent inadvertent pleural puncture.

Figure 7. *'Walking off' the inferior edge of the transverse process and advancing 1cm*

Medial redirection should be avoided because of the risk of neuroaxial blockade. Following aspiration to exclude intrathecal or intravascular placement, local anaesthetic can be injected. The classic technique described by Moore and Katz, involves repeating the block at each required level, depending on the surgical site involved. This can be modified by performing a block at every other level, or one single injection.

For major breast surgery, a block from T1–T6 is required. This can be performed with multiple injections of 4ml 0.5% bupivacaine at each level, or 7ml injections at T1, T3 and T5. Alternatively a single injection of 15ml of 0.5% bupivacaine will produce a unilateral somatic block over 3 to 4 dermatomes, and can produce satisfactory analgesia depending on the incision. However for wider dermatomal spread multiple injection sites are more reliable and the authors suggest a compromise by performing the block at every second level.

The procedure normally takes between 5 and 15 minutes and is simple to perform. Surgical analgesia usually occurs within 20–30 minutes.

To increase the duration of the block it is possible to insert a catheter and run a continuous infusion or administer intermittent boluses of local anaesthetic.

ADVANTAGES OF PVB

- Simple and quick to learn
- Avoids the potential complications of a thoracic epidural
- Reduced postoperative pain
- Lower postoperative analgesic requirements
- Reduced postoperative nausea
- Reduced incidence of chronic pain after breast surgery.

CONTRAINDICATIONS

Absolute

- Cellulitis or cutaneous infection at site of needle puncture
- Empyema
- Tumour occupying the paravertebral space
- Allergy to local anaesthetic drugs.

Relative

- Coagulopathy
- Kyphoscoliosis - deformity may predispose to pleural puncture
- Previous thoracotomy - scarring may cause adhesions to the parietal pleura and increase the risk of pneumothorax.

COMPLICATIONS

- Sympathetic blockade and hypotension
- Horner's syndrome is frequent, short duration and of no lasting consequence, but patients should be warned. Incidence is between 5 and 20%
- Vascular puncture
- Haematoma
- Pneumothorax. The incidence is between 0.01 to 0.5%. Risk of bilateral pneumothorax should be considered if performing bilateral blocks. If pleural puncture occurs, a chest radiograph should be obtained to exclude pneumothorax A chest radiograph is not routinely required otherwise.
- There is one single report of a haemothorax, using a loss of resistance technique.[6]

FINAL REMARKS

Variations on this technique have been described, including the use of a low resistance syringe to identify the paravertebral space via a loss of resistance. Use of nerve stimulation has been described with good results using an initial current of 3-5mA. It is suggested that as the movements are difficult to see an assistant places a hand in the axilla to feel movement of the intercostal muscles. Lastly, there is increasing interest in the use of ultrasound, firstly to identify and measure the depth to the paravertebral space and secondly to perform the block under real-time ultrasound, which requires a curvilinear probe.[7]

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