A Clinical Overview Of Paravertebral Blockade

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Abstract

INTRODUCTION

Paravertebral somatic nerve blockade (PVB) is an old technique that was first described in 1919 by Kappis. It was initially utilized as an alternative to spinal anesthesia which would minimize the cardiovascular and respiratory effects of central neuraxial block. However, after its initial description PVB's were used sparingly to provide anesthesia and analgesia. More recently, there has been renewed interest in this technique for the treatment of acute and chronic pain. Paravertebral nerve blocks involve injection of local anesthetic in a space immediately lateral to where the spinal nerves emerge from the intervertebral foramina. Because of the ability to provide long-lasting unilateral anesthesia, PVBs have been successfully used to provide analgesia for multiple thoracic and abdominal procedures in both children and adults. At our institution, this technique has been extensively employed to provide anesthesia for a variety of breast cancer procedures, inguinal herniorrapphy, thoracotomy and non-invasive heart surgery.

ANATOMY

The paravertebral space is a wedge shaped anatomical compartment adjacent to the vertebral bodies. The space is defined anterior-laterally by the parietal pleura, posteriorly by the superior costotransverse ligament (thoracic levels), medially by the vertebra and intervertebral foramina, superiorly and inferiorly by the heads of the ribs. Within this space, the spinal root emerges from the intervertebral foramen and divides into dorsal and ventral rami. In addition, sympathetic fibers of the ventral rami enter the sympathetic trunk via the preganglionic white rami communicantes and the postganglionic gray rami communicantes in this space. Because of the multiple neurologic structures confined within this compact space, local anesthetics introduced here can produce unilateral motor, sensory, and sympathetic blockade. (See Chan V, "Continuous thoracic paravertebral block" for an excellent description of the anatomy)

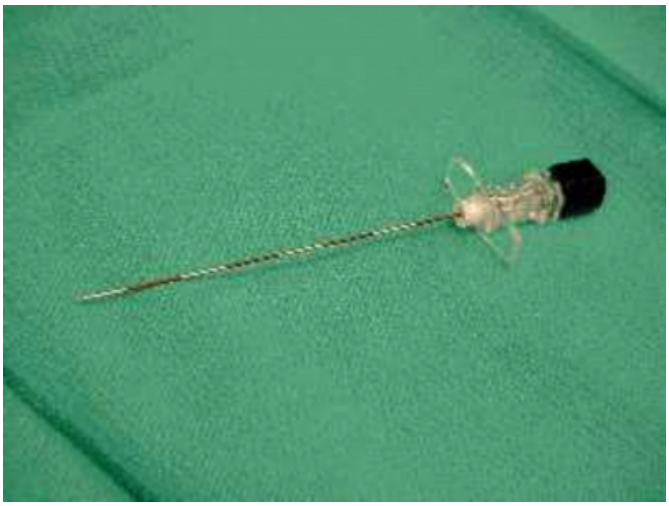
TECHNIQUE

As with all regional anesthetic techniques, adequate hemodynamic monitoring and resuscitation equipment should be available. At our institution, the blocks for both thoracic and lumbar PVB are carried out with patients in the sitting position. To maximize operating room efficiency block placement is usually performed in a monitored pre-operative holding area. After application of the monitors and supplemental oxygen, patients are usually sedated using midazolam 1-5 mg IV and fentanyl 50-250 m g IV.

Equipment: 22 gauge tuohy needle (B. Braun medical, Bethlehem, PA)(figure 1), extension tubing, skin marker, local anesthetic skin wheal, antiseptic solution (betadine)

Figure 1

Figure 1: 22 gauge tuohy epidural needle



Levels: Choose which dermatomes will be involved in the operative field. For mastectomy with axillary dissection we routinely block T1-T6. For breast biopsy we usually make one injection at the dermatome corresponding to the needle

localization. When performing the block for inguinal herniorrhaphy, levels T10-L2 are blocked.

Position: Patient's are sitting with their neck flexed, back arched, and shoulders dropped forward (similar to the positioning for thoracic epidural placement) (figure 2).

Figure 2

Figure 2: Patient positioned for thoracic paravertebral block. The superior aspects of C7-T5 vertebrae are marked

Landmarks: The spinous process of each level is identified and a mark is placed at its most superior aspect. From the midpoint of these marks a needle entry site is marked 2.5 cm lateral to each spinous process ipsilateral to the incision (figure 3). These marks should overlie the transverse process of the immediately caudal vertebra (because of the extreme angulation of the thoracic spinous processes).

Figure 3

Figure 3: The needle insertion site 2.5 cm lateral to the superior edge of the spinous process

Placement: Employing aseptic technique a skin weal is placed at each mark.

Using a 22-gauge, 3.5 inch tuohy epidural needle attached via extension tubing to a syringe, the shaft of the needle is grasped by the dominant hand of the operator. The needle is inserted through the skin wheal and advanced anteriorly in the parasagital plane (perpendicular to the back in all directions) until it contacts the transverse process, 2-5 cm, depending on the body habitus of the patient (see figure 4). As a safety measure, to prevent inadvertent deep placement, we grasp the needle at a point from its tip that is equal to the estimated depth from the skin to the transverse process. Inserting the needle 1 cm past this predicted depth is allowed. If the transverse process is not identified at an appropriate depth, it is assumed that the needle tip lies between adjacent transverse processes. The needle is then redirected cephalad and then caudad until the transverse process is successfully contacted. This depth is noted as the estimated distance to subsequent transverse processes. The needle is then withdrawn to the subcutaneous tissue and angled to walk off the caudad edge of the transverse process 1cm. At thoracic levels it is common to appreciate a loss of resistance or a subtle "pop" as the needle passes through the superior costotransverse ligament. After aspiration of the syringe, 3-5 ml of local anesthetic are injected at each level. When performing this block for breast biopsies we routinely inject 10 ml of local anesthetic at one level. It is important to note that in the lumbar region, the transverse process is very thin. Hence, the needle should not be inserted more than 1 cm past the transverse process. In addition, there is no superior costotransverse ligament in this region. If a distinct "pop" is sensed here then the needle has likely punctured the psoas fascia and should be withdrawn to a more shallow depth. For both thoracic and lumbar blockade the local anesthetic solution should inject easily, with little resistance.

Figure 4

Figure 4: Needle insertion for T3 paravertebral block:

Local Anesthetic: The selection of local anesthetic as with other regional techniques should be based on available agents, onset, duration and side effects. We routinely use 0.5% ropivacaine with 1:400,000 epinephrine (intravascular marker) and achieve sensory blockade in 5-15 min. In the past we have utilized bupivacaine with similar results.

COMPLICATIONS

Potential complications from paravertebral nerve blockade involve inadvertent needle penetration of adjacent structures.

Local anesthetic toxicity- As with all regional anesthesia techniques involving local anesthetics, inadvertent intra-vascular injection or excessive milligram doses can result in local anesthetic toxicity. However, despite the close proximity to the epidural space, systemic absorption of local anesthetic appears to be less than with conventional epidural techniques. Bupivacaine doses of 1mg/kg and ropivacaine doses of 2mg/kg have been administered safely. As always, incremental injection techniques are essential.

Pneumothorax-Because of the close relationship of the paravertebral space to the parietal pleura, incorrect needle placement may result in lung injury. In skilled hands this complication was rare. In one study examining our early experience with thoracic paravertebral block for breast cancer surgery, the authors found that a pneumothorax occurred in only 1 patient in 319. In our subsequent series, a clinically significant pneumothorax has not occurred.

Epidural/spinal- Due to the close proximity of the paravertebral space with central neuraxial structures, inadvertent medial needle insertion can result in epidural or spinal blockade. Even properly placed PVB can result in medial spread of local anesthetic due to dural cuffs extending from the midline. Despite, the close relationship of these structures, bilateral anesthetic spread at the thoracic level is relatively rare.

Hypotension-Bilateral sympathetic blockade from epidural spread can result in hypotension, similar to a thoracic epidural. In general unilateral and bilateral PVB due not result in hypotension.

Vascular puncture-As with all regional anesthesia techniques, careful aspiration and incremental injection should be done to minimize potential intravascular injection.

PEARLS

For thoracic PVB's find the mid-point of the superior aspect of each spinous process, measure 2.5 cm laterally and mark these points. These will generally overly the caudad portion of the transverse process of the vertebra below. Remember because of the extreme angulation of the thoracic spinous process, a line lateral will overly the transverse process of the vertebra below. For example, a line lateral to the T3 spinous process overlies the transverse process of T4.

Start with the most superficial transverse process (e.g. T3, T4) and work up and down from these.

Insert the Tuohy needle perpendicular to the skin a distance of 2-4 cm (more in the obese) to contact the transverse process. If the transverse process is not contacted at an appropriate needle depth, do not go deeper, you are probably between two transverse processes. Return the needle to the skin pont and search either cranially or caudad until a transverse process is successfully contacted. If bone is contacted at a point that seems too deep, this is rib which is anterior to the transverse process - again return to skin and search cranially or caudad for bone contact which is more superficial.
If while attempting to walk caudally off the transverse process, too much angulation of the needle is required, you have probably contacted the transverse process at its cephalad rather than caudad aspect. Return the needle to the skin and re-insert at a skin site 1 cm more caudal. If further attempts continue to result in an extreme angulation, attempt to walk cephalad off the transverse process recognizing that you may be blocking a root one level higher than anticipated.

If many attempts result in continued bony contact you may

be too medial (walking along lamina) or more commonly, contacting transverse processes which are much closer together (e.g. from degenerative disease in the elderly resulting in vertebral body collapse). In these patients, slight caudad or cephalad insertions after a perpendicular insertion resulting in bony contact will usually result in successfully passing the transverse process. If this is not the case, see if it is possible to flex the patient's spine further, to increase the distance between the transverse processes.

Scoliosis may require that the needle be inserted parallel to the spinous process (i.e. at an angle) since the spines are rotated.

For hernia surgery blockade of T11, T12, L1, L2 are made. In the lumbar area the same technique is used as for thoracic block, however, since the transverse processes are much thinner in the lumbar area, the needle is walked off the transverse process only 0.5 cm before local anesthetic is injected. Deep insertion of the needle beyond the transverse process puts the needle in the psoas muscle which results in decreased effect.

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