Bilateral paravertebral block: a satisfactory alternative for labour analgesia

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Purpose: To describe a new technique of paravertebral block for labour analgesia and to report the successful use of bilateral paravertebral block in four parturients with contraindications to conventional labour epidural analgesia.

Clinical Features: Four parturients with contraindications to lumbar epidural analgesia, who were seen either in consultation prenatally or after requesting analgesia when in labour, consented to paravertebral blocks for the management of first stage of labour pain. Bilateral paravertebral blocks were performed at T₁₀-L₁ level, initially blocking all four levels with 4 ml bupivacaine 0.5% with epinephrine 1:200000 and then reducing the number of levels blocked to two and finally one. With the entry point 2 cm lateral to the inferior edge of the T₁₁ spinous process, a 22G spinal needle was advanced perpendicular to all planes until contact was made with the transverse/superior articular process of T₁₂, at a depth of 3-5 cm. The needle was then walked superiorly (T₁₁) and inferiorly (T₁₂ nerve root) off the transverse/articular process and advanced 1.5 cm into the paravertebral space.

All four patients had relief of pain such that they were "comfortable" and able to cope with labour although they continued to experience deep pelvic and rectal pain. The patients tolerated the initiation of the blocks well, remained hemodynamically stable, and did not suffer any adverse effects.

Conclusion: Bilateral paravertebral block provides adequate analgesia for the first stage of labour and could be an alternative analgesic technique for some parturients with contraindications to conventional labour epidurals.

Objectif : Décrire une nouvelle technique de bloc paravertébral utilisée pour l'analgésie pendant le travail obstétrical et signaler l'usage réussi du bloc paravertébral bilatéral chez quatre parturientes pour qui il y avait des contre-indications à l'analgésie péridurale traditionnelle.

Éléments cliniques : Quatre parturientes pour qui il existait des contre-indications à l'analgésie péridurale lombaire et qui ont été examinées, soit en consultation avant l'accouchement, soit après avoir demandé une analgésie pendant le travail, ont consenti à recevoir un bloc paravertébral analgésique pendant la première phase du travail. Des blocs paravertébraux bilatéraux ont été réalisés au niveau de T₁₀-L₁, touchant d'abord les quatre niveaux, avec 4 ml de bupivacaine à 0,5 % adrénalinée à 1:200 000 puis, réduit à deux niveaux et, enfin, à un seul. Une aiguille rachidienne 22G a été introduite, latéralement, à 2 cm du bord inférieur de l'apophyse épineuse de T₁₁ et avancée perpendiculairement à tous les plans jusqu'à ce qu'un contact se fasse avec l'apophyse articulaire transverse/supérieure de T₁₂, à une profondeur de 3-5 cm. L'aiguille a été ensuite orientée en direction céphalique (T₁₁) et caudale (racine nerveuse de T₁₂) à partir de l'apophyse transverse/articulaire et avancée de 1,5 cm dans l'espace paravertébral.

Les quatre patientes ont éprouvé un soulagement de la douleur qui leur a donné plus de confort et leur a permis de réagir efficacement au travail malgré la persistance de douleur pelvienne et rectale profonde. Elles ont bien toléré l'amorce du bloc, ont présenté une hémodynamie stable et n'ont pas subi d'effets indésirables.

Conclusion : Le bloc paravertébral bilatéral fournit une analgésie adéquate pendant la première phase du travail et peut être une technique analgésique de remplacement chez certaines parturientes pour qui il existe des contre-indications à l'analgésie péridurale traditionnelle.

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LUMBAR epidural analgesia has established itself as the gold standard for labour analgesia.^{1,2} In addition to the obvious analgesic benefits, the lumbar sympathectomy provided by an epidural may also speed up the first stage of labour.³ However, clinical contraindications (coagulopathy, anatomical abnormality and infection) and personnel/institutional limitations preclude some parturients from receiving an epidural.^{4,5} Alternatives to epidurals such as opioids and nitrous oxide provide inferior analgesia and are associated with a higher incidence of neonatal depression and adverse maternal psychological effects.²

Paravertebral block has been used to provide analgesia for a variety of pain problems.^{6,7} However, the only reports of their use for labour analgesia were in 1927 and 1933.^{8,9} We report the successful use of a modified technique for bilateral paravertebral blocks for labour analgesia in four patients who had contraindications to lumbar epidurals.

Paravertebral block technique

The anatomical differences between the thoracic and lumbar vertebrae occur at the level of the T₁₂ vertebral body. The T₁₂ transverse process is smaller and more medial than its higher counterparts and is fused with the T₁₂ superior articular process. Structurally, it resembles the superior articular processes of the lumbar vertebral bodies. (Figure 1) We used these bony

prominences as our landmarks for paravertebral block at the T₁₀L₁ level.

Our goal was to deposit local anesthetic into the lateral aspect of the intervertebral foramen, the paravertebral space, to anesthetize the ventral nerve root and the sympathetic chain. (Figure 2) Local anesthetic deposited at this site spreads cephalad and caudad, covering 2-10 segments depending on the volume used.⁶ Although we initially injected all four of the T₁₀ to L₁ nerve roots bilaterally, we subsequently found that either a bilateral single level block of T₁₁ or both T₁₁ and T₁₂ roots, provided an equally effective block for the first stage labour.

Local anesthetic was infiltrated subcutaneously at the entry point 2 cm lateral to the inferior edge of the T₁₁ spinous process with a 30G needle. A 22G, 9 cm (3½ inch) spinal needle was then inserted and advanced perpendicular to all planes until contact was made with the transverse/superior articular process of T₁₂ usually at a depth of 3-5 cm. (Figures 1,3) The needle was then walked superiorly (T₁₁ nerve root) and inferiorly (T₁₂ nerve root) off the transverse/articular process and advanced 1.5 cm. Care was taken not to direct the needle medially to avoid dural puncture. If bone was still contacted, the needle was directed slightly laterally. Aspiration for blood and cerebrospinal fluid was done prior to injecting local anesthetic in small aliquots. For continuous catheter techniques, a 17G Tuohy needle was used. The catheter was advanced just beyond the

FIGURE 1

FIGURE 2

Case report #1

She was admitted at 41 wk gestation for induction following an uneventful antenatal course. As labour progressed, she received three doses of 15 mg morphine *im* over eight hours. The membranes were artificially ruptured and oxytocin *iv* was required to augment labour, but was limited because of increasingly painful contractions. The patient requested paravertebral block.

The diagram illustrates the structure of a thoracic vertebra, specifically T12. Key features labeled include the large vertebral body at the top, the transverse process extending laterally, and the spinous process extending inferiorly. The T11-T12 facet joint is shown between the transverse process of T11 and the vertebral body of T12. The lamina is the lower part of the vertebral arch. The T12 articular process is shown on the right side of the vertebral body. The T12 spinous process is the lower part of the spinous process.

FIGURE 3

Analgesia lasted nearly four hours, at which time supplemental analgesia was requested and was provided again with morphine. Six hours after the initial paravertebral block, the procedure was repeated using a 17G Tuohy needle for placement of bilateral catheters at T11. Twelve milliliters of the same solution were used on each side with excellent results.

Case report #2

A 27-yr-old primigravida presented in spontaneous labour at term. The patient had undergone neuroblastoma resection at the age of six months followed by numerous surgical procedures on her lower extremities and back which left her with leg weakness, arachnoiditis, and a neurogenic bladder. Analgesic options for labour, including paravertebral blocks, were discussed with the patient in consultation with Anesthesiology before the onset of labour.

Morphine, 15 mg *im*, and nitrous oxide 50% in oxygen provided adequate analgesia for the first stage of labour, and she achieved complete dilatation of her cervix with oxytocin augmentation. Then, she started to complain of severe back pain such that she was unable to push with her contractions and the oxytocin had to be discontinued. Supplemental analgesia was requested and paravertebral blocks were performed.

Paravertebral blocks were placed as in Case 1 using 5 ml bupivacaine 0.25% with 1:200000 epinephrine at each nerve root for a total of 40 ml. Hemodynamic stability was maintained and her pain score was reduced to 1/10. She fell asleep within 15 min and the oxytocin infusion was restarted.

Two hours later, the obstetrician performed a pudendal nerve block and delivered a healthy baby, with Apgar scores of 5 and 9, using mid-forceps. The third stage was complicated by an avulsed umbilical cord. Manual extraction of the placenta was completed hours later with the addition of another pudendal nerve block. No complications were encountered and the patient remained hemodynamically stable.

Case report #3

A 30-yr-old G3P1 at 40 wk gestation presented in spontaneous labour after an uncomplicated antenatal course. Her past medical history was significant for spina bifida occulta. Anesthesiology declined an epidural and provided PCA fentanyl (25 µg bolus, lockout five minutes, no basal infusion). After five hours, the patient began to complain of severe labour pain, rating it at 10/10 and was unable to cope with oxytocin augmentation. After consultation with the author, paravertebral blocks were offered, and the patient consented.

Bilateral single-shot paravertebral blocks were performed above (T_{11} nerve root) and below (T_{12} nerve root) the T_{12} transverse/articular processes, with 7.5 ml bupivacaine 0.5% with epinephrine 1:200000 at each root (total 30 ml). The pain score decreased to 5/10 within 10 min, with residual suprapubic pain. The PCA fentanyl was left with the patient but was used minimally.

Three hours later, the pain recurred, mainly in the perineal and suprapubic areas. The large fetus was noted to be in the OP position. The blocks were repeated with 20 ml of the same solution deposited above and below T_{11} bilaterally. Again, her pain settled within 10 min. However, despite oxytocin augmentation, the fetal head did not engage and a Cesarean section was performed under general anesthesia for failure to progress. A healthy 3730 g, female neonate with Apgar scores of 4 and 9 was delivered.

Case report #4

This 33-yr-old G2P1 presented at term after an uneventful antenatal course with right upper quadrant pain. She was subsequently diagnosed with HELLP syndrome. As labour progressed she requested analgesia. Given the degree of thrombocytopenia (platelet count $41 \times 10^9 \cdot L^{-1}$), Anesthesiology declined an epidural. Other means of analgesia were discussed and the patient consented to bilateral paravertebral block. In anticipation of a prolonged labour, bilateral paravertebral catheters were inserted at T_{11} as described above. Fifteen milliliters of bupivacaine 0.5% with epinephrine 1:200000 were injected into each catheter. She remained hemodynamically stable, and felt comfortable within 15 min. A female neonate was delivered with Apgar scores of 9 and 9 about 90 min after initiation of the block. There were no complications.

Paravertebral blocks provided three to four hours of analgesia for the first stage of labour, and controlled the back pain associated with contractions well. All four patients experienced a rapid diminution of their labour pain from an unbearable 10/10 to a tolerable 1-5/10. Their back pain, in particular, was completely relieved and they were able to cope with the residual pelvic pressure. Perineal pressure from the fetal head and second stage labour pain were not blocked by this technique, requiring supplemental opioids and/or pudendal nerve blocks in some cases. All of the patients experienced abdominal sensory deficit, no significant hemodynamic changes were observed and none of them required urinary bladder catheterization. Our patients were satisfied with the performance of the block and would undergo paravertebral blocks again if an epidural remained contraindicated. On follow-up the first day post-partum, none of them had any residual neurological symptoms.

Discussion

We initiated paravertebral blocks for labour with four blocks bilaterally and evolved to using single level bilateral injections with acceptable results. Paravertebral catheters with continuous infusion of local anesthetic could be used if labour is anticipated to continue for longer than three hours. We considered using bupivacaine 0.1 - 0.25% plain at $5 \text{ ml} \cdot \text{hr}^{-1}$ bilaterally as the initial infusion rate, using separate infusion pumps. Furthermore, the infusion could be continued for post-Cesarean section analgesia for the first 24 hr.

The first reported use of paravertebral block by Hugo Sellheim in 1905 claimed to avoid the potential cardiovascular collapse associated with spinal anesthesia.¹⁰ Dellepiane and Badino in 1927⁸ and Cleland in 1933⁹ described the use of paravertebral blocks in

labour for the management of first stage labour pain. Dellepiane developed an intricate technique for blocking the hypogastric plexus and although they were successful in abolishing the pain of uterine contractions, the technique was too difficult and considered impractical for routine use. Cleland, using animal experiments as the basis for his arguments, hypothesized that the uterine afferent roots in the human are in the eleventh and twelfth thoracic nerve roots. He then reported on five cases of paravertebral nerve blocks using 5 ml novocaine 1% at T₁₁ and T₁₂ bilaterally for first stage labour pain, using a supplemental caudal block for the perineal pain of second stage labour.

There are no other reports of regional anesthesia in labour until lumbar sympathetic blocks (LSB) for labour analgesia were explored in the 1940s. They were found to provide good analgesia for the first stage of labour, minimal motor weakness, and "rapid dilatation of the cervix", reducing the duration of the first stage of labour.¹¹⁻¹³ Two subsequent trials published in 1978 and 1999, confirmed the efficacy of LSB for labour but found them to be technically more difficult and more painful to perform with a higher risk for serious complications than lumbar epidurals.^{14,15}

Anatomically, the thoracic paravertebral space is defined posteriorly by the superior costotransverse ligament, anteriorly by the parietal pleura, medially by the postero-lateral aspect of the vertebral body, the intervertebral disc and the intervertebral foramen, and laterally by the posterior intercostal membrane.⁶ (Figure 2) In the lumbar region, the psoas muscle provides the anterior border and it has been considered an impediment to spread of local anesthetic to the lumbar region.¹⁶ However, spread does occur via the medial and lateral arcuate ligaments of the diaphragm, by the epidural space, and by communications anterior to the vertebral bodies.^{17,18} Structures in the paravertebral space include the spinal nerve, dorsal ramus, rami communicantes, and anteriorly, the sympathetic chain.

The anatomical landmarks used to identify the paravertebral space include the transverse process, the vertebral body, and the lamina of the vertebrae.^{6,7,19} The classic approach utilizes the transverse process as the bony landmark, approaching from 3-4 cm lateral to the midline, with the needle advanced perpendicular to all skin planes.⁶ After contact with the transverse process, the needle is redirected above or below with a medial direction, until contact is made with the vertebral body. Shaw (1952) and Bonica (1959), aiming to reduce the incidence of pneumothorax and dural puncture, described the paralaminar technique.^{19,20} Needle entry is 1-1.5 cm lateral to midline and directed per-

pendicular to all skin planes until contact is made with the lamina, from which the needle is then walked laterally and advanced 1 cm further. Tenicela and Pollan (1990) described the 'paravertebral-peridural' technique.²¹ Starting 3 cm lateral to the midline, the needle is advanced at a 45 angle medially towards the lamina. Upon contact, the needle is walked off the lateral edge of the lamina by redirecting the needle closer to the perpendicular, restricting advancement of the needle to 1.0-1.5 cm beyond the lamina.

We have simplified the paravertebral technique further. The 12th thoracic transverse processes are structurally similar to the superior articular processes of the lumbar vertebrae, while the lumbar transverse processes are deeper to skin, narrower and longer than their thoracic counterparts. The lumbar superior articular processes are only 1.5-2 cm lateral to midline and approximately 0.5-1.0 cm closer to the skin surface than their corresponding transverse processes. (Figures 1,3)

We aim to make contact with the transverse process of T₁₁ and the superior articular process of T₁₂ and L₁, and then redirect the needle cephalad or caudad from this bony landmark while maintaining the needle in the same sagittal plane. Advancing 1.5 cm beyond the bony landmark places the needle tip well into the medial aspect of the paravertebral space. This technique remains the same, even with the transition from thoracic to lumbar vertebral anatomy. (Figure 1)

The failure rate for paravertebral blocks performed in surgical patients was found to be 10%, with the following incidence of complications: hypotension (4.6%), vascular puncture (3.8%), pleural puncture (1.1%), and pneumothorax (0.5%).²² The incidence of urinary retention and hypotension was lower with paravertebral blocks compared to epidurals in thoracotomy patients.²³ There has been one report of a total spinal as a consequence of a paravertebral block using the transverse process as the landmark.²⁴ Should vessel puncture occur, the consequences of a hematoma in the paravertebral space are unknown. Based on the work of Saito *et al.*, although a paravertebral hematoma may possibly track back into the epidural space, blood is more likely to spread away from the vertebral foramina.¹⁷

Conclusion

Lumbar epidural analgesia has become the standard for labour analgesia. In situations where an epidural is contraindicated, current alternatives can fall short in providing adequate pain relief. LSBs have been used as an alternative with success, but are technically demanding and therefore not suitable for general use.

Our case series exemplifies four such scenarios where epidurals were absolutely or relatively contraindicated. Paravertebral blocks were used with good results for the management of the first stage of labour, and offer a useful alternative for some parturients with contraindications to epidurals. Given the ease of performance, degree of analgesia, and stable hemodynamics this procedure warrants further investigation as an alternative or supplement to parenteral opioids and/or nitrous oxide.

Further scrutiny is required in order to confirm the role and safety of paravertebral blocks when epidurals are contraindicated. The optimum number of levels injected, and the optimum concentration and volume of local anesthetic required needs to be determined.

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