

Thoracal paravertebral block for breast surgery

Meme cerrahisi için torakal paravertebral blok

Serbülent Gökhan Beyaz¹, Tolga Ergöncü², Fatih Altıntoprak³, Ali Fuat Erdem¹

ABSTRACT

Thoracic paravertebral block (TPVB) is an alternative method to general anesthesia because of provides a safe anesthesia with balanced hemodynamic response, allows postoperative pain control by means of catheter and has low side effect profile. TPVB performed safely for the patients undergoing breast cancer surgery with the same reason, has used in too few center instead of general anesthesia. This technique provides an adequate anesthesia for the patients undergoing breast surgery and in addition provides stable hemodynamic status with unilateral somatic and sympathetic blockade, near-perfect control of postoperative pain, minimal nausea and vomiting rate, early discharge and low cost. For this reason, thoracic paravertebral block which is a standard method in breast surgeries for some centers should be known by all anesthesiologists. We believe that, thoracic paravertebral block is a method can be applied instead of general anesthesia.

Key words: Paravertebral block, thoracic, breast surgery, regional anesthesia

INTRODUCTION

Paravertebral block is a technique creating unilateral somatic and sympathetic nerve block as a result of local anesthetic solution injection close to the spinal nerves along the columna vertebralis. First paravertebral block was performed by Hugo Sellheim of Leipzig in 1905 for obstetric surgeries (especially caesarean section operations) as an alternative of neuraxial block.^{1,2} Paravertebral block was defined as a method producing unilateral analgesia without seeing hemodynamic changes. Although paravertebral block have gained a good popularity

ÖZET

Torakal paravertebral blok (TPVB), dengeli hemodinamik yanıtla seyreden güvenli bir anestezi sağlaması, kateter aracılığıyla postoperatif ağrı kontrolüne imkân vermesi ve düşük yan etki profili nedeniyle genel anesteziye alternatif bir yöntemdir. Meme kanser cerrahisi geçiren olgularda da aynı nedenle güvenle uygulanabilir bir yöntem olan TPVB çok az merkezde genel anestezi yerine uygulanmaktadır. Meme cerrahisi altında hastalar için yeterli bir anestezi sağlamasının yanında, unilateral somatik ve sempatik blokaj ile stabil bir hemodinamik denge, mükemmel yakın postoperatif ağrı kontrolü, minimal bulantı-kusma oranı, erken taburculuk ve düşük maliyet sağlar. Bu nedenle bazı merkezlerde meme cerrahileri için standart bir yöntem olan torakal paravertebral blok tüm anesteziistler tarafından bilinmelidir. Torakal paravertebral bloğun genel anestezinin yerine uygulanacak bir yöntem olduğu kanaatindeyiz.

Anahtar kelimeler: Paravertebral blok, torakal, meme cerrahisi, rejyonel anestezi

in 1920 and 1930 's, had felt from favor until have been revived by Eason and Wyatt in 1979.³

Paravertebral block may be used for 4 region:

- 1- Cervical
- 2- Thoracic (T1-T10)
- 3- Thoraco-lumbar (T11-L2)
- 4- Lumbar or psoas compartment (L2-L5)

Thoracic paravertebral block (TPVB) provides high quality analgesia and great advantage for the patients undergoing many different surgeries. At the same time, relieves the acute postoperative pain

¹ Sakarya University Medical School, Anesthesiology, Sakarya, Turkey

² Sakarya University Training And Research Hospital, Anesthesiology, Sakarya, Turkey

³ Sakarya University Medical School, General Surgery, Sakarya, Turkey

Yazışma Adresi /Correspondence: Dr. Serbülent Gökhan Beyaz,
Sakarya University Medical School Korucuk Campus, Anesthesiology, Sakarya, Turkey Email: sgbeyaz@gmail.com

Geliş Tarihi / Received: 06.07.2012, Kabul Tarihi / Accepted: 27.08.2012

Copyright © Dicle Tıp Dergisi 2012, Her hakkı saklıdır / All rights reserved

and may prevent the pain becomes chronic.^{4,5} Especially, breast cancers are the most common cancers required surgical procedure for women. For about 40% of patients underwent breast surgery, the traditional pain management have been reported to cause inadequate pain control.⁶

ANATOMY OF THE PARAVERTEBRAL SPACE

Thoracic paravertebral block is the technique of injecting local anesthetic drug to ipsilateral spinal nerves at thoracic paravertebral space resulting in somatic and sympathetic nerve blockade.^{7,8} Spinal nerves are derived from the two roots of spinal cord named as sensory dorsal root and motor ventral root. The dorsal branches of thoracic nerves are divided into two branches where they are present by passing through the transverse processes. The ventral branches of thoracic nerves take the name of intercostal nerves and disperse segmentally. The thoracic paravertebral space extends from T1 paravertebral space to caudal and ends at the level of T12.⁹

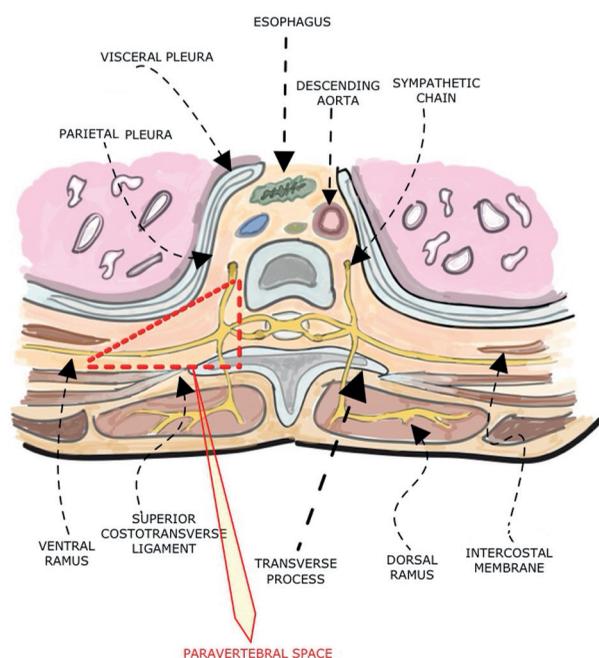


Figure 1. Anatomy of the thoracic paravertebral space

Thoracic paravertebral space is triangular wedge-shaped and limited by the superior costo-

transverse ligament, the transverse process, anterolateral parietal pleura and intercostal membrane at posterior and adjacent ribs at superior and inferior. In the base of this triangle, there is vertebral body, intervertebral disc and intervertebral space at the medial.¹⁰ The thoracic paravertebral space is larger on the left than on the right.¹¹ Endothoracic fascia divides the thoracic vertebral space into two separate potential compartments. Extrapleural paravertebral compartment is at anterior, subendotoracic paravertebral compartment is at posterior.¹¹ Thoracic paravertebral space contains adipose tissue, spinal nerves, sympathetic chain, intercostal vascular structures, preganglionic white and postganglionic grey rami communicantes (Fig.1).^{11,12}

INDICATIONS

Thoracic paravertebral block is applied as primary anesthetic technique and for purpose to provide postoperative analgesia. As the primary anesthetic technique:

- 1- Simple breast biopsies, modified radical mastectomy surgeries with axillary dissection
- 2- Breast reduction and augmentation surgeries
- 3- Resections of chest wall with rib resection
- 4- Orthopedic and general surgical procedures including upper extremity
- 5- Endovascular aortic aneurysm surgery

As an analgesics

- 1 - Thoracotomy
- 2 - Thoracoscopy
- 3 - Minimally invasive cardiac surgery
- 4 - Cardiac surgeries including sternotomy and thoracotomy
- 5 - Multiple rib fractures
- 6- Inguinal hernia repair
- 7- Cholecystectomy
- 8- Nephrectomy
- 9- Acute and postherpetic neuralgia
- 10- Infectious and neoplastic syndromes
- 11 - Post mastectomy pain
- 12 - Chronic postthoracotomy pain

CONTRAINDICATIONS

Contraindications for TPVB applications are not different from any contraindications determined for peripheral nerve block (the infection in insertion site, unspecified neuropathy, allergy to local anesthetics, major coagulopathy and the situations that patient does not accept the intervention). Coagulopathy, bleeding disorders, and anticoagulants applied subsequently are the relative contraindications for TPVB. The major complication of epidural analgesia is epidural hematoma, the major complication of paravertebral block is intercostal bleeding.

POSITION AND APPLICATION

There are different techniques for TPVB applications. These techniques based on the position of patient are separated into three; sitting, lateral decubitus and the prone position. Often preferred position is the sitting position. This position is advantageous in terms of patient comfort and easily recognized of landmarks. In sitting position, head and neck are at flexion position, chin leans to chest and shoulders are collapsed condition, the back region makes the arc to the behind. Practitioner is situated behind the patient as well as in epidural anesthesia applications. Often, the using method is the conventional loss of resistance technique (Table 1). The spinal processes of vertebrae are marked with palpation at the level of dermatomes which fit the surgical site. The points of needle insertions are determined at vertical plane parallel to midline at 2-2.5 cm lateral to these marked points. Excessive lateral of needle insertion have risk of pneumothorax; excessive medial of needle insertion have risk of drilling of duramater. The patient was administered with incremental doses of midazolam 1-3 mg and fentanyl 50-250 µg. Under aseptic conditions, followed by infiltration of the skin and subcutaneous tissue, 22 G needle, approximately 3-5 cm is advanced until the transverse process may detect. If transvers processes have not been in contact despite 5 cm advancement of the needle from the skin, the needle should be withdrawn and re-directed. Otherwise, the risk of pleural puncture is very high. After contact with the transverse processes, the needle is withdrawn until subcutaneous tissue and loss of resistance injector is placed behind. The needle is advanced by making angle of 15-20 into the cephalic or a preferably caudal direction caudal direction.

The needle, slightly touched to the bottom edge of the transverse processes, is advanced 1-1.5 cm more after this point. It should be kept in mind that the thickness of transverse process is approximately 0.6-0.7 cm. Following the receipt of sense of loss of resistance at this point and after negative aspiration is observed, local anesthetic agent is applied carefully and slowly. For neurostimulator technique, injection should be done after observation of 0.5 mA motor movement at anterior abdominal wall or breast. If multiple injection will be performed, the amount of local anesthetic agent has to be regulated as 3-5 ml (0.5% bupivacaine or levobupivacaine) for each segment. For single injection technique, 15 or 20 ml local anesthetic may be sufficient for a complete block. Resistance felt during the transition of superior costotransverse ligament with loss of resistance technique is less than the resistance felt during the transition of ligamentous flavum. This situation makes difficult to detect the paravertebral area. For paravertebral block applications with the combination of neurostimulator and ultrasound, has obtained lower complication and higher success of blocks (Figs. 2 and 3). Ultrasound-guided paravertebral block applications have become more popular with using echogenic needles. Different application techniques are shown in Table 1.



Figure 2. Anatomical landmarks for thoracic paravertebral block

Table 1. Paravertebral Block Techniques

1	The blind technique
2	Loss of resistance technique
3	Neurostimulation techniques
4	Ultrasound guided technique
5	Pressure monitoring technique
6	Fluoroscopic directly imaging technique
7	Direct application technique with thoracoscopy or thoracotomy

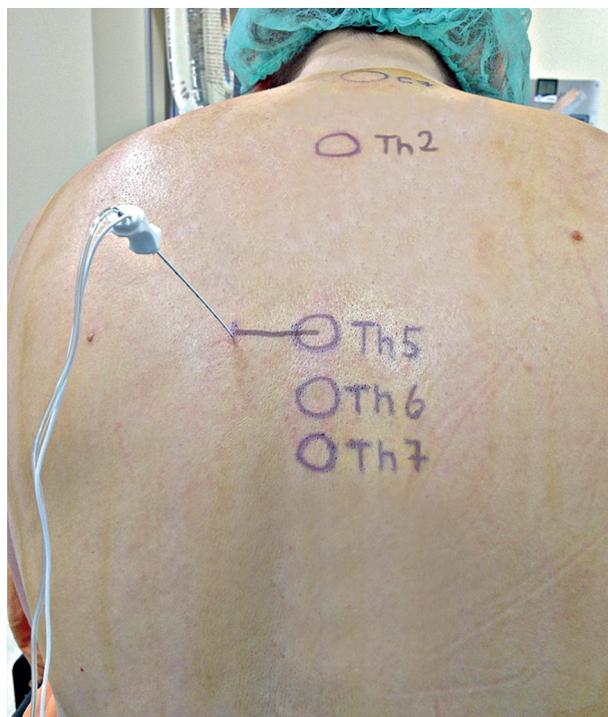


Figure 3. 2.5 cm left-lateral intervention site at the level of Th5 with the help of Neurostimulator

DOSAGE AND SPREAD

There is not an optimal dose defined for single or multiple injections. Applications of multiple-level TPVB, for each level; 0.5% levobupivacaine, 0.5% bupivacaine, 2% lidocaine injections dose of 3-5 mL may be administered. For fast initiation of block, adrenaline (2.5 mg / ml) may be added to each level. For single-injection paravertebral block, 0.5% levobupivacaine or 0.5% bupivacaine 15-20 mL of local anesthetic may be applied. Single injection of local anesthetic is not recommended by some authors because of intravascular injection, spread into the epidural space or unpredictable spread.

Detectable spreads as a result of the paravertebral injection^{13,14} (Figure 4):

1 - Cephalad-caudal spread at paravertebral space (ideally)

2 - “ Cloud” spread limited in few segments

3 - Lateral spread to intercostal space

Despite the academic debate on these distributions; there is no evidence about which way; single injection, multiple injection or catheter placement may provided more consistent and ideal spread. In our clinic, we use the single injection technique.

Single dose injection paravertebral block is not reliable for surgical anesthesia for large volumes. In one study, 15 ml of 0.5% bupivacaine has been reported spread to a wide range such as 1-9 dermatomes.⁷ In another study, 1.5 mg / kg with 0.5% bupivacaine injection has been reported that able to cephalic spread for 0-4 dermatomes and caudal spread for 0-7 dermatomes.¹⁵ In other words, spread of local anesthetic with paravertebral injection does not occur like epidural injection. In epidural injections; 3-4 dermatomes cephalic and 2-3 dermatomes caudal spread are seen. But, in application of paravertebral block; 2-3 dermatomes cephalic and 3-4 dermatomes caudal spread are seen.

FAILURE RATES AND COMPLICATIONS OF PARAVERTEBRAL BLOCK

Thoracic paravertebral block is a technique which has high success rate without regarding the number of blocks, easy to learn and does not depend on the ability of practitioner.^{1,16,17} Failure rates vary from 6.8% to 10%.^{1,18} In fact, these high rates are shown that encountering technical difficulties in determining the thoracic paravertebral space, compared to other commonly used regional anesthetic techniques. Despite Richardson and Sabanathan¹⁹ have reported that the complication rate was below 5%, Coveney et al¹ have reported complications only for 4 patients especially performed multiple levels in 156 patients applied thoracic paravertebral block. Lönnqvist et al,¹⁸ in their prospective study with 367 patients, have encountered vascular puncture (3.8%), hypotension (4.6%), pleural puncture (1.1%) and pneumothorax (0.5%). It is difficult to determine the current complication rates based on the past scientific publications. Today it is anticipated that, higher success rates will be gained due to starting to use of ultrasound and neurostimulator in clinical practice.

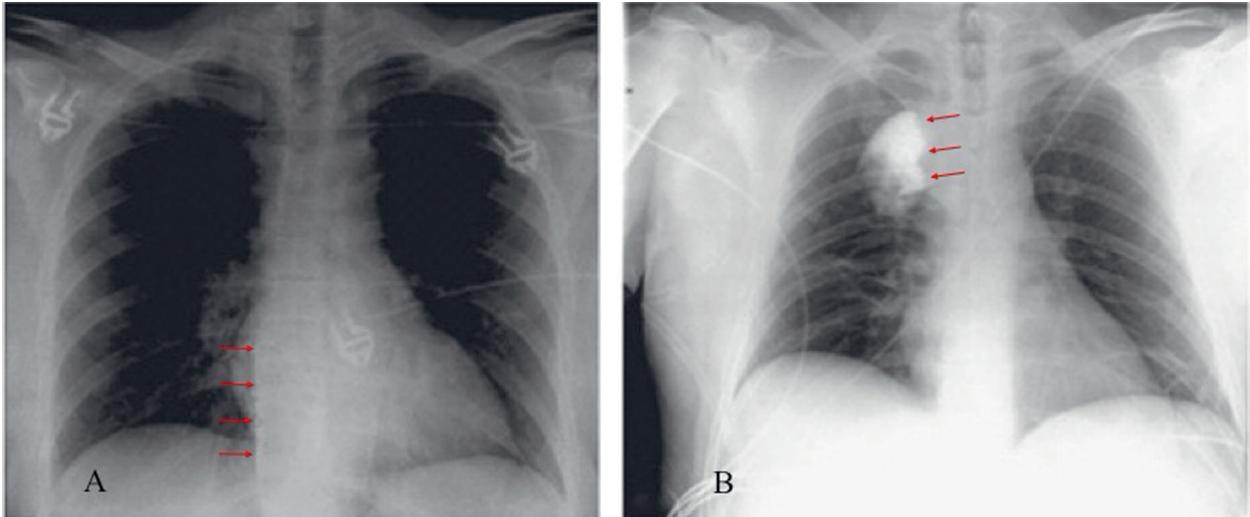


Figure 4. A) Cephalo-caudal spread of radiopaque material. B) Cloud-shaped spread of radiopaque material. Reproduced with permission from Renes (Reg Anesth Pain Med. 2010; 35(2): 212-6).

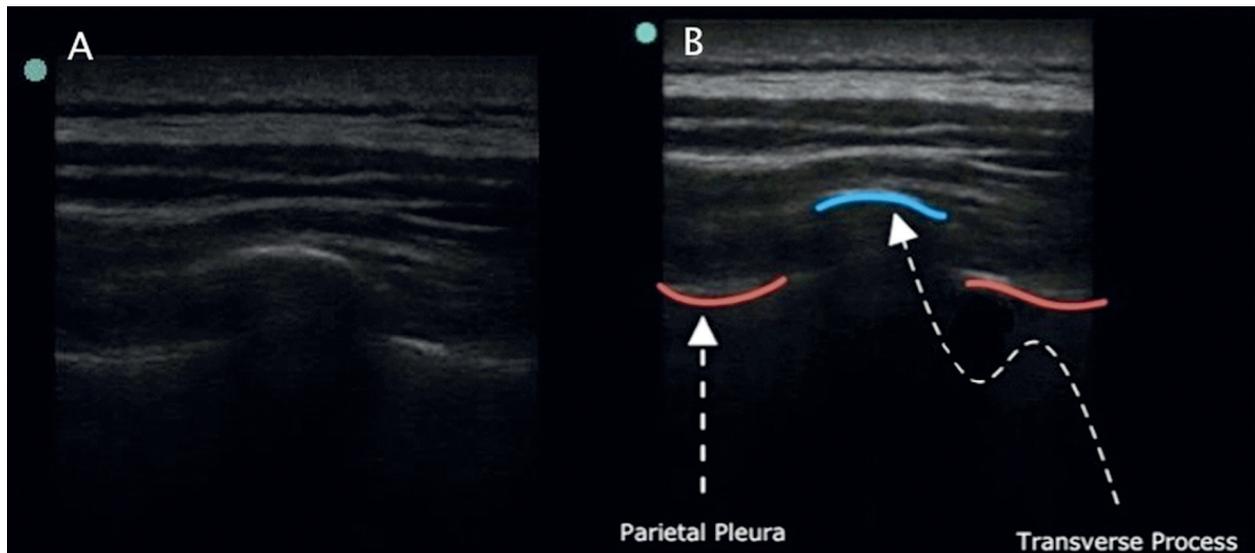


Figure 5. Ultrasound image in sagittal paramedian plane

Accidental pleural injury is not common and pneumothorax is not developed as a result of each pleural puncture. If pleural puncture has occurred; it may be used as interpleural analgesia. During pleural puncture a “pop sensation” or a irritating cough, sharp pain at shoulder and chest pain may occur. Air can not aspirated until lungs perforate mistakenly or in using stile needle it is understood that pleural cavity was entered if air aspirate after stile is removed. Some patients should be closely monitored for possible development of pneumothorax. If interpleural injection occurs; with the help of contrast material given by here, the movement of con-

trast material with breathing may be seen. Contrast material does not situate in any anatomical plane, helps us to recognize the complication by spreading quickly to diaphragmatic angle and the horizontal fissure. If pneumothorax occurs, hence a click (clicking) sound was defined in a case.²⁰ This clinical entity is seen very commonly in left apical small pneumothorax and it is characterized by “Hamman sign” appearing as clicking; bubbling and crackling in the auscultation of the regions close to heart apex for certain positions.²⁰

Hypotension is not a common complication.^{7,17} Especially due to unilateral sympathetic blockade,

to observe hypotension is not expected theoretically for normovolemic patients after thoracic paravertebral block. If the present status of a patient is hypovolemic, thoracic paravertebral block can reveal this and hypotension may occur as a result. Interestingly, even after a bilateral thoracic paravertebral block, it is reported that hypotension was not seen as a problem.¹¹ As well as during the interference hypotension may also be seen related with vasovagal stimuli. In addition, depending on accidental intravascular application during the injection, the temporary seizure has also been reported.²¹

Excessive medial entrance to the TPVB; complications such as intrathecal injection, spinal anesthesia and postdural headache associated dura mater puncture may be observed.^{8,10,11,19} The most serious complication reported is Brown Sequard paralysis occurred due to the paravertebral alcohol injection in 1931.²⁴

During catheter placement into thoracic paravertebral space, may be encountered with complications. Normally it should be encountered with a resistance in placing the catheter. If catheter can advanced easily, interpleural, epidural or intrathecal settling must be considered. In addition, very muscular patients, obese patients, previous thoracic surgeries and formed scar tissue can facilitate wrong catheter placement.²

Ipsilateral Horner's syndrome may also develop as a result of the spread of the local anesthetic to ipsilateral stellate ganglion or preganglionic fibers derived from the first few segments of thoracic spinal cord.^{17,25,26} Contralateral Horner's syndrome may occurred by spread of local anesthetic through epidural or prevertebral way.²⁷⁻³⁰ Ipsilateral sensory changes in arms may occur as a result of spread of the local anesthetic to T1 component of brachial plexus at thorax or C8 spinal root. Bilateral symmetrical anesthesia and ipsilateral thoracolumbar anesthesia may occur.³¹ Lönnquist et al¹⁸ have reported epidural spread for 1.1% of 367 pediatric and adult patients underwent paravertebral block, but they have not distinguished in which region intervention performed has occurred. While catheter has been emplaced for paravertebral region, segmental thoracic pain may be observed due to intercostal nerve trauma. To date, fatal cases directly related to the TPVB have not been reported.

ANESTHESIA FOR BREAST SURGERY

In our center, Stewart (transverse) incision is used for mastectomy surgery. After preparing the skin flaps with the help of electrocautery, breast tissue is excised together with the pectoral fascia. The axillary dissection process is completed in the same incision for the patients undergoing mastectomy and for the patients undergoing breast-conserving surgery is completed with the help of separate incision reaching from anterior axillary line (pectoral muscle boundary) to posterior axillary line (latissimus dorsi) which is independent from the incision performed to breast. For axillary dissection; the routine process applied is dissection of Level I-II axillary lymph nodes. In patients undergoing modified radical mastectomy, incision is closed after 2 drain (one is at the axilla, the other is under the skin flap) were emplaced. In patients undergoing breast-conserving surgery and axillary dissection, incision performed at axilla is closed after 1 aspirated drains emplaced, breast incision is closed without emplacing drain. All materials resected from patients in operation are delivered to pathology laboratory for the final examination at one time (except the patients performed frozen section examination).

When multiple level injections, single-shot injection at the level of (C7-T6) or T4 combined with intra-operative sedation, for the majority of patients undergoing major breast surgery, as well as safe and effective surgical anesthesia is obtained, minimal complications and high degree of patient satisfaction is provided.^{2,32}

Nausea and vomiting are seen in 20-50% of all surgical procedures taking into account.³³ Postoperative nausea and vomiting seen following breast surgery are higher compared to other surgeries (intra-abdominal surgery, gynecological surgery, strabismus repair and otolaryngology surgery).^{1,9,34} In fact, the incidence of postoperative nausea and vomiting may be up 80% after breast cancer surgeries.^{34,35} The etiology of postoperative nausea and vomiting followed by breast surgery under general anesthesia is complex. It depends on many factors such as age, obesity, vehicle motion sickness and a history of previous postoperative nausea and vomiting, surgical procedures, anesthetic techniques, postoperative pain, menstrual cycle phase and psychological factors.³⁴ The incidence of nausea and

vomiting in 24-hour period followed by breast surgeries performed under general anesthesia has been reported as 59%.^{36,37} It may be considered that due to observing less nausea and vomiting for the patients undergoing TPVB, propofol used for intraoperative sedation potentiated this effect. At the same time, early mobilization, early discharge from hospital and reduction in postoperative analgesic requirements were reported in many studies.^{2,9,37-39}

Addition to nausea and vomiting, postoperative pain is also a common and important symptom in postoperative period. It is considered that, acute postoperative pain after breast surgery is around 40%, and this rate becomes much higher as result of inadequate pain management.⁴⁰ TPVB application after mastectomy improves shoulder movement restricted due to pain.⁴¹ Karmakar⁴⁰ has been reported that the duration of postoperative analgesia was average of 23 hours (range 9-38 hours) for the patients applied TPVB by bolus injection. In a study, it has been reported that, while the duration of analgesia may extend to 21 hours for the patients undergoing TPVB after breast surgery compared to general anesthesia; Klein et al⁴² have reported that 24 hours duration of analgesia was provided for patients. In fact, in one publication has also been reported that this duration may extend up to 72 hours.¹¹

It is known that regional anesthesia and methods of analgesia have been reduced the need for opioids by related stress response to surgery and thus improved immune function. A different benefit of paravertebral block has been demonstrated by Exadaktylos et al⁴³ in their retrospective study on 129 patients undergoing breast cancer surgery. They have been reported that tumor recurrence and metastases are decreased significantly in the patients applied TPVB. In addition, breast cancer cells has caused the release of substance P and neurokinin-1 receptors more than normal cells, it was proposed that, due to neurokinin-1 overexpression and substance P are suppressed in tumor cells by regional techniques such as paravertebral block; these techniques have prevented the recurrence of cancer.⁴⁴ TPVB has been performed for the patient with myasthenia gravis rather than general anesthesia for breast surgery and it has been reported that the operation was completed without any complications.⁴⁵ For 24-years-old pregnant patient at 19 gestational weeks has been performed TPVB due to axillary

lymph node dissection and left breast tumor excision and it has been reported that the operation was completed without any complications by providing a perfect surgical environment.⁴⁶

USE OF ULTRASOUND FOR TPVB

The use of ultrasound provides many advantages compared to the blind technique. These are; able to view the anatomical structures, the needle shaft, the tip of the needle, catheter, the spread of local anesthetic and possibly a shorter duration of interference, short startup time, long duration of the block, less local anesthetic volume, low failure and complication rate.⁴⁷ The real-time ultrasound is very helpful in determining the exact distance of vertebral transverse process and parietal pleura depth from the skin to paravertebral space with sonographic measurements by using ultrasound.⁴⁸ As in other applications of the practice of regional anesthesia, ultrasound-guided paravertebral block applications are useful for patients with anatomical anomalies (eg, scoliosis).

Initial reports of ultrasound-guided paravertebral block applications with in-plane technique performed between superior costotransverse ligament and parietal pleura have been published (Figure 4). Despite published small serial reports without complications, the effort of continuously seeing the needles directed towards deep structures with vertical angles may cause complications such as pneumothorax. When these concerns were taken into account; in learning period should be carefully and wary as entering the paravertebral space ultrasound-guided, even drilling superior costotransverse ligament by directing the needle, after needle touch slightly to transverse process like applied in blind technique.

In another study, catheter was successfully placed to the paravertebral areas with company of in-plane real-time ultrasound. The catheter insertion can be difficult even after dilatation of paravertebral space with 10 mL normal saline. Even development of epidural in 6 patients; prevertebral in 1 patient, and pleural migration in 1 patient have been reported.⁴⁹ Ultrasound-guided continuous paravertebral block application (intercostal approach) was defined for abdominal processes.⁵⁰

Ultrasound imaging not only helped determine needle insertion sites, but also provides information

on the depth to the paravertebral space. Ultrasound imaging may make thoracic paravertebral block easier to perform and help avoid inadvertent pleural puncture.

POST MASTECTOMY PAIN

Post mastectomy pain is a neuropathic pain occurring followed by breast cancer surgeries such as radical mastectomy, modified radical mastectomy and segmental mastectomy (lumpectomy). Post mastectomy often develops after surgical trauma of second intercostabral nerve lateral cutaneous branch and intercostabral nerve occurring during mastectomy. This nerve is damaged in 80-100% of patients with mastectomy with axillary dissection. Other possible causes include traumatic neuroma, other cutaneous branches of intercostabral nerve injury, radiation injury and deafferentation pain. In addition, radiation-induced fibrosis and involvement of brachial plexus by tumor should be considered among the causes of the pain.⁵¹⁻⁵³

In post mastectomy period for 23-100% of patients, abnormal sensory feeling at axilla and the medial side of the arm have been reported. Symptoms are associated with chronic dysesthesia; like combustible manner, electric strikes, or the constant sensation of pain. Pain typically begins postoperative period or may takes 6 months or more longer to begin. The pain may continue also during the normal healing characteristically. As a result it prevents the patient's daily activity and professional skills.⁵¹

Initial treatment of post mastectomy pain are simple analgesics and NSAIDs. Regional nerve blocks, adjuvant drugs and transcutaneous electrical nerve stimulation is necessary occasionally for the treatment of pain when these drugs are not sufficient to relieve the pain. If post mastectomy pain has a neuropathic origin, often resists to conventional pain treatment and the drugs widely used in the treatment of neuropathic pain such as anticonvulsants and antidepressants drugs are used. Regional nerve blocks performed by using neurolytic agent which has high risk of neurological injury and a local anesthetic; and spinal cord stimulation is recommended for persistent pain.

Thoracic paravertebral block was used for the treatment of neuralgia with benign or malignant origin in thoracic dermatomes. Kirvela and Antila¹⁶ have reported that post mastectomy post thoracotomy pain have been relieved with single dose of 15 mL 0.5% bupivacaine injection in thoracic paravertebral space for 99% of patients. Unfortunately, they could not catch the same success rates of post mastectomy pain. In many studies 20-50%⁵⁴ of the chronicity rates of post mastectomy pain which are 20-50%⁵⁴ have been reported that reduced.^{3,5,7,55,56}

CONCLUSION

The results of this review and meta-analysis demonstrate with a high level of evidence that, combined with sedation, TPVB provides effective surgical anaesthesia for patients undergoing oncological breast procedures and breast augmentation.⁵⁷ Thoracic paravertebral blocks may also offer significant advantages over GA in terms of postoperative pain, opioid consumption, PONV, length of hospital stay and patient satisfaction.⁵⁷ In addition to decreased pain in the immediate period, TPVB also seems to provide analgesia that exceeds the duration of action of the local anaesthetic agent. The findings review and meta-analysis seem to echo the recent observations by Shnabel et al.⁵⁸ In the latter, the authors also concluded that, compared with GA, TPVB resulted in lower (worse) postoperative scores as well as a decreased incidence of PONV.

Thoracic paravertebral block is a technique with low complication rates besides easy to practice and learn (Table 2). In addition, provides an adequate anesthesia for patients undergoing breast surgery and also provides a stable hemodynamic status with unilateral somatic and sympathetic blockade, near-perfect postoperative pain control, minimal nausea and vomiting rate, early discharge and low cost. For this reason, in some centers, thoracic paravertebral block as a standard practice for breast surgery should be known by all anesthetists. We believe that, TPVB is a method can be applied instead of general anesthesia.

Table 2. The advantages of thoracic paravertebral block

Simple and easy to learn.
Easier and more reliable than thoracic epidural administration.
Provides unilateral somatic and sympathetic block reaching to many dermatomes with single dose injection.
Eliminates the cortical response to thoracic dermatomal stimulation.
Reduces stress and pressor response to surgical stimulation.
Provides a good hemodynamic stability.
Reduces the need and usage of opioid.
Reduces complication rates.
Protects the lower extremity motor function and bladder sensation.
Provides early mobilization.
Does not require extra wakefulness of nurse.

REFERENCES

1. Coveney E, Weltz CR, Greengrass R et al. Use of paravertebral block anesthesia in the surgical management of breast cancer: experience in 156 cases. *Ann Surg* 1998;227(4):496-501.
2. Hala E.A. Eid. Paravertebral block: An overview. *Current Anaesthesia & Critical Care* 2009;20(1):65-70.
3. Eason MJ, Wyatt R. Paravertebral thoracic block-a reappraisal. *Anaesthesia* 1979;34(5):638-42.
4. Richardson J, Lönnqvist PA. Thoracic paravertebral block. *Br J Anaesth* 1998; 81(2): 230-8.
5. Richardson J, Lönnqvist PA, Naja Z. Bilateral thoracic paravertebral block: potential and practice. *Br J Anaesth* 2011;106(2):64-71.
6. Poleshuck EL, Katz J, Andrus CH et al. Risk factors for chronic pain following breast cancer surgery: a prospective study. *J Pain* 2006;7(9):626-34.
7. Cheema SP, Ilsley D, Richardson J, et al. A thermographic study of paravertebral analgesia. *Anaesthesia* 1995;50(1):118-21.
8. Yeğın A, Erdoğan A, Hadimoğlu N. Postoperative analgesia for thoracic surgery. *Turkish J Thorac Cardiovasc Surg* 2005;13(4):418-25
9. Greengrass RA, Duclas R Jr. Paravertebral blocks. *Int Anesthesiol Clin.* 2012;50(1):56-73.
10. Park S, Kim Y, Han K, et al. Thoracic paravertebral block for breast surgery in a pregnant woman. *Korean J Anesthesiol* 2010; 59(Suppl):73-6
11. Karmakar MK. Thoracic paravertebral block. *Anesthesiology* 2001;95:771-80.
12. Tighe SQM, Greene MD, Rajadurai N. Paravertebral block. *Continuing Education in Anaesthesia. Critical Care & Pain* 2010;10(5):133-7.
13. Conacher ID, Kokri M. Postoperative paravertebral blocks for thoracic surgery. A radiological appraisal. *Br J Anaesth* 1987;59(2):155-61.
14. Naja MZ, Ziade MF, El Rajab M, et al. Varying anatomical injection points within the thoracic paravertebral space: effect on spread of solution and nerve blockade. *Anaesthesia* 2004;59(4):459-63.
15. Richardson J, Jones J, Atkinson R. The effect of thoracic paravertebral blockade on intercostal somatosensory evoked potentials. *Anesth Analg* 1998;87(3):373-6.
16. Kirvela O, Antila H. Thoracic paravertebral block in chronic postoperative pain. *Reg Anesth* 1992;17(3):348-50
17. Tenicela R, Pollan SB. Paravertebral-peridural block technique: a unilateral thoracic block. *Clin J Pain* 1990;6(3):227-34.
18. Lönnqvist PA, MacKenzie J, Soni AK, et al. Paravertebral blockade. Failure rate and complications. *Anaesthesia* 1995;50(9):813-5.
19. Richardson J, Sabanathan S. Thoracic paravertebral analgesia. *Acta Anaesthesiol Scand* 1995;39(8):1005-15.
20. Lall NG, Sharma SR. "Clicking" pneumothorax following thoracic paravertebral block. Case report. *Br J Anaesth* 1971;43(4):415-7.
21. Fagenholz PJ, Bowler GM, Carnochan FM, et al. Systemic local anaesthetic toxicity from continuous thoracic paravertebral block. *Br J Anaesth* 2012. doi:10.1093/bja/aes126
22. Calenda E, Baste JM, Danielou E, et al. Temporary quadriplegia following continuous thoracic paravertebral block. *J Clin Anesth* 2012;24(3):227-30.
23. Lin HM, Chelly JE. Post-dural headache associated with thoracic paravertebral blocks. *J Clin Anesth* 2006;18(5):376-8.
24. Buckenmaier 3rd CC, Steele SM, Nielsen KC, et al. Paravertebral somatic nerve blocks for breast surgery in a patient with hypertrophic obstructive cardiomyopathy. *Can J Anaesth* 2002;49(5):571-4.
25. Karmakar MK, Booker PD, Franks R, et al. Continuous extrapleural paravertebral infusion of bupivacaine for post-thoracotomy analgesia in young infants. *Br J Anaesth* 1996;76(6):811-5.
26. Purcell-Jones G, Pither CE, Justins DM. Paravertebral somatic nerve block: A clinical, radiographic, and computed

- tomographic study in chronic pain patients. *Anesth Analg* 1989;68(1):32-9.
27. Karmakar MK, Kwok WH, Kew J. Thoracic paravertebral block: Radiological evidence of contralateral spread anterior to the vertebral bodies. *Br J Anaesth* 2000;84(2):263-5.
 28. Lönnquist PA, Hesser U. Radiological and clinical distribution of thoracic paravertebral blockade in infant and children. *Pae-diatric Anaesth* 1993;3(1):83-7.
 29. Naja Z, Lönnquist PA. Somatic paravertebral nerve blockade: Incidence of failed block and complications. *Anesthesia* 2001;56(9):1184-8.
 30. Cooter RD, Rudkin GE, Gardiner SE. Day case breast augmentation under paravertebral blockade: a prospective study of 100 consecutive patients. *Aesthetic Plast Surg* 2007;31(6):666-73.
 31. Karmakar MK, Gin T, Ho AM. Ipsilateral thoraco-lumbar anaesthesia and paravertebral spread after low thoracic paravertebral injection. *Br J Anaesth* 2001;87(2):312-6.
 32. Thavaneswaran P, Rudkin GE, Cooter RD, et al. Brief reports: Paravertebral block for anesthesia: A systematic review. *Anesth Analg* 2010;110(6): 1740-4.
 33. Hirsch J. Impact of postoperative nausea and vomiting in the surgical setting. *Anaesthesia* 1994; 49 (Suppl):30-3.
 34. Singhal AK, Kannan S, Gota VS. 5HT3 antagonists for prophylaxis of postoperative nausea and vomiting in breast surgery: a meta-analysis. *J Postgrad Med* 2012;58(1):23-31.
 35. Cohen MM, Duncan PG, DeBoer DP, et al. The postoperative interview: Assessing risk factors for nausea and vomiting. *Anesth Analg* 1994;78(1):7-16.
 36. Miguel R, Rothschilder J, Majchrzak J. Breast surgery is a high risk procedure for development of nausea and vomiting. *Anesthesiology* 1993;79(9):1095-9.
 37. Greengrass R, O'Brien F, Lyerly K, et al. Paravertebral block for breast cancer surgery. *Can J Anaesth* 1996;43(8):858-61.
 38. Das S, Bhattacharya P, Mandal MC, et al. Multiple-injection thoracic paravertebral block as an alternative to general anaesthesia for elective breast surgeries: A randomised controlled trial. *Indian J Anaesth* 2012;56(1):27-33.
 39. Bhuvanewari V, Wig J, Mathew PJ, et al. Post-operative pain and analgesic requirements after paravertebral block for mastectomy: A randomized controlled trial of different concentrations of bupivacaine and fentanyl. *Indian J Anaesth* 2012;56(1):34-9.
 40. Li NL, Yu BL, Tseng SC, et al. The effect of improvement of recovery and pain scores of paravertebral block immediately before breast surgery. *Acta Anaesthesiol Taiwan* 2011;49(3):91-5.
 41. Pusch F, Freitag H, Weinstabl C, et al. Single-injection paravertebral block compared to general anaesthesia in breast surgery. *Acta Anaesthesiol Scand* 1999;43(7):770-4.
 42. Klein SM, Bergh A, Steele SM, et al. Thoracic paravertebral block for breast surgery. *Anesth Analg* 2000;90(6):1402-5.
 43. Exadaktylos AK, Buggy DJ, Moriarty DC, et al. Can anesthetic technique for primary breast cancer surgery affect recurrence or metastasis? *Anesthesiology* 2006;105(4):660-4.
 44. Muñoz M, Rosso M, Casinello F, et al. Paravertebral anesthesia: how substance P and the NK-1 receptor could be involved in regional block and breast cancer recurrence. *Breast Cancer Res Treat* 2010;122(2):601-3.
 45. Oğuz S, Küçük C, Eskiçirak E, et al. Thoracic paravertebral block or breast surgery in a patient with myasthenia gravis. *J Anesth* 2007;21(3):449-50.
 46. Stamiatiou G, Athanasiou E, Simeoforidou M, et al. Thoracic paravertebral block for breast surgery. *Anaesthesia* 2004;59(7):723-4.
 47. Bondár A, Szucs S, Iohom G. Thoracic paravertebral blockade. *Med Ultrason* 2010;12(3):223-7.
 48. O Riain SC, Donnell BO, Cuffe T, et al. Thoracic paravertebral block using real-time ultrasound guidance. *Anesth Analg* 2010;110(1):248-51.
 49. Luyet C, Eichenberger U, Greif R, et al. Ultrasound-guided paravertebral puncture and placement of catheters in human cadavers: an imaging study. *Br J Anaesth* 2009;102(4):534-9.
 50. Ben-Ari A, Moreno M, Chelly JE, et al. Ultrasound-guided paravertebral block using an intercostal approach. *Anesth Analg* 2009;109(5):1691-4.
 51. Miguel R, Kuhn AM, Shons AR, et al. The effect of sentinel node selective axillary lymphadenectomy on the incidence of postmastectomy pain syndrome. *Cancer Control* 2001;8(5):427-30.
 52. Wallace AM, Wallace MS. Postmastectomy and post-thoracotomy pain. *Anesthesiol Clin North America* 1997;15(2):353-370.
 53. Kwekkeboom K. Postmastectomy pain syndromes. *Cancer Nurs* 1996;19(1):37-43.
 54. Beyaz SG, Bayar F, Erdem AF. Acute postoperative pain. *J Anesth Clin Res* 2011;12(7):634-9.
 55. Kairaluoma PM, Bachmann MS, Korpinen AK, et al. Preincisional paravertebral block reduces the prevalence of chronic pain after breast surgery. *Anesth Analg* 2006;103(6):703-8.
 56. Naccache N, Jabbour H, Nasser-Ayoub E, et al. Regional analgesia and breast cancer surgery. *J Med Liban* 2009;57(2): 110-4.
 57. Tahiri Y, Tran de QH, Bouteaud J et al. General anaesthesia versus thoracic paravertebral block for breast surgery: a meta-analysis. *J Plast Reconstr Aesthet Surg* 2011;64(10):1261-9.
 58. Shnabel A, Reichl SU, Kranke P, et al. Efficacy and safety of paravertebral blocks in breast surgery: a meta-analysis of randomized controlled trials. *Br J Anaesth* 2010;105(6):842-52.