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# THE ROLE OF PARAVERTEBRAL BLOCKS IN AMBULATORY SURGERY: REVIEW OF THE LITERATURE

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**SUMMARY** – Ambulatory surgery often involves surgical procedures on the thorax, abdomen and limbs, which can be associated with substantial postoperative pain. The aim of this narrative review is to provide an analysis of the effectiveness of paravertebral block (PVB) alone or in combination with general anaesthesia, in this setting, with an emphasis on satisfactory postoperative analgesia in comparison to other modalities. We have conducted a search of current medical literature written in English through PubMed, Google Scholar and Ovid Medline®. Peer-reviewed professional articles, review articles, retrospective and prospective studies, case reports and case series were systematically searched for during the time period between November 2003 and February 2019. The literature used for the purpose of creating this review showed that utilisation of paravertebral block either alone or in combination with general anaesthesia, has a positive effect on satisfactory analgesia in ambulatory surgery. With a multimodal analgesic approach of PVB and other techniques of anaesthesia and analgesia there is a reduction in postoperative opioid consumption, fewer side effects, lower pain scores, decreased mortality, earlier mobilisation of patients and reduced hospital stay.

**Key words:** *ambulatory surgery; breast surgery; local anesthetics; nerve blocks; paravertebral; regional anesthesia.*

## Introduction

Ambulatory surgery often involves surgery of the extremities, thorax and abdomen<sup>1,2</sup>. Orthopaedic surgery, thoracoscopy, breast surgery, nephrolithiasis, in-

guinal herniorrhaphies and other abdominal wall procedures are often associated with significant postoperative pain<sup>2,3</sup>. Although, neuraxial techniques are widely utilised for ambulatory surgery, they are often insufficient for providing postoperative pain therapy once the patient has been discharged from hospital<sup>2-4</sup>. Paravertebral block (PVB) is a technique where a local anaesthetic is deposited into a space found on both sides of the spine, called the paravertebral space. It is a block

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Table 1. The most relevant studies included in the review.

Trial	No of patients	Type of surgery	Type of PVB	Type of local anesthetics
Hanoura et al. <sup>13</sup>	50	ESWL	MPVB (Th)	0.5% bupivacaine
Naja et al. <sup>14</sup>	60	Breast surgery	MPVB (Th)	0.5% bupivacaine
Agarwal et al. <sup>15</sup>	50	Laparoscopic cholecystectomy	BSPVB (Th)	0.25% bupivacaine
Hadzic et al. <sup>16</sup>	50	Inguinal herniorrhaphy	MPVB (Th + L) + PS	0.75% ropivacain
Naja et al. <sup>17</sup>	50	Inguinal herniorrhaphy	MPVB (Th + L) + GA	2% lidocaine, 0.5% bupivacaine

BSPVB = Bilateral single paravertebral block; ESWL = extracorporeal shock wave lithotripsy; GA= general anesthesia; MPVB – multiple paravertebral block; L = lumbar; Th = thoracic; PS= propofol sedation; PVB = paravertebral block; SPVB = single paravertebral block

with a dermatomal distribution of pain relief depending on the level of the spine at which the block is sited and the quantity and type of deposited local anaesthetic<sup>5</sup>.

PVB is effective for therapy of both acute and chronic pain in the thoracic, abdominal and limb regions as well as in ambulatory surgery<sup>6-8</sup>. It has been in use since the beginning of the 20<sup>th</sup> century, when it was first described by surgeon Hugo Sellheim (1871–1936), for abdominal analgesia. After several decades of neglect, its application was revitalised in the 1940s with the use of paravertebral catheterisation for analgesia purposes (Eason & Wyatt 1979)<sup>5,9</sup>. With the progress of surgery and anaesthesia, more and more surgical procedures are conducted on ambulatory, day-surgery principles<sup>1,3,4</sup>. As with other techniques of regional anaesthesia, PVB alone, or in combination with general anaesthesia, results in a better quality of analgesia, fewer side effects and a shorter length of hospital stay<sup>10-12</sup>.

The aim of this narrative review is to assess the efficacy of PVB alone or in combination with general anaesthesia, in order to achieve a satisfactory perioperative analgesia in ambulatory surgery.

## Material and Methods

We conducted a search of medical literature published in English, through PubMed, Google Scholar and Ovid Medline®. Peer-reviewed professional articles, review articles, retrospective and prospective studies, case reports and case series, were systematically reviewed for the time period from November 2003 until February 2019. Other types of publications such as editorials and letters to editors, animal experiments, in vitro studies and studies in infants were ex-

cluded. The search strategy consisted of the following Medical Subject Headings (MeSH) terms: abdominal surgery; ambulatory surgery; breast surgery; local anaesthetics; nerve blocks; orthopaedic surgery; paravertebral; regional anaesthesia; thoracic surgery. The initial screen was based on titles and abstracts of articles on PVB in ambulatory or same day surgery with adverse effects and complications. First, we had read the abstracts of 180 papers and excluded 130 irrelevant articles. We have read 50 full-text articles and excluded articles which do not meet inclusion criteria and those not mentioning PVB anaesthesia/analgesia and pain management or those articles which we found not suitable for the aim of our review.

## Results

We reviewed twenty-nine articles for relevant information and a critical appraisal of the literature was performed. The most important studies included in the review were; 11 systematic reviews, 2 meta analyses, 2 retrospective and 9 randomised controlled trials (RCT). RCTs included in this review showed an efficiency of PVB application in ambulatory surgery both as a sole technique and in combination with general anaesthesia, when compared to other methods and modalities of anaesthesia and analgesia (Table 1)<sup>13-17</sup>. The failure rate associated with PVB is from 2.8 – 6.1 %<sup>7,12</sup>. Pneumothorax and pleural puncture are reported in 1% of cases, but with the additional use of ultrasound, these numbers are further reduced.

Haematoma formation is seen in 2.4% of patients and a risk of inadvertent vessel puncture is present in 5% of patients. Hypotension occurred in 4% of patients with unilateral PVB and in 9% when bilateral PVB was applied, which can be explained by the as-

sociated sympathetic blockade, epidural spread of local anaesthetic or the vasodilatory effect of local anaesthetics<sup>10,13,18</sup>. The incidence of complications is increased with bilateral use of PVB.

Postoperative nausea and vomiting are significantly decreased in patients with PVB application in comparison to general anaesthesia<sup>15,16</sup>.

## Discussion

In this narrative review, we analysed the role of PVB in ambulatory surgery with regard to the site and type of application and to the surgical procedure performed. PVB is, according to the site of application, classified as cervical, thoracic or lumbar<sup>5</sup>.

*Cervical PVB* is administered between the 5<sup>th</sup> and 7<sup>th</sup> cervical vertebrae for anaesthesia and analgesia of the upper limb (especially in shoulder surgery, where there is a need for preservation of motor function in the arm and hand) and as a method of pain therapy with tumours that infiltrate the brachial plexus (Pan-coast tumour)<sup>19,20</sup>.

*Thoracic PVB (TPVB)* is applied in the wedge shaped paravertebral space, found on both sides of the spinal column. The anterior and lateral border of the space is formed by the parietal pleura, while the base is formed by the posterior and lateral parts of the vertebrae, intervertebral disc and intervertebral foramina. The posterior wall is formed by the superior costovertebral ligament which is spread between two transverse processes of the vertebrae.

Laterally, from the tip of the transverse process, the paravertebral space is continued by the intercostal space. Cranially, the paravertebral space is adjacent to the adipose tissue surrounding the humeral nerve complexes, the phrenic nerve and the cervical sympathetic chain, which can result in local anaesthetic spread to these structures after block application.

The space contains adipose tissue in which the spinal nerves, intercostal vessels and sympathetic chain are lodged<sup>5,9</sup>. The caudal border is formed by the psoas major at the level of the 12<sup>th</sup> thoracic vertebra. Therefore, local anaesthetic administration in the lower thoracic paravertebral space (thoracic 11) behind the internal thoracic sheath, can result in a caudal spread of local anaesthetic in the retroperitoneal space beyond the transverse fascia where the roots of the lumbar nerves can be found. This method of administering local anaesthetics most commonly results in a prolonged

unilateral anaesthesia as well as a possible lumbar PVB, depending on the dose and volume of anaesthetic<sup>5,21</sup>. There are many studies stating the benefits of ambulatory breast surgery in only PVB or in combination with general anaesthesia<sup>10,11,14,22</sup>. There is also a significantly present application of PVB in day surgery of inguinal hernia repair in both children and adults, in lithotripsy, video assisted thoracic surgery, gall bladder removal and chronic pain therapy<sup>7,9,10,13,15-18,23</sup>. Depending on the type of surgery and expected postoperative analgesic requirement, PVB is applied either unilaterally, bilaterally or with a catheter insertion technique for continued postoperative analgesia<sup>8,10,24</sup>.

Unilateral application can be conducted on one or more vertebral levels, with or without catheter insertion<sup>5,8,10,12,24</sup>. Bilateral application is most commonly a single shot technique on two levels, depending on the type of surgery, in order to avoid potential complications (local anaesthetic toxicity and haemodynamic instability)<sup>5,8,10,12,25</sup>. Unilateral application is used in breast surgery, thoracic surgery, cardiac pacemaker insertion, rib fractures, open cholecystectomy, liver resections, oesophageal and gastric surgery, partial or complete nephrectomies, inguinal herniorrhaphy<sup>5,7,8,10,12,13,15-18,23</sup>. Bilateral application is used in cardiac surgery, oesophageal surgery, umbilical hernia repair, pelvic surgery, vaginal delivery, prostatectomy and hysterectomy<sup>5,8,10,24</sup>. Studies to date, show that bilateral PVB application in adult and paediatric surgery is not related to increased risk of systemic toxicity mediated by local anaesthetics<sup>26</sup>. Application of catheters for continued postoperative analgesia is especially recommended in surgery on the thorax with lung resection, serial rib fractures, nephrectomy and extensive breast surgery<sup>5,8,10,19,24</sup>.

*Lumbar PVB* is applied 2.5 cm away from the spinous process at the level of the lumbar spinal nerve roots (lumbar 1 to 4) with a combination of nerve stimulator and ultrasound use, such that the patient is positioned in a lateral supine position, with the non-operative side being dependent, with the legs flexed at the hips and the patella and muscles of the upper leg visible to the eye of the operator. Indications for lumbar PVB are analgesia for hip and knee surgery, paediatric orthopaedic procedures, vaginal delivery, and femoropopliteal bypass surgery<sup>27,28</sup>. It is often compared with lumbar plexus block<sup>27</sup>. PVB is contraindicated if there are infections at the intended block application site, history of allergy to local anaesthetics,

tumours that infiltrate the paravertebral space and patient refusal. Coagulopathy, clotting disorders or anti-coagulant therapy are relative contraindications for PVB. According to the existing guidelines for regional anaesthesia, PVB represents a medium risk type of procedure for patients who are on anticoagulant or antiplatelet medication, with a defined time period between drug administration and block application<sup>29</sup>. There are two main types of techniques for PVB: landmark technique and ultrasound guided technique.

During PVB application, the positioning of the patient is very important and patients can either be positioned supine or in a sitting position. Every patient should be fully monitored in accordance to regional anaesthesia guidelines, sedated and analgised as appropriate with full resuscitation equipment available for an emergency situation<sup>24</sup>.

## Conclusions

Our narrative review has shown an efficacy of PVB either alone or in combination with general anaesthesia in providing a satisfactory perioperative analgesia in ambulatory surgery.

Application of PVB is associated with better post-operative pain control during the first 24 hours after surgery, resulting in reduced opioid consumption, fewer side effects and lower pain scores when compared to general anaesthesia alone. By using a multimodal analgesic approach through a combination of PVB with other types of anaesthesia and analgesia, there is a net reduction in mortality, earlier mobilisation and reduced length of hospital stay.

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#### Sažetak

### ULOGA PARAVERTEBRALNIH BLOKOVA U AMBULATORNOJ KIRURGIJI: PREGLED LITERATURE

M. Župčić, D. Dedić, S. Graf Župčić, V. Duzel, T. Šimurina, L. Šakić, I. Grubješić, I. Šutić, I. Šutić i A. Korušić

Ambulatorna kirurgija uključuje kirurške zahvate na udovima, u području prsnog koša i trbuha koji su često povezani s pojavom jake perioperacijske boli. Cilj ovoga narativnog preglednog članka je preispitati učinkovitost primjene paravertebralnoga bloka (PVB) samostalno ili u kombinaciji s općom anestezijom u postizanju zadovoljavajuće perioperacijske analgezije kod ambulatorne kirurgije naspram drugih analgetskih metoda. Proveli smo istraživanje aktualne medicinske literature napisane na engleskom jeziku kroz PubMed, Google Scholar i Ovid Medline®. Recenzirani stručni članci, pregledni članci, retrospektivne i prospektivne studije, prikazi slučajeva i serije slučajeva sustavno su pretraživani u razdoblju između studenog 2003. i veljače 2019. godine. Istraživanja uključena u naš narrative review prikazala su učinkovitost primjene PVB samostalno ili u kombinaciji s općom anestezijom u postizanju zadovoljavajuće perioperacijske analgezije kod ambulatorne kirurgije. Multimodalnim analgetskim pristupom primjene kombinacije PVB s drugim tehnikama anestezije i analgezije postiže se smanjenje potrošnje opioida, manje nuspojava, niže vrijednosti procjene boli na vizualno analognoj ljestvici, smanjenje mortaliteta, brža mobilizacija bolesnika te skraćanje vremena boravka u bolnici.

Ključne riječi: *ambulatorna kirurgija; kirurgija dojke; lokalni anestetici; živčani blokovi; paravertebralni; regionalna anestezija.*