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Efficacy of pectoral nerve block *versus* thoracic paravertebral block for postoperative analgesia after radical mastectomy: a randomized controlled trial†

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Abstract

Background: Pectoral nerve (PecS) block is a recently introduced technique for providing surgical anaesthesia and postoperative analgesia during breast surgery. The present study was planned to compare the efficacy and safety of ultrasound-guided PecS II block with thoracic paravertebral block (TPVB) for postoperative analgesia after modified radical mastectomy.

Methods: Forty adult female patients undergoing radical mastectomy were randomly allocated into two groups. Group 1 patients received a TPVB with ropivacaine 0.5%, 25 ml, whereas Group 2 patents received a PecS II block using same volume of ropivacaine 0.5% before induction of anaesthesia. Patient-controlled morphine analgesia was used for postoperative pain relief.

Results: The duration of analgesia was significantly prolonged in patients receiving the PecS II block compared with TPVB [mean (SD), 294.5 (52.76) *vs* 197.5 (31.35) min in the PecS II and TPVB group, respectively; $P<0.0001$]. The 24 h morphine consumption was also less in the PecS II block group [mean (SD), 3.90 (0.79) *vs* 5.30 (0.98) mg in PecS II and TPVB group, respectively; $P<0.0001$]. Postoperative pain scores were lower in the PecS II group compared with the TVPB group in the initial 2 h after surgery [median (IQR), 2 (2–2.5) *vs* 4 (3–4) in the Pecs II and TPVB group, respectively; $P<0.0001$]. Seventeen patients in the PecS II block group had T2 dermatomal spread compared with four patients in the TPVB group ($P<0.001$). No block-related complication was recorded.

Conclusions: We found that the PecS II block provided superior postoperative analgesia than the TPVB in patients undergoing modified radical mastectomy without causing any adverse effect.

Clinical trial registration: CTRI/2014/06/004692.

Key words: anaesthesia technique, paravertebral block, pectoral nerve block; postoperative analgesia; radical mastectomy

Modified radical mastectomy, usually performed for the treatment of breast cancer, is associated with considerable acute postoperative pain and restricted shoulder mobility.[1] Although the thoracic paravertebral block (TPVB) is the most widely used technique to provide postoperative analgesia after breast surgeries,[2–6] patients having radical mastectomy under TPVB frequently complain of pain in the axilla and upper limb, because TPVB does not block medial and lateral pectoral nerves as effectively

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Editor's key points

- Regional techniques may be useful for pain control after mastectomy, with paravertebral block (PVB) commonly used.
- Pectoral nerve block (PecNB) may offer improved analgesia, particularly in the axilla and upper limb.
- Improved pain relief and reduced morphine consumption were found with PecNB compared with PVB.
- Pectoral nerve block may be a useful regional technique for radical mastectomy; further larger trials are needed.

as long thoracic and thoracodorsal nerves, leading to inadequate analgesia. The TPVB also involves the risk of pneumothorax, spinal cord trauma, sympathetic block, and hypotension.[7]

Pectoral nerve (PecS) block is a new technique for providing surgical anaesthesia and postoperative analgesia during breast surgery that relies upon the placement of local anaesthetic between the thoracic wall muscles[8 9] and is therefore devoid of major adverse effects. The PecS I block is a superficial block that has been used effectively for surgical procedures such as placement of breast expanders and subpectoral prosthesis, shoulder surgery with deltopectoral groove involvement, and insertion of a pacemaker or intercostal drain.[8] The PecS II block favours mastectomy and axillary clearance, because long thoracic and thoracodorsal nerves are also blocked in addition to the lateral branches of the intercostal nerves that exit at the level of the mid-axillary line to innervate the mammary gland and the skin from T2 to T6.[9] The aim of this study was to compare the efficacy and safety of an ultrasound-guided PecS II block with TPVB for postoperative analgesia after modified radical mastectomy.

Methods

The study was approved by the institutional ethics committee, reference no. NK/1130/MD/13532-533, dated September 10, 2013. After providing written informed consent, 40 ASA grade I–II female patients in the age group of 18–65 yr, who were undergoing modified radical mastectomy under general anaesthesia between April and December 2014, were included. Patients with pre-existing infection at the block site, coagulopathy, morbid obesity (BMI >40 kg m^{-2}), allergy to local anaesthetics, decreased pulmonary reserve, major cardiac disorders, renal dysfunction, pre-existing neurological deficits, and psychiatric illness were excluded. All patients were kept fasting overnight and premedicated with alprazolam 0.25 mg and ranitidine 150 mg orally the night before and 2 h before surgery.

Patients were randomly allocated into two groups using computer-generated random numbers. The group allocation numbers were concealed in sealed opaque envelopes that were opened after enrolment of the patients. Group 1 patients received TPVB, whereas Group 2 patients received PecS II block. Both the groups received ropivacaine 0.5%, 25 ml. The blocks were performed under all aseptic precautions in the preoperating room 30 min before surgery with a 22 gauge echogenic needle (Pajunk, sonoplex stim cannula, Geisingen, Germany; 80 mm) using the same ultrasound machine (Sonosite, Inc., Bothell, WA, USA) and linear array probe (38 mm, 7–12 MHz frequency) by an anaesthetist not involved in the preoperative or postoperative assessment of the patient, anaesthesia management, and data collection.

The TPVB was administered at the T3 level with the patient in the sitting position. The skin was infiltrated with lidocaine 2% down to the T2 transverse process (2.5 cm lateral to the T3 spinous process). The ultrasound probe was placed 5 cm from the midline in the craniocaudal direction and moved medially to identify the transverse process and parietal pleura. The superior costotransverse ligament was identified as a collection of homogeneous linear echogenic bands alternating with echo-poor areas running from one transverse process to the next. Ropivacaine 0.5%, 25 ml was deposited in the space between the pleura and the costotransverse ligament.

The PecS II block was performed on the side of surgery with the technique used by Blanco and colleagues.[9] The patient was placed in the supine position with the arm abducted. The ultrasound probe was placed at the midclavicular level inferolaterally to locate the axillary artery and vein, and then moved laterally until pectoralis minor and serratus anterior muscles were identified at level of the third rib. After skin infiltration with lidocaine 2%, the needle was advanced in the plane of probe from medial to lateral in an oblique manner until the tip entered the plane between pectoralis major and minor and ropivacaine 0.5%, 10 ml was injected. After depositing the local anaesthetic, the needle was advanced further until it lay in the potential space between pectoralis minor and serratus anterior muscles, and ropivacaine 0.5%, 15 ml was deposited in this space.

The patients were observed for 30 min after performing the block. The sensory level of block was assessed by a blinded observer with pin-prick sensation every 5 min in each dermatomal distribution from T1 to T8. The total number of dermatomes that had less pain to pin prick compared with opposite side were noted. If the pin-prick sensation did not decrease in any segment up to 30 min, it was considered as a block failure. The patient's ECG and oxygen saturation (Sp_{O_2}) were monitored continuously, and heart rate (HR) and non-invasive blood pressure were recorded at baseline, after performing the block, and every 5 min for 30 min. Any block-related complications, such as hypotension, vascular puncture, or Horner's syndrome, were recorded.

General anaesthesia was induced with injection of fentanyl 1 μg kg^{-1} i.v. followed by propofol 1.5–2 mg kg^{-1} i.v. until loss of verbal response. Vecuronium 0.1 mg kg^{-1} i.v. was used to facilitate tracheal intubation. Anaesthesia was maintained with nitrous oxide 60% in oxygen and isoflurane (minimal alveolar concentration 1–1.3). The patient's lungs were ventilated with positive pressure ventilation to maintain end-tidal carbon dioxide between 4.0 and 4.5 kPa. The patients were monitored for ECG, non-invasive blood pressure, Sp_{O_2}, and nasopharyngeal temperature during surgery. The HR and blood pressure were recorded before induction, after induction, after tracheal intubation, at skin incision, and then every 5 min until the end of surgery. All patients received a continuous infusion of normal saline at a rate of 5–8 ml kg^{-1} h^{-1} during surgery. If mean arterial pressure exceeded 120% of baseline for two consecutive readings, a fentanyl 1.0 μg kg^{-1} i.v. bolus was given. Hypotension (mean arterial pressure <80% of baseline) was treated with boluses of normal saline and, if required, mephentermine 3–6 mg i.v. Bradycardia (HR <40 beats min^{-1}) was treated with atropine i.v. 0.6 mg. All the patients received antiemetic prophylaxis with ondansetron 0.1 mg kg^{-1} i.v. before completion of surgery. The residual neuromuscular block was antagonized with neostigmine and atropine, and the trachea was extubated when the patients were fully awake and breathing adequately.

The patients were monitored for 24 h after surgery in the postoperative room. A patient-controlled analgesia pump, programmed to deliver morphine 2 mg boluses with a lockout interval of 10 min, was attached to the patient for rescue analgesia. No background infusion was allowed. The primary