

# Ultrasound-guided Thoracic Paravertebral Block for Postoperative Pain Treatment after Thoracoscopic Surgery

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## Abstract

**Background:** Acute pain management following thoracoscopic surgery (TS) presents challenges for anaesthesiologists. In this manuscript we compared the efficacy of three different techniques for postoperative pain treatment following TS.

**Methods:** Thirty patients scheduled to undergo TS under general anaesthesia were randomly allocated into 3 groups (10 patients each group) according to pain relief modality to be used postoperatively.

**Group A:** Patients received ultrasound guided thoracic paravertebral block (USGTPV) with bupivacaine 0.5%, consisting of a 10 ml bolus and continuous infusion of bupivacaine 0.0625%, 4 to 6 ml/hr. Rescue analgesia using patient controlled IV analgesia (PCA) was available, using 1 mg bolus Morphine with a 6 minute lock-out.

**Group B:** Patients received patient controlled IV analgesia alone, morphine 1 mg/ml with lock out time of 6 minutes postoperatively.

**Group C:** Patients received interpleural spray of 0.5% bupivacaine (20 ml) at the end of surgery followed by PCA morphine at same setting for groups A and B. Postoperative pain was assessed using the 11-point numeric rating score (NRS) at 7 different intervals (immediately on admission to PACU, every 2 hours for the next 8 hours then at 12 and at 24 hours postoperatively). Pain was assessed at rest, during deep inspiration and whilst coughing. Total dosages of morphine used in the first 24 hours postoperatively were recorded for each group. Non-Parametric Kruskal-Wallis Test was used for comparisons between the three groups and Spearman's correlation coefficient (rs) was used to identify the correlations between morphine dose and pain at different conditions in the three groups. Mann-Whitney Test was used for comparisons within each group where P values < 0.05 were considered significant.

**Results:** The median values (range) of NRS at rest were 1.5 (0-30), 4 (3-5) and 2 (1-4) for groups A, B and C respectively with significant differences (P < 0.05). The median values of NRS at deep inspiration and on coughing showed nonsignificant difference between the three groups (P > 0.05).

The median values (range) of morphine consumption in the first 24 hours were 2 (0-30), 26.5 (10-47) and 10 (4-15) mg in groups A, B and C respectively with significant differences (P < 0.0001).

**Conclusions:** Compared to interpleural bupivacaine or conventional systemic analgesics with morphine, USGTPV block with bupivacaine provided superior postoperative analgesia following thoracoscopic surgery.

**Keywords:** Thoracoscopic surgery, interpleural analgesia, ultrasound-guided thoracic paravertebral block.

## INTRODUCTION

Thoracoscopic surgery (TS) has become the standard method of surgical treatment of some thoracic surgical patients. Postoperative pain following TS is underestimated. It is well-known that although TS is a minimally invasive procedure, patients can experience moderate to severe pain

in the early hours postoperatively.<sup>1,2</sup> In one study, the effect of continuous intra and postoperative paravertebral block after video-assisted thoracoscopic surgery (VATS) was evaluated and proved to be effective.<sup>3</sup> Vogt et al. had shown that single-shot paravertebral block was an effective procedure to improve pain treatment after thoracoscopic

surgery.<sup>4</sup> In another study Asslia et al, had shown that interpleural analgesia was effective following TS for palmar hyperhidrosis.<sup>5</sup> In another study on the effect of single-dose, multilevel paravertebral nerve blockage after thoracoscopic procedures, it was shown that the technique was effective only for 6 hours because of the limited duration with the currently available local anaesthetic agents and the authors suggested that this paravertebral technique was not indicated in the setting of thoracoscopic surgery.<sup>6</sup> As previously mentioned, acute pain management following TS has been described in the literature with conflicting results. Therefore, we have conducted a randomised controlled trial to compare three different techniques of pain relief following TS, namely; ultrasound guided thoracic paravertebral block (USGTPV) with bupivacaine, systemic conventional analgesia with morphine, and interpleural bupivacaine analgesia. To the best of our knowledge this is the first study performed to compare between these three different techniques of pain relief following TS.

## PATIENTS AND METHODS

After written informed consent was obtained and hospital Ethic Committee approval, a prospective trial of 30 adult patients, ASA I or II (21 males, 9 females) scheduled to undergo elective unilateral TS for treatment of spontaneous pneumothoraces or lung biopsy were enrolled in the study. Patients with significant cardiorespiratory diseases were excluded from the study. A closed envelop assignment, computer generated random number scheme was used to ensure balance between patient numbers assigned to each group. Premedication for all patients was achieved with oral lorazepam 2 mg, 2 hours preoperatively. Standard intra-operative monitoring was applied. Patients were randomly allocated into three groups (each 10 patients) depending on the pain relief modality used.

### Group A

Patients received ultrasound guided thoracic paravertebral block (USGTPV) with bupivacaine 0.5%, 10 ml bolus and continuous infusion drip of bupivacaine 0.0625%, 4 to 6 ml/hours, postoperatively.

### Group B

Received patient controlled IV analgesia (PCA) with morphine 1 mg/ml with 6 minutes lock out time postoperatively.

### Group C

Patients received interpleural spray of 0.5% bupivacaine (20 ml) using a powder blower (Karl Storz, Germany) before the end of surgery followed by PCA morphine at same setting for groups A and B. Induction of anaesthesia for all three groups was achieved with sufentanil 0.1 mcg/kg and propofol 3 mg/kg followed by atracurium 0.5 mg/kg to facilitate endobronchial intubation with left sided double lumen tube (DLT). Fiberoptic bronchoscopy was used to verify correct placement of the DLT.

Anaesthesia was maintained with mixture of 50% O<sub>2</sub> in air and 1 MAC sevoflurane. Incremental dosage atracurium was given when required. Since the duration of surgery was relatively short no additional dosages of sufentanil was given to any patient in the three groups. Surgery was performed in all patients by the same surgical team. Patients were positioned as for standard thoracoscopy where two ports technique was used, one for the camera and other for the diathermy or staple. Upon completion of surgery, IV atropine 1.2 mg and neostigmine 2.5 mg were given and the trachea was extubated. The patients then were sent to PACU where they were received by an investigator who was unaware to which group the patient belonged. In the PACU, NRS for pain assessment was used (0 = no pain, 10 = worst pain). Patients were asked to rate their pain at rest, deep inspiration, and at coughing every hour in the recovery room and then 2, 4, 6, 8, 10, 12 and 24 hours in the ward. Both the nurse and physician were unaware to which group the patient belonged while recording the NRS data.

### Statistical Analysis

Sample size calculation was based on the assumption that nearly 80% of patients who receive USGTPV block will be pain free. This means that at least 10 patients should be recruited for each group to achieve an alpha error (confidence level) of 5%, and statistical power of 98.3%. We have used Kolmogrov-Smirnov for testing our data normality. We found that our data did not follow a normal distribution; therefore we used Non-Parametric Kruskal-Wallis Test for comparisons between the three groups. Spearman's correlation coefficient (rs) was used to identify the correlations between morphine doses and pain score in the three groups. Mann-Whitney Test was used for comparisons within each group where P values < 0.05 were considered significant.

## RESULTS

Thirty patients fulfilling the inclusion criteria were included in the trial. The median ages for groups A, B and C were 33 (SD 4.5), 26 (SD 6.3) and 29 (SD 3.4) year respectively. The median values of NRS under different conditions of pain assessment protocol in the three study groups are given in Table 1. The median values of total morphine dose used in the first 24 hours postoperatively in groups A, B and C were 2 (0-30), 26.5 (10-47) and 10 (4-15) respectively (Table 1). Comparisons between NRS and different conditions of pain assessment (deep breathing and coughing) within each group A,B and C showed nonsignificant relationship ( $P > 0.05$ ). However, positive correlation was found in group A between postoperative morphine consumption and NRS during deep inspiration ( $P < 0.013$ ).

## DISCUSSION

Thoracoscopic surgery has become the standard technique in most thoracic surgical procedures. Thoracoscopy allows surgical procedures, previously done through thoracotomy incision, to be done through much smaller incisions, with less postoperative pain, and less risk of narcotic induced respiratory depression, atelectasis due to splinting, hypoxemia, and retained secretions, permitting faster recovery and discharge from the hospital.

Anaesthesia for TS is challenging. We have published a few articles on anaesthetic management of TS.<sup>8,9</sup> Post-thoracoscopy pain is under estimated. Thoracoscopy includes insertion of two to four ports through the chest wall with transaction of the intercostal muscles and stretching of the intercostal nerves. Pain after thoracoscopic surgery is significant and extends into the first postoperative day. Though there are few reports in the literature comparing postoperative pain management techniques following TS, however, the ideal postoperative analgesic regimen following

TS has not been established. In one of our studies on pain relief following TS we concluded that combination of interpleural bupivacaine and intramuscular ketoprofen provided good analgesia with a reduction in postoperative morphine consumption.<sup>10</sup> Transcutaneous electrical nerve stimulation has been reported as effective in reducing analgesic requirement after Video-assisted Thoracoscopy Surgery (VATS).<sup>11</sup> Diclofenac and ketorolac were both reported as effective in treating post-thoracoscopy pain.<sup>2</sup> Local anesthetics have been used effectively, both paravertebrally and interpleurally, in reducing pain after thoracoscopic surgery.<sup>4-6</sup> Ben-David et al, suggested the use of continuous paravertebral block for treating post-thoracoscopy pain.<sup>12</sup> Their approach includes preoperative placement of a single paravertebral catheter, at a level of T5, with minimal side-effects. Also intercostal blockade has been reported to provide effective pain relief and a dramatic reduction in morphine requirement following VATS.<sup>13</sup> Recently, infusion of local anaesthetic into an extra pleural pocket demonstrated excellent postoperative pain relief following thoracoscopic resection, through multilevel intercostal nerve blockade.<sup>14</sup> Since the introduction of ultrasound into anaesthesia, there is increasing interest in using it for regional anaesthetic techniques. Ultrasonography offers direct visualisation of anatomical structures, the needle, and the pattern of spread of local anaesthetic with subsequent increased margin of safety and optimal block quality. In the literature there are published reports describing the ultrasound features of the thoracic paravertebral space and clinically successful ultrasound-guided paravertebral block.<sup>15-17</sup> In another study the authors found that bilateral thoracic paravertebral block was superior to intraperitoneal bupivacaine for pain management following laparoscopic cholecystectomy.<sup>18</sup> In the present study we have used USGTPV block successfully for postthoracoscopy pain relief. In this prospective, randomised, double-blinded study of

**Table 1:** Comparison of NRS between A, B and C groups regarding at different conditions and total dose of morphine in the first 24 hours

NRS	Group A	Group B	Group C	*P-value
	Median (min-Max)	Median (min-Max)	Median (min-Max)	
<b>Rest</b>	1.5 (0-14 )	4 (3-5)	2.0 (1-4)	0.006*
<b>Deep inspiration</b>	3 (1-28.0 )	5 (2-7 )	2.5 (2-4 )	0.268
<b>Cough</b>	3.5 (2-31)	5 (2-7 )	2.5 (2-5 )	0.173
<b>Morphine (mg)</b>	2 (0-30)	26.5 (10-47 )	10 (4-15)	P < 0.0001*

\*By Non-Parametric Kruskal-Wallis Test.

postoperative pain relief following TS, a significant decrease of pain NRS in patients receiving USGTPV block *vs* interpleural local anaesthetics or systemic analgesics was reported up to 24 hours postoperatively.

In conclusion, compared to interpleural bupivacaine or conventional systemic analgesics with morphine, USGTPV block with bupivacaine provided superior postoperative analgesia following thoracoscopic surgery. To the best of our knowledge this is the first study performed comparing USGTPV block with bupivacaine *vs* conventional analgesic techniques.

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