

**Original article:**

**Can Awake Thoracoscopy Procedure be Performed with the Help of Thoracic Paravertebral Anesthesia?**

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**Abstract:**

**Aim:** The aim of this study was to present our experience with 11 patients who were spontaneously breathing with Awake Video Thoracoscopy (AVATS) procedure with the help of TPB because of rareness in the literature. **Materials and Methods:** Between December 2015 and December 2017, a total of 125 VATS cases were performed; 11 cases underwent VATS operation with the help of TPB; age, gender, operation performed, duration of operation, time of onset of mobilization-oral intake, duration of hospital stay, Visual Analogue Scale (VAS) scores were evaluated retrospectively. **Results:** All cases were treated with uniportal AVATS procedure with the help of TPB. The mean age was  $40,3 \pm 17,4$  years (range 18-64 years), nine (82%) of the patients were male and two (18%) were female. Operation procedures included wedge resection in eight (73%) patients (six of them for pneumothorax, two of them for diagnosis), in three (27%) patients pleural biopsy (one of them used talc pleurodesis). There were no perioperative events. The mean operation time was  $27,7 \pm 6,4$  minutes (range, 20-40 min) and the mean anesthesia time was  $25 \pm 3,8$  minutes (range 20-30 min). The mean time of mobilization, oral intake opening time and length of hospital stay was  $1,1 \pm 0,4$  hours (1-2 hours),  $3,5 \pm 0,5$  hours (3-4 hours),  $2,6 \pm 0,5$  days (2-3 days), respectively. **Conclusion:** Awake Video Assisted Thoracoscopic Surgery with the help of TPB has less side effects and less complication risks than other awake procedures with the help of other regional anesthesia techniques. We conclude that; although AVATS with the help of TPB has some minor complications, it has advantages such as early discharge, early mobilization and early oral intake, low pain levels in well-selected patient groups.

**Keywords:** awake; thoracic; thoracoscopy; paravertebral

Bangladesh Journal of Medical Science Vol. 17 No. 04 October'18. Page : 576-582  
DOI: <http://dx.doi.org/10.3329/bjms.v17i4.38319>

**Introduction:**

Thoracic paravertebral block (TPB) is a procedure that can be applied alone or with general anesthesia for thoracic surgery as well as in many surgical procedures. TPB provides post-thoracotomy pain relief comparable with other regional anesthesia methods with lower side effects than minimally invasive thoracic surgery procedures in recent years<sup>1,2</sup>In the last year, the awake and non-entubated thoracoscopic operation was used only diagnostic pleural biopsies. There have been case series and randomized

controlled trials in the literature showing that AVATS (Awake Video Assisted Thoracoscopic Surgery) has been safely and effectively administered in many lung resection operations.<sup>3,4</sup> We aimed to present our experience with 11 cases who were spontaneously breathing with AVATS procedure with the help of TPB because of rare in the literature.

**Material metod:**

Our study was a retrospective, non-randomized, uncontrolled study of a cohort of cases underwent VATS. Between December 2015

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**Table 1:** Evaluation of the demographic characteristics and surgical outcomes of the cases.

Case	Age/ Gender	Indication	Operation	Definitive pathology	Operation time/ Anesthesia time (Minutes)	Mobilization/ Oral intake opening time(Hours)	Length of hospital stay(Days)	Level of TPB	VAS score (Median)
1	59/M	Gastric cancer, Nodule in the lung	Right lower lob wedge resection	Metastasis of adenocarcinoma	35/30	2/4	3	T4-T6	2,75
2	35/M	Recurrent pnx	Apical wedge resection+ Mechanical abrasion	Emphysema-like changes	25/25	1/3	3	T5-T6	3,25
3	55/M	Malign pleural effusion	Pleural biopsy + talc pleurodesis	Adenocarcinoma of lung	20/20	1/3	2	T5-T6	2,50
4	18/M	Recurrent pnx	Apical wedge resection+ Mechanical abrasion	Emphysema-like changes	30/20	2/4	2	T5-T6	3
5	40/M	Pnx, Extended air leak	Apical wedge resection+ Mechanical abrasion	Emphysema-like changes	30/25	1/4	3	T4-T8	2,75
6	59/F	Pleural effusion	Pleural biopsy	Fibrinous pleuritis	20/20	1/3	2	T5-6	2,50
7	64/M	Pleural effusion	Pleural biopsy	Benign mesothelial cells	20/25	1/3	2	T5-6	3
8	18/M	Recurrent pnx	Apical wedge resection+ Mechanical abrasion	Amfizamatöz değişiklikler	30/30	1/4	3	T4-T8	2
9	20/M	Recurrent pnx	Apical wedge resection+ Mechanical abrasion	Pleural bleb	25/25	1/3	3	T4-T8	3
10	30/M	Recurrent pnx	Apical wedge resection+ Mechanical abrasion	Simple bullous cyst	30/30	1/4	3	T4-T8	3,25
11	46/F	Pulmoner nodul	Middle lobe wedge resection	Sarcoidosis	40/25	1/4	3	T4-T8	3,5

VAS (Visual Analog Scale): Median of the values at 1, 2, 4, 8, 12, 24,48 hours.

Pnx: Pneumothorax, TPB: Thoracic Paravertebral Block, T:Thoracal vertebra

and December 2017, a total of 11 VATS cases were performed with the help of TPB. The mean age was  $40,3 \pm 17,4$  years (range 18-64 years), 9 (82%) of the patients were male and 2 (18%) were female. Age, gender, type of operation, duration of operation, time

to oral intake and mobilization postoperatively, length of stay in hospital, Visual Analogue Scale (VAS) scores were evaluated retrospectively. The demographic features and surgical outcomes of the cases are shown in Table 1. All cases were treated

with uniportal AVATS procedure with the help of TPB. Right AVATS was performed in seven cases, left AVATS was performed in four cases. Operation procedures included wedge resection in eight (73 %) cases (six of them for pneumothorax, two of them for diagnosis), in three (27%) cases pleural biopsy (one of them used talc pleurodesis). Endoscopic staplers were used in eight cases with wedge resection. The average number of staples used was  $2,8 \pm 0.8$ .

#### **Anesthesia and operative technique:**

In all cases planned for AVATS after carefully case selection. The cases were evaluated according to American Society of Anesthesiologists (ASA) physical status I to III. Anesthetic protocols were explained to the participants before the informed consent was obtained. Exclusion criteria from the study included; contraindications for epidural catheter placement (local infection in puncture place, bacteremia, hypovolemia, platelet count  $< 100\ 000/\text{mm}^3$ , prothrombin time  $> 40$  sec or thromboplastin time  $< 80\%$ , a bleeding disorder, previous surgery of the cervical or upper thoracic spine, liver or kidney failure, alcohol or drug abuse, and a history of allergy to local anesthetics. Surgical exclusion criteria included: disorders in bleeding parameters, hemodynamic instability, ASA scores of greater than 3, previous thoracic surgery on same side or previous history of pneumonectomy, severe pleural adhesions on same side, severe heart-kidney failure and sleep apnea syndrome, sepsis, history of chest radiotherapy, unfavorable airway or spinal anatomy and cases refused the procedure.

Two percent Lidocaine was administered by inhalation 30 min before the operation to suppress a cough in the intraoperative period. Electrocardiography, noninvasive blood pressure, peripheral arterial oxygen saturation (SpO<sub>2</sub>), temperature, end-tidal carbon dioxide (ETCO<sub>2</sub>) pressure were monitored at the operation room. Sedation was achieved with IV dexmedetomidine of  $1\ \mu/\text{kg}$  after given right lateral decubitus position. For multilevel injections performed one to four points marked in 3 cm lateral to the T4-8 vertebra spinous process. Tuohy needle (18G, Braun, Melsungen, Germany) has been entered of these points with a right angle to the skin and advanced until the transverse process. Then the needle was retracted until the skin and redirected again at an angle of  $10^\circ$  over transverse process and was achieved paravertebral space using loss of resistance method by serum physiological. According to the operation location separate levels or only one level 50 mg of bupivacaine 0.5% and

50 micrograms of remifentanyl from the thoracic paravertebral gap was administered by injection with TPB. Anesthesia levels were evaluated with "Pinpricktest" in the dermatome level after the roots' blockage. After verifying analgesia, 4-5 cm single utility incision was made for wedge resection, and 2 cm single incision for diagnostic VATS. We introduced the 10-mm thoracoscope into the incision and explored the chest cavity. Thus artificial pneumothorax was created and the lung achieved to be collapsed for exploration of the chest cavity. After the operation the chest cavity was filled with isotonic, air was aspirated by negative aspiration and control leakage was made ensuring the expansion of the lung. The lung expansion is not well as in positive pressure ventilation, but was found to be enough to show the air leaks. Involuntary cough reflex and diaphragmatic contractions during the operation did not create a disadvantage in any case. In all cases, oxygen was given by mask during the operation to keep SpO<sub>2</sub> in range of 92-96%. One chest tube was inserted in all cases and the operation was terminated. In postoperative period, expansion of lung was monitored on chest X-ray. Prophylactically all cases were applied cephlosporin 2x1 gr IV until take out the chest tube. For analgesia, paracetamol 3x500 mg peroral and lornoxicam 8 mg IV were administered. All cases were followed up with noninvasive monitor postoperatively and VAS scores in the first 24 hours were recorded.

#### **Statistical analysis:**

The data including case demographics, vital parameters, VAS scores, complications and the surgical results were collected from the institutional database, anesthesia and surgical notes, and the medical and nursing records. Statistical analysis was performed by using SPSS Statistical Package 15.0 (SPSS Inc. California USA). For sample size analysis PASS 11 (NCSS Inc, Utah, USA) package program was used. The statistical data were expressed as the mean  $\pm$  standard deviation or median (range) and categorical variables are reported as percentages. Other variables were assessed via non-parametric tests.

#### **Results:**

We used single level block at T5-6 for five (45,5%) of cases, two level block at T4 to T6 one (9%) of case and finally four level block at T4 to T8 for five (45,5%) of cases. TPB block reached the desired level after the mean  $21,2 \pm 3,73$  minutes (range 18-34 minutes). There was no occurrence of hypotension and bradycardia during or after TBP.

Table 2: Preoperative and postoperative outcomes of the cases

Number of case	ASA score	Comorbidity	Complication related to anesthesia	Complication related to operation
1	II	HT, Gastric Cancer	∅	∅
2	I	∅	∅	∅
3	II	CAD, HT	Headache	∅
4	I	∅	Nausea, Vomiting	∅
5	II	∅	∅	∅
6	II	DM, HT	∅	∅
7	III	COPD, CAD	∅	∅
8	I	∅	∅	Expansion defect
9	I	∅	∅	Hemothorax
10	I	∅	∅	∅
11	II	DM	Headache	∅

ASA: American Society of Anaesthesiologists Physical Status Classification System, TPB: Thoracic Paravertebral Block, HT: Hypertension, CAD: Coronary Arterial Disease, DM: Type 2 Diabetes Mellitus, COPD: Chronic Obstructive Pulmonary Disease

No cases required conversion to general anesthesia, tracheal intubation or thoracotomy. It was necessary to use an additional sedative agent (remifentanyl 0,5 µg/kg) in three cases. Preoperative and postoperative outcomes of the cases are shown in Table 2.

The perioperative course was uneventful. The mean operation and anesthesia time were  $27,7 \pm 6,4$  minutes (range, 20-40 min),  $25 \pm 3,8$  minutes (range 20-30 min) respectively. The mean used of intraoperative fluid volume (crystalloid + colloid) was  $912 \text{ mL} \pm 305 \text{ mL}$  (range, 700-1800 mL). Two (18%) cases developed complications related to operation (one expansion defect that managed with negative aspiration from a chest tube, and one hemothorax managed with tube thoracostomy).

The mean duration of a chest tube was  $1,8 \pm 1,1$  days (range 1-4 days). The mean pain level using the VAS scores for all postoperative hours was  $2,2 \pm 1,3$  cm (range, 1-6 cm). Mean VAS pain score was found at postop 0. day:  $2,9 \pm 0,9$  cm (range, 1-5 cm), 1. day:  $2,3 \pm 0,8$  cm (range, 0-4 cm) and 2. day:  $1,7 \pm 0,5$  cm (



**Figure**

**A:** The image of performing transverse process contact technique for TPB

**B:** The image of performing AVATS procedure with the help of TPB for apical wedge resection+mechanical abrasion on a recurrent primary spontaneous pneumothorax case.

range, 0-4 cm). The mean time of mobilization, oral intake opening time and length of hospital stay was  $1,1 \pm 0,4$  hours (1-2 hours),  $3,5 \pm 0,5$  hours (3-4 hours),  $2,6 \pm 0,5$  days (2-3 days), respectively (Table 1).

After the surgery, TPB- anesthesia side effects were noted in three cases (18%) including; headache in two cases), nausea and vomiting in one. All cases were treated with appropriate medication. Hemodynamic parameters and blood gas values of all cases were stable both perioperative period and postoperative follow up period.

### **Discussion**

Thoracal paravertebral block was first identified in the beginning of the 1900s to increase muscle relaxation and analgesia during abdominal surgery. Since then, many techniques have been proposed to increase the effectiveness of the process. Among them, the most widely used and safe is the technique developed by Greengrass. According to this technique, the paravertebral space is reached after the needle is contacted with the transverse process<sup>5</sup>In recent years it has been reported that TPB can be performed in ultrasound-guided<sup>6</sup> or nerve stimulator-assisted<sup>7</sup>, thus increasing the safety and efficacy of the procedure. In our 11 cases, transverse process contact technique for TPB was used.

Studies in the literature about TPB are mostly related to reducing postoperative pain. AVATS procedure with PVB rarely was reported in literature. TPB procedure and technique are relatively easy and more success full when compared to other regional anesthesia techniques. Failure in TPB with single injection is 10.7% and 6.1% in multiple injections. Main complications related to the procedure; vascular injuries (6.8%), hypotension (4%), epidural or intrathecal injection (1%), pleural injury (0.8%) and pneumothorax (0.5%). Other possible complications include bradycardia, infection-hematoma at the injection site, urinary retention, and local anesthetic toxicity. Complications with TPB are lower than thoracic epidural anesthesia.<sup>[8,9]</sup> In our study, five cases were single level and six cases were multiple levels TPB performed. Both level block was also successful and no complications were seen in perioperative period. However, less hyperpnea, diaphragm-lung motion and cough reflex were observed during the operation in the cases with multiple injections.

Cough is a desirable situation that complicating surgical manipulation in non-intubated AVATS procedures. It has been described that satellite ganglion blockade, vagal nerve blockade, or local anesthetic inhalation can be used to suppress coughing. In some cases, intravenous fentanyl can be used for vagal block to decrease cough suppression during the operation.<sup>[2,4,5]</sup> We also used 3 ml of

lidocaine with 5% inhalation 30 minutes before the operation in our cases. In our cases, cough reflex during the operation was so small that it did not affect the surgical maneuver and exploration.

It is known that, in conventional VATS technique under general anesthesia with single-lung ventilation, leads to neuromuscular problems, increase the risk of pneumonia, deep and decrease cardiac performance. In addition, single lung ventilation can lead to pulmonary edema and pneumothorax<sup>10</sup> Although regional anesthesia has some minor disadvantage and complications such as slow effect, inadequate block, high or total spinal block, headache, spinal / epidural hematoma, intravascular injection, local anesthetic toxicity, neurological deficit, nausea vomiting and hypotension, when compared with general anesthesia. It has low mortality rates and positive effect on cardiovascular, pulmonary, gastrointestinal and coagulopathy system, cognitive functions, immune response, stress response. In awake procedures, it is also potential to avoid complications due to endotracheal intubation; such as trachea-laryngospasm, esophagus-tracheal rupture, tooth fracture, mandibular subluxation, aspiration, cardiac arrhythmias.<sup>11</sup> Although there are some minor risks associated AVATS procedure with the help of TPB, but, it is possible to protect cases from major complications related to general anesthesia and intubation.

The appropriate selection of cases is important to perform AVATS procedure with the help of regional anesthesia. In not eligible cases, the procedure can lead to catastrophic outcomes. Indications and contraindications are defined for case selection of nonintubated VATS procedures. Indications for standard VATS are same for nonintubated VATS and contraindications as; hemodynamically unstable cases, expected difficult airway management, obesity (body mass index >30), extensive pleural adhesions, inexperienced and poorly cooperative surgical team, large and central pulmonary lesions (>6 cm) for pulmonary resections, thoracic spinal deformity and coagulopathy when thoracic theparavertebral block considered(4). The additionally, AVATS procedures should not be performed for the cases who have American Society of Anesthesiologists (ASA) physical status 4 and higher, bleeding disorders, obstructive sleep apnea syndrome, strict contralateral lung isolation, clinically significant sputum production, bronchiectasis, asthma, in psychiatric nonstable cases. Furthermore, noncompliance to the procedure or case refusal should be an exclusion

criterion.<sup>12</sup> Despite the choice of the appropriate case, the awake procedures have their own unique advantages and disadvantages. Advantages can be explained as; avoiding the potential risks of tracheal intubation, best results in postoperative fasting time, duration of postoperative antibiotic use, and length of hospital stay, earlier improvement of some quality-of-life domains, better mortality, morbidity and costs, improved the surgical stress response and had a smaller impact on the postoperative lymphocyte response.<sup>13</sup>

Some disadvantages can be considered as; challenge and increased labor intensity to anesthesiologists, disapproval from some thoracic surgeons, the risk of mental stress and post-traumatic stress disorder for some cases, incompatible teamwork, hypercapnia, airway support and preparation for conversion to intubated general anesthesia, fewer economic benefits in some countries.<sup>13,14</sup>

Piccioni et al.<sup>14</sup> reported two oncologic cases with severe respiratory disease who operated with AVATS with the help of TPB. They performed pleural biopsy and pleurodesis and reported that have a surgically satisfactory condition, a painless postoperative period, early mobilization, early discharge. Furthermore, the respiratory risks of anesthetic agents and intubation were reduced to a minimum. Similarly, when we performed AVATS with the help of TPB, early mobilization and early discharge were possible, while postoperative pain was minimized. In all of cases; the surgically created artificial pneumothorax, and double lumen option was awaited during the operation in case of emergency conditions.

Pompeo et al.<sup>15</sup> reported a randomized study in 2004 in which they performed wedge resection via AVATS with the help of thoracic epidural anesthesia in 30 cases with a solitary pulmonary nodules. They compared intubated general anesthesia and awake technique and awake technique and clarified in terms of awake technique, more positive in terms of case satisfaction, less nursing care, less hospital staying, safer and feasible for surgery. The rates of awake procedures pass to general anesthesia and intubation are between 2.7% and 4.3%, depending on the surgical procedure and learning curve.<sup>16,17</sup> We also think that the AVATS procedure with the help of TPB is a safe and feasible procedure in well-selected case group and it had similar advantages in our case group. We did not have to go to general anesthesia or intubation in any case.

In a similar study; Dostbil et al.<sup>18</sup> reported that awake cardiac surgery could be performed in 14 cases with the help of thoracic epidural anesthesia + femoral block.

**Conclusion:**

Awake Video Assisted Thoracoscopic Surgery with the help of TPB can have lower side effects and complication than other awake procedures with the help of other regional anesthesia techniques. It is also possible to avoid the risks of general anesthesia and intubation with this method. However, there is a need for studies involving larger series of cases to determine the contribution of the paravertebral block to AVATS operations.

**Conflict of interest :** None declared

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