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Original Research Article

May awake video-assisted thoracoscopic surgery with thoracic epidural anesthesia use routinely for minimaly invasive thoracic surgery procedures in the future?

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ABSTRACT

Background: In the last years thoracic surgery developed in greater extent with equipments and techniques in one lung ventilation. Still general anesthesia in one lung ventilation approved as gold standard. In thoracic surgery most performed surgeries are plerural decortication and lung biopsy. Avoidance of intubation in Video Assisted Thoracoscopic Surgery (VATS) procedures gains us some advantages in postoperative period; a better respiratory parameters, survival and morbidity mortality rates, reduced hospitalization time and costs, reduced early stress hormone and immune response.

Methods: In this study, we reported our experience of 24 consecutive patients undergoing VATS with Thoracic Epidural Anesthesia (TEA) between December 2015 through July 2016 to evaluate the feasibility, safety and indication of this innovative technique whether it will be a gold standart in thoracic surgeries or not in the future.

Results: Operation procedures included wedge resection in 11 (46%) patients (eight of them for pneumothorax, three of them for diagnosis), in 10 (42%) patients pleural biopsy (eight of them used talc pleurodesis), in two (8%) patients air leak control with fibrin glue and in one (4%) patient bilateral thoracal sympathectomy for hyperhidrosis. We used T4-5 TEA space for 17 (72%) of patients, while we used T4-6 TEA space for 7 (28%) of patients. TEA block reached the desired level after the mean 26.4±4.3 minutes (range 21-34 min). There was no occurrence of hypotension and bradycardia during and after TEA. One (4%) patient required conversion to general anesthesia and tracheal intubation because of significant diaphragmatic contractions and hyperpne. Conversion to thoracotomy was not needed in any patient.

Conclusions: We conclude that nVATS procedure with aid of TEA is feasibile and safety with minimal adverse events. The procedure can have such advantages as early mobilization, opening of early oral intake, early discharge, patient satisfaction, low pain level. Nevertheless, there is a need for randomized controlled trials involving wider case series on the subject.

Keywords: Awake, Epidural anesthesia, Iatrogenic pneumothorax, Thoracoscopic surgery

INTRODUCTION

In the last years thoracic surgery developed in greater extent with equipments and techniques in one lung ventilation. Still general anesthesia in one lung ventilation approved as gold Standard.[1] The reasons for preference of awake patient includes; avoidance of several complications related to general anesthesia such as; deterioration in respiratory functions (like atelectasis, ventilator-induced lung injury, dimished functional residual capacity leading to difficult weaning from mechanical ventilation), impaired cardiac performance and reduced postoperative nausea and vomiting.[2]

In thoracic surgery intubation and techniques without intubation leads different physiologic changes. With intubation diphragm is completely curarized and mechanical ventilation takes in action. However, in nonintubated techniques patients breathe spontanously and diaphragm muscle contracts. In thoracic surgery most, performed surgeries are video assisted thoracoscopic surgery (VATS), pleural decortication and lung biopsy.

Avoidance of intubation in such procedures gains us some advantages in postoperative period; a better respiratory outcome, survival and morbidity mortality rates, reduced hospitalization time and costs, reduced early stress hormone and immune response.[3]

In nonintubated VATS (nVATS) procedures patients undergone regional anesthesia with or without sedation while preserving spontanous breathing. Local anesthesia, intercostal nerve blocks, thoracic epidural anesthesia (TEA) and paravertebral blocks are among the techniques for nonintubated anesthesia.[2] In some demanding procedures surgeons prefer thoracic epidural anesthesia which grants superior thoracic analgesia.[4] Main aim of TEA is to block somotasensory and motor fibers between T1-8 while preserving spontanous breathing.[5]

One of the main disadvantage of the technique is patient's respiratory reaction and poor surgical manipulation by the reason of diaphragm and lung movements.[6] Morover hypoxemia and hypercapnia may still exist in nonintubated thoracic surgery.

In lateral decubitus position nVATS preserves ventilation perfusion match by ventilation of dependent hemidiaphragm in comparison to intubated one-lung ventilation under general anesthesia. Usually mild hypercapnia may ocur which is well-tolerated and when patient starts two-lung breathing carbondioxide levels return to normal. Additional oxygen therapy by a face mask usually sufficient after surgery.[7]

In this study, we reported our experience of 24 consecutive patients undergoing VATS with TEA in a 1-year period of time to evaluate the feasibility, safety and indication of this innovative technique whether it will be a gold standart in thoracic surgeries or not in the future.

METHODS

Study design and patients

Twenty-four patients undergoing thoracoscopic operation were included into a retrospective study. The age range was between 19 and 79 including 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 (puncture in the skin, infection, bacteremia, hypovolemia, platelet count <100 000/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 insitability, 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, cases with sepsis, cases with a history of chest radiotherapy, cases with unfavorable airway or spinal anatomy.

Anesthesia

Anesthetic management of nonintubated thoracoscopic operations has been described in previous studies8. 2% lidocaine (Jetmonal 2%, Adeka Pharmaceutical, Turkey) was administered by inhalation 30 minutes before operation due to suppress cough reaction in the intraoperative period.[9]

The patient was sedated with a 0.06 mg/kg midazolam (Dormicum, Deva Pharmaceutical, Turkey) intramuscular before arrival to the operating room. The procedure was planned in awake patients under TEA and adequate sedation. In the operating room, intravenous peripheral catheter was placed in the forearm and a continuous infusion of Ringer's solution was started. Routine monitoring devices were placed including; five lead electrocardiography, noninvasive blood pressure, heart rate (HR), pulse oxygen saturation (SpO_2), end tidal cardondioxide ($ETCO_2$), respiratory rate (RR), axillary body temperature, and urine output.

In the sitting position thoracic epidural anesthesia was performed by insertion of an epidural catheter at the T4-6 interspace with an 18-gauge Tuohy needle (B-Braun Medical, Abbott, Turkey) via the saline loss of resistance technique and a test dose of 2 mL lidocaine 1% was given (Table 1).

After insertion of catheters, dopamine infusion at a dose of 3 to 4 µg/kg/min was started and continued to keep Mean Arterial Pressure (MAP) > 60 mmHg. If there was deterioration in MAP to less than 60 mmHg than the infusion of dopamine was increased to 5 to 6 µg/kg/min. Bradycardia (heart rate <50 beats/min) was treated with in-travenous atropine (Atropin sulfate, Biofarma Pharmaceuti¬cal, Turkey) at a bolus dose of 0.5 mg. From the thoracic epidural catheter 3 mL of 0.5% bupivacaine (Bustesin 0.5%, Vem Pharmaceutical, Turkey) was administrated followed by reinjection of another 3 mL 5 minutes later to reach a level of anesthesia between T1 and T9. The dose was not repeated. One of the major objectives was to achieve motor block of the intercostal muscles while preserving diaphragmatic respiration. Sedation state was kept at cooperated, oriented and tranquilized at Wilson 2 level and the sedation was stopped during wound closure.[10]

Table 1: Demographic features of 24 cases underwent nVATS procedures.

Sex/Age	Indication	Operation	Definite Pathology	Operation time (min)	Mobilizitation/ Oral intake opening time (h)	Length of hospital stay (days)	TEA stay
F/46	Pleural nodule	VATS bx	Rheumatoid nodule	28	2/4	1	T_{4-5}
M/67	Pleural effusion	VATS bx+TP	Adenocarsinoma ELCs	22	1/3	2	T_{4-5}
M/32	Rec. Px	VATS wedge+MP	ELCs	25	1/3	4	T_{4-5}
M/33	ILD	VATS wedge	Chronic inflamatuar fibrosis	35	2/4	4	T_{5-6}
M/33	Rec. Px	VATS wedge+MP	Pleural bleb	20	1/4	4	T_{4-5}
M/24	Rec. Px	VATS wedge+MP	ELCs	35	1/2	3	T_{4-5}
M/27	ILD	VATS wedge	Interstitial fibrosis	30	1/3	4	T_{5-6}
M/50	ILD	VATS wedge	BOOP	40	1/4	4	T_{5-6}
F/27	Rec. Px	VATS wedge+MP	ELCs	35	1/3	4	T_{4-5}
M/23	Rec. Px	VATS wedge+MP	ELCs	30	1/3	4	T_{4-5}
M/79	Sec.Spon.Px	VATS air leak control		25	2/4	3	T_{4-5}
M/77	Pleural effusion	VATS bx+TP	Adenocarsinoma	20	1/4	2	T_{4-5}
M/60	Pleural effusion	VATS bx+ TP	SCLC	25	1/3	2	T_{4-5}
M/79	Pleural effusion	VATS bx+ TP	Sarcomatoid type lung carsinom	20	2/4	3	T_{4-5}
M/61	Pleural effusion	VATS bx+TP	Squamous cell carsinoma	25	1/3	2	T_{4-5}
M/24	Rec.Px	VATS wedge + MP	Pleural bleb	35	2/4	3	T_{5-6}
F/54	Pleural effusion	VATSbx+TP	RCC	20	1/3	2	T_{4-5}
M/71	Pleural effusion	VATS bx	Benign	15	1/3	3	T_{4-5}
M/78	Pleural effusion	VATS bx+TP	Inflammator	25	2/3	2	T_{4-5}
M/22	Hyperhidrosis	VATS symphatectomy	SCLC	45	16/8	5	T_{5-6}
M/19	Px Prol.Air Leak	VATS wedge+MP	Pleural bleb	25	1/2	2	T_{5-6}
F/22	Rec. Px	VATS wedge+MP	ELCs	35	2/3	3	T_{5-6}
M/66	Pleural effusion	VATS bx+TP	Adenocarsinoma	15	1/2	2	T_{4-5}
M/55	Prol. Air Leak	VATS air leak control	20		1/3	7	T_{5-6}

TEA: Thoracic epidural anesthesia, Px: Pneumothorax, Rec Px: Recurrent pneumothorax, ILD: Interstitial lung disease, Sec Spon Px: Secondary spontaneus pneumothorax, Prol Air Leak: Prolonged air leak, MP: Mechanical pleurodesis, TP: Talk pleurodesis, VATS: Video-assisted thoracoscopic surgery, ELCs: Emphysema-like changes, BOOP: Bronchiolitis obliterans organizing pneumonia, SCLC: Small cell lung carsinoma, RCC: Renal cell carsinoma, *Required conversion to general anesthesia nd tracheal intubation because of significant hyperpnea

The intensity of intraoperative pain was assessed by a visual analogue scale (VAS; 0 represented no pain and 10 represented intractable pain). During the thoracoscopic procedure, through a nasal cannula, at least 3-4 L/min oxygen was continuously administered along with detection of ETCO2.

Asissted ventiation is mandatory when SpO2 decreased below %90 during surgery. Also, if arterial partial pressure of carbon dioxide (PaCO2) levels reach 80 mmHg, operation had to be halted and ventilation had to be achieved by mechanically. If this procedure failed endobronchial intubation via double-lumen tube (Broncho-cath; Mallinckrodt, Dublin, Ireland) should be applied. Then, the induction was performed via intravenous 2 mg/kg propofol and 1 μg/kg fentanyl (fentanyl Janssen, Janssen Pharmaceutica, Belgium).

Neuromuscular blockage was maintained by intravenous 0.6 mg/kg rocuronium (Esmeron, Organon Pharmaceuticals, U.S.A.) prior to intubation. Anaesthesia was continued by 0.15 mg/kg rocuronium, 50% oxygen and 50% air, 0.5 to 2% sevoflurane (Sevorane, Abbott Pharmaceutical, USA). Vital signs were monitored at before thoracic epidural anesthesia 0, 5, 10, 15, 20, 30, 45, 60, 75 minutes intraoperative. Intraoperative arterial blood gas was extracted for blood gas analysis to detect values of pH, arterial partial pressure of oxygen (PaO2), PaCO2, HCO3 and lactate.

An iatrogenic pneumothorax was made by creating incisions through the chest wall for thoracoscopy and the ipsilateral lung collapsed gradually.

After closure of pleural cavity, ventilation may be supplied by a face mask and patient should be encouraged for spontanous breathing.

Anesthesia time, operation time, arrhythmia and the cases transferred to endotracheal intubation were all recorded. The patients were transferred to a post anesthesia care unit (PACU). The epidural catheter was not used for pain control and the catheter was removed 2 hours after surgery in the PACU.

Operative technique

The patients were turned into the lateral decubitus position, with slight flexion of the table at the level of the mid-chest. The level of TEA was controlled by pain and heat sensitivity.

An incision of about 30 mm in length was made into the sixth intercostal space in the midaxillary line. A port was opened and a thoracoscope with a diameter of 10 mm and a length of 32 cm between 0 and 90 degrees was placed through a 15-mm thoracic port. All cases were completed as uniportal. Thus, we first created an artificial pneumothorax and collapsed the lung. Lung resections were performed with 40 mm endoscopic staplers.

The pleural biopsy was performed with various punchers. Mechanical pleurodesis was created using cautery sandpaper on apical parietal pleura. Chemical pleurodesis was performed with talc in cases with diffuse pleural nodule with malignant effusion. The resected specimen was removed in an organ retrieval bag through the single port incision.

The chest was isotonically filled, the air was aspirated. The lung was expansive via negative aspiration and by this way leak control was applied. It was seen that the lung was not expanding as much as the positive ventilation applied with the mechanical ventilator, but it was ventilated enough to show whether it was leaked. During the operation, involuntary cough reflex and diaphragmatic contractions were at a level that would not prevent the operation from succeeding.

Upon completion of the procedure, a 28-F chest tube was inserted via the 15-mm port. Chest X-ray was performed immediately at the end of the operation or at the next morning. Drinking and meal intake were resumed 2 to 4 hours after surgery. The chest tube was removed if no air leak was present, a complete re-expansion demonstarted by a chest X-ray.

Data collection and Statistical analysis

The data including patient 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 programme was used.

The statistical data were expressed as the mean ± standard deviation or median (range) and categorical variables are reported as percentages. Other variables were assessed via non-parametric tests. A p value of < 0.05 was considered statistically significant.

RESULTS

From December 2015 through July 2017, nVATS was performed on 24 consecutive patients. The demographic features of the cases are shown in Table 1. The mean age was 47.04 ± 21.6 years (range 19-79 years), 20 (84%) of the pateints were male and 4 (16%) were female.

Operation procedures included wedge resection in 11 (46%) patients (eight of them for pneumothorax, three of them for diagnosis), in 10 (42%) patients pleural biopsy (eight of them used talc pleurodesis), in two (8%) patients air leak control with fibrin glue and in one (4%) patient bilateral thoracal sympathectomy for hyperhidrosis.

We used T4-5 TEA space for 17 (72%) of patients, while we used T5-6 TEA space for 7 (28%) of patients. TEA block reached the desired level after the mean 26.4±4.3 minutes (range 21-34 min). There was no occurrence of hypotension and bradycardia during and after TEA. One (4%) patient required conversion to general anesthesia and tracheal intubation because of significant diaphragmatic contractions and hyperpne.

It was necessary to use additional sedative agent (remifentanil 0.5 µg/kg) in three patients. Conversion to thoracotomy was not needed in any patient. The operative and anesthetic results are shown in Table 2. There were no perioperative events and the mean operation time was 27.08±7.84 min (range, 15-45 min). The mean used of intraoperative fluid volume (crystalloid+colloid) was 912 mL±305 mL (range, 700-1800 mL). Two (8%) patients developed complications (1 atelectasis requiring bronchoscopy and 1 prolonged air leak). The mean duration of chest tube was 2.5±1.1 days (range 1-7 days).

Table 2: Outcomes of the nVATS operation procedure with TEA.

Variable	Main	Range (minimum–maksimum)
Age (years)	47.04±21.6	38-77
Sex (n, male/female)	20/4	
Duration of surgery (min)	27.08±7.84	(15-45)
Mean chest tube duration (days)	2.5±1.1	(1-7)
Mean length of hospital stay (days)	3.12±1.29	(1-7)
Mean mobilization (min)	1.91±3.03	(1-16)
Oral intake opening time (min)	3.41±1.17	(2-8)
Mean VAS pain scale	2.1±1.1 (1-6)	(1-6)
Mean TEA block desired level time (min)	26.4±4.3	(21-34)
Complications, n (%)		
Related operation (atelectasis, prolonged air weak)	2 (8)	
Related TEA (headache, vomiting and backache)	3 (12)	
Rate of passing to general anesthesia and intubation	1 (4)	

TEA: Thoracic epidural anesthesia, VAS: visual analogue scale (0 represented no pain and 10 represented intractable pain), Data are given as mean±SD, median [min-max]

The mean pain level using the VAS score for all postoperative hours was 2.1±1.1 cm (range, 1-6 cm). Mean VAS pain score was found at postop 0. day: 2.8±0.7 cm (range, 1-5 cm), 1. day: 2.2±0.9 cm (range, 0-4 cm) and 2. day: 1.9±0.6 cm (range, 0-4 cm). The mean time of mobilizitation, oral intake opening time and length of hospital stay was 1.91±3.03 hour (1-16 hours), 3.41±1.17 hours (2-8 hours), 3.12±1.29 days (1-7 days), respectively (Table 1, 2).

Table 3: The mean hemodynamic parameters of 24 patients during preoperative and intraoperative period.

	Preoperative	Intraoperative after TEA blockade	Intraoperative 15th min	Intraoperative 30th min
SAP (mmHg)	95.4±13.2	120.1±11.2	126.7±12.4	125.1±14.3
DAP (mmHg)	66.1±8.2	74.4±9.3	67.2±10.4	71.9±8.5
MAP (mmHg)	72.2±11.1	97.4±7.7	97.1±6.7	98.4±7.9
HR (beats/minute)	82.1±13.3	97.8±6.7	109.7±5,9	105±8.8
SpO_2 (%)	92.7±2.7	97.8±3.9	93.8±2.7	96.4±2.4
RR (breaths/minute)	14.7±3.1	17.6±3.8	22.7±4.3	16.8±5.1

SAP: Systolic arterial pressure, DAP: Diastolic arterial pressure, MAP: Mean arterial pressure, HR: Heart rate, SpO2: Peripheral oxygen saturation, RR: Respiratory rate, Data are given as mean±SD, median [min-max]

After the surgery, TEA side effects were noted in 3 patients (12%) including; headache, vomiting and backache requiring medication. Hemodynamic parameters and blood gas values of all patients were stable. The mean hemodynamic parameters of 24 patients during preoperative, intraoperative and postoperative period are shown in Table 3 and 4.

Table 4: The mean hemodynamic parameters of 24 patients during the postoperative period.

	Postoperative basal	Postoperative 2th hour	Postoperative 4th hour	Postoperative 8th min	Postoperative 24th min
SAP (mmHg)	117±9.8	115.5±11.2	132.1±13.6	124.5±15.9	122±11.9
DAP (mmHg)	76.4±10.1	67.8±8.3	71.3±9.2	79.8±10.4	63.4±8.7
MAP (mmHg)	88.9±7.2	84.4±7.1	92.3±7.8	94.5±9.1	88.4±7.9
HR (beats/minute)	89.2±9.3	82.5±10.3	81.2±9.8	82.6±8.9	89.5±6.8
SpO_2 (%)	95.6±4.2	95±3.3	91.3±2.8	92.4±3.1	93.4±3.2
RR (breaths/minute)	13.7±2.1	13.1±2.4	12.1±1.8	12.2±2.1	12.3±1.8

SAP: Systolic arterial pressure, DAP: Diastolic arterial pressure, MAP: Mean arterial pressure, HR: Heart rate, SpO_2: Peripheral oxygen saturation, RR: Respiratory rate, Data are given as mean±SD, median [min-max]

DISCUSSION

During VATS in awake patients, other intraoperative concerns include hypoxemia and hypercapnia may occur however, these are usually at a tolerable level and after return of the bilateral lung functions, spontaneous respiration can be established.[11-14] The VATS procedure has been reported to preserve lung functions better than thoracotomies.

Thoracic epidural anesthesia has been reported to reduce vital capacity (VC) and FEV1 by 5.6% and 4.9% respectively due to blockade of the intercostal muscles however, increase of FRC moves tidal volume above closing volume, whereas an increase of VC enhances oxygenation and decreases the risk of atelectasias.[15] In our patients we have observed that during the nVATS procedure intraoperatively the arterial blood gas values, pulse oximetry and lactate levels remained stable.

Another reason for prevention of deterioration in lung functions is increase in diaphragmatic shortening.[16] During procedure, TEA in nVATS patients provided a good preservation of pulmonary functions which are reflected in arterial blood gas values. In our case, during surgery iatrogenic pneumothorax did not cause deterioration in hemodynamic parameters other than increase in respiratory rate to compensate for the hypercapnia which occured about 5 minutes after the initiation of pneumothorax however it is relieved within 20 minutes after reexpansion of the lungs.[13-17]

Recently there are case series and a few randomized controlled studies on the use of VATS procedure in awake patients. In the studies by Mineo et al. and Pompeo et al. only 12 of 42 patients underwent lung volume reduction surgery in a nonintubated setting with use of thoracic epidural analgesia and they reported successful and safe use of this method.[13,14] In the study by Chen et al. the incidence of ineffective thoracic epidural analgesia was reported to be low (2/285, 0.7%) and only one patient (1/285, 0.4%) was converted to thoracotomy because of bleeding.[12]

Recently, a randomized study including 60 patients was conducted to compare the outcome including postoperative complications of general anesthesia with one-lung ventilation and nonintubated thoracoscopic lobectomy using thoracic epidural anesthesia in nonintubated patients and no significant differences were recorded in overall comparisons.[18]

The rates of general anesthesia and intubation are 2.7% to 4.3%, depending on the surgical procedure and learning curve.[8,19] In our study for one case (4%) had to go to general anesthesia and intubation for hyperpne. No open thoracotomy needed in any patient.

The use of thoracic epidural anesthesia in an awake patient is not without risks. The most significant one is that sympathetic blockade could lead to increased bronchial tone and airway hyperreactivity. During nVATS procedure, other intraoperative concerns include; intrathoracic vagal blockage may prevent cough reflex and may cause diminished clearance of bronchial secretions, hypoxemia and hypercapnia may occur however, these are usually at a tolerable level and after return of the bilateral lung functions, spontaneous respiration can be established.[2,11-13]

However, in comparison of postoperative complications between patients undergoing nonintubated thoracoscopic lobectomy and intubated thoracoscopic lobectomy under general anesthesia in geriatric patients with early-stage lung cancer, the incidence of air leaks greater than five days postoperatively did not differ (5, 13.9% versus 7, 14.6%) and also the incidences of stridor and delirium was present in the intubated group in comparison to none in the nonintubated group (3, 6.25% versus 4, 8.3%).[8]

The recent case series also indicate that; intraoperative hypercapnia is tolerable and hypoxemia with facial mask was not reported. Postoperative side effects include; sore throat, headache, and vomiting.[20] In our study, 2 (8%) postoperative complications (atelectasis, prolonged air weak) and 3 (12%) TEA side effects (headache, vomiting and backache requiring medication) were noted.

With the aid of regional anesthesia, awake nVATS procedure cough can make both exploration and surgical technique difficult. In order to suppress cough during the operation, either satellite ganglion blockage, vagal nerve blockage or local anesthetic inhalation can be applied in the preoperative period.[9,21] In all cases, 3 mL of lidocaine 5% inhalation was administered 30 minutes before the operation and cough reflex during the procedure was so little that it did not affect surgical maneuver. It is known that VATS technique with one lung ventilation under general anesthesia increases the risk of pneumonia as a result of deep sedation and muscle relaxation, reduces cardiac performance, causes neuromuscular problems.

Also, many complications can develop such as, laryngotracheal spasm, esophageal or tracheal rupture, tooth fracture, mandibular subluxation, tracheal aspiration cardiac arrhythmia depending on endotracheal intubation.[22] In addition, one-lung ventilation can lead to edema, lung damage and pneumothorax.[23]

Although regional anesthesia have such complications such as slow start, failed or inadequate block, high or total spinal block, headaches, spinal/epidural hematoma, intravascular injection, local anesthetic toxicity, neurological deficits, nausea, vomiting, hypotension; compared to general anesthesia, mortality; effects on cardiovascular, pulmonary, gastrointestinal and coagulation system, cognitive functions; major morbidity on immune and stress response are known to be less. Although some minor risks of TEA may occur during nVATS procedure, it is possible to prevent major complications related with general anesthesia and intubation.

CONCLUSION

In conclusion, we think nVATS procedure with aid of TEA is feasibile and safety with minimal adverse events. The procedure can have such advantages as early mobilization, opening of early oral intake, early discharge, patient satisfaction, low pain level. Nevertheless, there is a need for randomized controlled trials involving wider case series on the subject.

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