Comparative Study between General Anesthesia and Awake Thoracic Epidural Anesthesia for Video-Assisted Thoracoscopic Surgery

SOMAYA M. EL-SHAIKH, M.D.*; WAEL A. IBRAHEM, M.D.†; SAYED M. ABED, M.D.*; ABD EL-RAHMAN A. ABD EL-RAHMAN, M.D.‡; and USAMA ABDEL EL-KHALEK, M.Sc.*
The Departments of Anesthesia, Intensive Care & Pain Relief* and Thoracic Surgical Oncology‡, National Cancer Institute, Cairo University, Egypt

Abstract

Background: This study evaluated the safety and feasibility of awake thoracic surgery under Thoracic Epidural Anesthesia (TEA) vs. a traditional thoracic surgery under General Anesthesia (GA).

Methods: Thirty patients scheduled for thoracic surgery were randomly assigned to receive either sole TEA at any level between T4-T6 with sedation (awake group [AG], n=15) or receive GA with One Lung Ventilation (OLV) and thoracic epidural analgesia (control group [CG], n=15). Evaluated variables included the technical feasibility and patient satisfaction for both techniques.

Results: The study groups as regards technical feasibility and anesthesia satisfaction, showed more patient satisfaction in the awake group than the general anesthesia group.

Conclusions: Awake thoracic surgery under TEA in highly selected patients and procedures is safe, satisfactory, and technically feasible, than the same procedures performed under GA.

Key Words: Thoracic surgery – Thoracic epidural anesthesia – Video-assisted thoracoscopic surgery.

Introduction

THORACIC surgery is routinely performed under GA, with OLV to assure adequate ventilation and is usually combined with thoracic epidural analgesia. However, GA with OLV may have adverse effects including peri-intubational hypoxia, trauma to the upper airway, mechanical ventilation-induced injuries, impaired cardiac performance, neuromuscular problems, increased risk of pneumonia, and release of proinflammatory mediators [1-3]. Recently, TEA has been used alone without GA in thoracic surgery [4-6]. The results achieved in these early studies have been encouraging. TEA may eventually provide an alternative method to GA for thoracic surgery in selected patients and procedures that would not only eliminate the need for OLV but also facilitate both surgical reconstruction and eventually patient recovery. Multiple studies evaluated the safety of intravenous ketamine/propofol combination for sedation and analgesia and there is evidence that this technique is both safe and effective [7].

The primary end point of this study is to test the hypothesis that thoracotomy could be safely and satisfactorily done in selected cancer patients and procedures solely under TEA with sedation. The secondary aim of this research is to study the cost-effectiveness of awake thoracotomy compared with conventional GA with OLV.

Patients and Methods

This randomized controlled study was conducted at the National Cancer Institute (NCI), Cairo, Egypt, during the period from March 2013 to April 2014. After obtaining approval from the institutional Medical Ethics Committee and obtaining written informed consent, 30 cancer patients were recruited. Inclusion criteria for (VATS), lung or pleural biopsies, solitary pulmonary metastases less than 3cm in the peripheral one-third of the lung by follow-up CT. Age range between 18 and 60 years, ASA score equal to or less than III, the absence of severe emphysema or clinical signs of active infectious disease, and the procedure is predicted to be completed within two hours.

Exclusion criteria were major lung resections, patients with poor cardiac function; with ejection fraction less than 50%, patients with bad PFT, and patients with absolute contraindication to TEA such as patient refusal, allergy to local anesthetics,
coagulopathy, active neurologic disorders, skin infection at insertion site, uncooperative patients, uncontrolled cough, or unfavorable anatomy for thoracic epidural. Preoperatively, patients in the AG group were counseled for awake thoracic surgery under sedation. Details of the procedures with the potential to cause discomfort (e.g., pleura opening) were discussed.

Patients were randomized using a computer-generated random list prepared using Graph Pad Stat Mate® version 1.01i (Graph Pad Software Inc., San Diego, CA) to receive either sole TEA at any level between T4-T6 with sedation (Awake Group [AG], n=15) or to receive GA with OLV and thoracic epidural analgesia (Control Group [CG], n=15). Preoperative radiologic study included chest X-ray and Computed Tomography (CT), Arterial Blood Gases (ABG), Pulmonary Function Tests (PFT) and routine laboratory work were done.

Evaluated variables included the technical feasibility as scored by the surgeon using the following 4-point scale: 1 = unsatisfactory; 2 = satisfactory; 3 = good; 4 = excellent. Patient satisfaction was scored using the same scale after complete recovery.

After application of standard monitoring (pulse oximetry, ECG, and non-invasive arterial pressure), an infusion of 500ml of lactated ringer’s solution was initiated in both groups followed by a continuous infusion of 4-8ml kg⁻¹ h⁻¹ until the end of the surgery. All patients were premedicated with 2-5mg of midazolam and 0.01mg kg⁻¹ atropine intravenously in the holding area, patients in both groups were placed in the lateral position with the operation side down to enhance gravitational distribution of local anesthetics, an epidural catheter was inserted at any level between T4-T6 intervertebral spaces using loss of resistance technique, an epidural catheter was introduced cephalic 6cm, and a test dose of 3ml of 2% lidocaine was given. Additional doses of 5ml of bupivacaine 0.25% and fentanyl were eventually given 1 hour thereafter if necessary. Patients were sedated with low doses of propofol (0.3-0.6mg kg⁻¹ h⁻¹) and ketamine (0.3-0.6mg kg⁻¹ h⁻¹) in a ratio of 1:1.

Level of sedation was assessed using the modified Wilson scale which is as follows:

1 = Oriented, eyes may be closed but can respond; 2 = Drowsy, eyes may be closed, arousable only to command; 3 = Arousable to mild physical stimulation (ear lobe tug); 4 = Unarousable to mild physical stimulation, 9 and patients were kept sedated but responsive (grade1or 2) most of the time. Additional doses of propofol and ketamine combination was given if necessary. Forty % to 50% oxygen was administered through face mask with nebulizer using 2% lidocaine to suppress the cough reflex.

In the Operating Room (OR) the patient was placed in lateral position with the surgical side up. The surgical procedure started when full sensory and motor block were obtained and the patient was sedated and responsive. When the chest wall was opened during thoracotomy or after insertion of the trocar in VATS, spontaneous pneumothorax and lung collapse occurred, if oxygen saturation was less than 90%, suction tube was inserted into the pleural cavity to counteract the pneumothorax and improve oxygen saturation by expanding the nonventilated lung and keeping it expanded until the cause of desaturation could be managed. We used oxygen through ventimask or mask with reservoir bag to deliver 100% oxygen when needed.

All patients of the CG were given GA following thoracic epidural insertion and activation with 10-12ml of bupivacaine 0.25% with 100µg of fentanyl given in a fractionated dose every 5 minutes. After preoxygenation, GA was induced with sodium pentothal 5-7mg kg⁻¹ and fentanyl 1-2µg kg⁻¹, intubation of the trachea with a double-lumen endobronchial tube was facilitated with atracurium 0.6mg kg⁻¹, and position of the tube was confirmed by auscultation and fiberoptic examination. Anesthesia was maintained with isoflurane with 65%-100% oxygen in air, using closed circuit ventilation, and neuromuscular blockade was maintained using atracurium. Patients were placed in the lateral position.

Surgical technique:

In all approaches, the camera port (5 to 10mm) is typically placed low in the chest-7th or 8th intercostal space-and either in the mid or anterior axillary line. A “utility” or “access” incision (3 to 6cm) is usually placed in the anterior axillary line, over the anterior hilum (about 5th intercostal space) in the cases of upper lobectomy, and an interspace or two lower (adjacent to the major fissure) for middle and lower lobectomies.
Third and fourth incisions, commonly 10mm in size, are placed either through the auscultory triangle, high in the mid-axillary line, or low in the chest in the posterior axillary line.

In all cases, no rib spreading is used at any of the incision sites. A soft tissue retractor, either a weitlaner or a commercially available device, is often used at the utility incision. Care must be used at all the incisions to avoid excessive “torquing” of the rigid instruments on the adjacent ribs and intercostal bundles to avoid postoperative neuralgia.

The surgical procedure is facilitated by roughly aligning the view of the camera with the general direction of the dissection.

This is most easily achieved with cameras designed to provide an angled view, either at 30 or 45 degrees from the long axis of the scope. This also allows the surgeon to “see around” the hilum with the camera in a trocar site low in the chest.

Chest tubes and water seal were inserted if needed and removed when no air leak and complete lung re-expansion was confirmed by chest X-ray. Vasopressor was given if blood pressure dropped more than 20% of baseline.

All patients in the control group were extubated in the operating room:

Study design and statistical methods:

The required sample size was calculated using G*Power© software version 3.1.0 (Institut für Experimentelle Psychologie, Heinrich Heine Universität, Düsseldorf, Germany). The primary outcome measure was the difference in the patient satisfaction and the technical feasibility scores in both groups. Since both variables were on an ordinal scale we expected the data to be skewed. Therefore we used the two-tailed Wilcoxon-Mann Whitney test to estimate our sample size. A previous study 4 reported that the median (interquartile range) for the patient satisfaction and technical feasibility scores in the general anesthesia group versus awake group were 3 (3-4) and 4 (3.5-4), respectively. Thus, assuming a two-tailed $\alpha$-error of 0.05, a $P$-error of 0.2, we estimated that a sample size of 15 patients in either group would have a power of 80% to detect an effect size ($d$) of 1.1.

All p-values are two-tailed. $p$-values <0.05 were considered statistically significant. Graphical presentations of data were plotted using Graph Pad Prism© version 5 (Graph Pad Software Inc., San Diego, CA).

Results

Thirty patients were enrolled in this randomized controlled study the flow of the study is depicted in Fig. (1): forty eight patients only fulfilled eligibility criteria of which 37.5% refused awake procedure and randomization. Table (1) shows the demographic and preoperative data of both groups. There were a statistically significant differences between the two groups as regards patient satisfaction and technical feasibility (Table 2).

The total anesthetic costs per case were significantly less in the AG group compared with the CG group [L.E. 213 (19) vs L.E. 709 (25), respectively]. L.E (Egyptian pound).

![Image](image1.png)

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Table (2): Technical feasibility and patient satisfaction scores. Data are presented as median (interquartile range) or number (percentage).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Awake group (n=15)</th>
<th>Control group (n=15)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical feasibility score</td>
<td>4 (3-4)</td>
<td>4 (4-4)</td>
<td>0.2</td>
</tr>
<tr>
<td>Patient satisfaction score</td>
<td>3 (3-4)</td>
<td>3 (3-4)</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Table (3)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Awake group (n=15)</th>
<th>Control group (n=15)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anesthesia cost (L.E.)</td>
<td>213 (19)</td>
<td>709 (25)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Discussion

This was a randomized control study done in awake thoracic surgery at the NCI, Cairo, Egypt. We proved that awake thoracic surgery could be safely performed and was well tolerated in highly selected group of cancer patients. Patient satisfaction and technical feasibility associated with awake thoracotomy was better than GA with less cost.

The results also contradict the concept that lung surgery necessitates one-lung ventilation under GA, and support the previous studies as they proved that awake thoracotomy, and VATS were easily feasible [4,6,15,17-19].

Moreover, the idea that operating on spontaneously breathing tubeless patient might be technically difficult, dangerous or intolerable was reversed by our experience as we noticed that the open pneumothorax created to perform the procedure produced a satisfactory lung collapse which facilitated the surgical maneuvers and was reversed rapidly after closure of chest wall as seen in blood gases and chest X-ray results. These results corroborate and support previous studies in awake thoracic surgery [4,6,12,19].

Conclusion:

From the implemented research it was concluded that awake thoracic surgery in highly selected cancer patients and procedures is safely feasible. It resulted in better patient satisfaction, technical feasibility with less cost than the same procedures performed under GA. Such innovation with excellent patient acceptance and the lowest cost for our institute may lead to a new standard for ambulatory thoracic surgery and play future role for protocols in oncologic surgery.

Limitation:

The inclusion criteria are the main limitation of our study. We assess feasibility and outcome in highly selected cancer patients and procedures as this was the first study done in awake thoracic surgery at the NCI Egypt. Therefore, we recommended larger studies recruiting larger numbers of patients and procedures in high risk patients to determine the validity of our findings.

References


الملخص العربي

هذه دراسة مقارنة اشتملت على 20 مريض بورام الصدر وذلك بعد موافقة كتابية مشروحة لكل الحالات. العلاج الجراحي هو الخضوع لمنظر الصدر تم تقسيم الحالات إلى 15 حالة لكل مجموعة المجموعة الأولى مجموعة التخدير فوق الام الجافة الصدرى والمجموعة الثانية مجموعة التخدير الكلى وتم قياس مدى إرياضة المريض بالتقنية ومدى مساحة التقنية بصورة عامة والتي اتضح من خلال عمل الجراح بسلامة وقد أثبتت الدراسة أن المجموعة الأولى مجموعة التخدير فوق الام الجافة الصدرى كانت تتمتع برضاء المرضى أكثر من والمجموعة الثانية مجموعة التخدير الكلى.