Comparison of Outcomes between Intubated and Non-intubated Video-assisted Thoracoscopic Wedge Resections Applied in the Same Patient

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In video-assisted thoracoscopic surgery (VATS), general anesthesia with endotracheal intubation was considered an optimal method of anesthesia for a long time. However, complications due to general anesthesia and one-lung ventilation have become a problem. In recent years, epidural anesthesia without endotracheal intubation has been attempted in various thoracic surgical procedures with various advantages and disadvantages reported. We compared postoperative pain and prognosis when different anesthesia methods were used in a patient who underwent the same operation twice in the interval of one year. When non-intubated video-assisted thoracoscopic surgery (NIVATS) underwent under epidural anesthesia, postoperative pain score was lower, adverse events were fewer, and the hospital stay was shorter than that of VATS. The patient also expressed high subjective satisfaction. Like previous studies, the results favored NIVATS under epidural anesthesia. However, greater attention and proficiency are required from the anesthesiologist for proper analgesia and sedation.

Keywords: Epidural anesthesia, Intubation, Non-intubated thoracoscopic surgery, Video assisted thoracoscopic surgery

Introduction

Since the double-lumen endotracheal tube was introduced, one lung ventilation after general anesthesia has been a common anesthesia method for video-assisted thoracoscopic surgery (VATS) [1]. However, general anesthesia with double-lumen endotracheal intubation may cause side effects such as upper airway mechanical damage due to double-lumen endotracheal intubation, damage due to high airway pressure,
damage due to overexpansion of lungs, secretion of various inflammatory mediators, and postoperative nausea and vomiting [2-5]. Deep anesthesia in thoracic surgery also increases morbidity, mortality, and rate of postoperative cognitive impairment [6].

Many studies have been conducted on non-intubated video-assisted thoracoscopic surgery (NIVATS) to reduce the side effects of general anesthesia with endotracheal intubation, and recent studies proved that NIVATS can be performed for pleural biopsy, wedge resection, pleural dermatomy, and lobectomy [7]. In addition, compared to VATS, many benefits of NIVATS have been reported, including a shorter hospitalization time, lower medical costs, and reduced surgery and anesthesia time [8,9]. But the difference in mortality rates between VATS under general anesthesia and NIVATS has not yet been described [10,11].

In a patient who visited our hospital due to recurrent pneumothorax at intervals of one year, we conducted VATS under general anesthesia at first and NIVATS under epidural anesthesia secondly. Next, we compared the operation time, duration of hospital stay, postoperative pain and complications, and patient satisfaction, when the same surgeon performed the same wedge resection in the same patient under different anesthesia methods. Here, we describe this case with the patient's consent.

**Case Report**

In April 2017, a 16-year-old male patient (height 184 cm, weight 61.1 kg) without an underlying disease was transferred to our hospital after the diagnosis of pneumothorax in a private clinic due to sudden respiratory distress. He didn't have abnormal findings in preoperative hematologic tests, urinalysis, and electrocardiography (ECG). We performed wedge resection under general anesthesia as we found right pneumothorax in the chest X-ray image (Fig. 1) and right upper lobe bullae in the chest CT. We did not use pre-anesthetic agents and monitored the patient with an ECG, non-invasive blood pressure monitor, and pulse oximeter in the operating room.

The vital signs measured before anesthesia were as follows: blood pressure of 140/80 mmHg, heart rate of 70 beats/min, pulse saturation of 99%, and no specific finding on ECG. After sufficient pre-oxygenation, we injected 80 mg of lidocaine and 160 mg of 2% propofol intravenously, and 50 mg of rocuronium for muscle relaxation after confirming loss of consciousness. We performed bag valve mask ventilation with 100% oxygen and 6% sevoflurane and intubated a 37 French double-lumen endotracheal tube after confirming that the muscle was fully relaxed. We fixed the endotracheal tube after checking its position with a flexible bronchoscope.
Anesthesia was maintained between a bispectral index of 40–60 by using 1–2% sevoflurane and remifentanil at 0.05–0.15 μg/kg/min. For one-lung ventilation, we set the tidal volume to 4–5 mL/kg and end-tidal positive pressure to 0–5 cmH₂O. After the operation, we injected 0.4 mg of glycopyrrolate and 15 mg of pizostigmine. We extubated the endotracheal tube after confirming full recovery of muscle relaxation and the patient was transferred to the recovery room. The total operation time was 50 minutes and the total anesthesia time was 70 minutes (Table 1). In the recovery room, we administered 10 mg of Macperan (metoclopramide) due to nausea. The patient measured 5 points in terms of pain on the numerical rating score (NRS), so remifentanil was increased from 0.01 μg/kg/min to 0.03 μg/kg/min. Thereafter, pain was reduced to 2 points and the patient left the recovery room after remifentanil removal. We applied postoperative intravenous pain controlled analgesia (PCA) (2000 μg fentanyl and 0.6 mg ramosetrone hydrochloride in 100 mL saline) but stopped due to severe nausea. We then controlled postoperation pain by oral administration of a compound pain killer (250 mg acetaminophen, 200 mg ibuprofen, and 10 mg of codeine phosphate hydrate). The patient complained of sore throat and left armpit pain along with surgical site pain, so we administered 5 mg of dexamethasone (Table 1). The patient was discharged 4th day after surgery without any complication. In order to control the pain after discharge, we prescribed in combination of 325 mg acetaminophen and 37.5 mg tramadol hydrochloride.

The patient revisited the emergency room in June 2018, about a year later, with shortness of breath and chest pain. Chest X-ray and CT scans in the emergency room revealed state of right upper lobe wedge resection, newly developed left pneumothorax, and multiple bullae in the left lung (Fig. 2). We performed NIVATS under epidural anesthesia in order to reduce nausea and sore throat caused by general anesthesia. There were no abnormal findings in the preoperative examinations.

Table 1. Comparison of intra and post-operative outcomes between VATS and NIVATS

<table>
<thead>
<tr>
<th></th>
<th>VATS</th>
<th>NIVATS</th>
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</thead>
<tbody>
<tr>
<td>Anesthetic method</td>
<td>General anesthesia</td>
<td>Epidural anesthesia</td>
</tr>
<tr>
<td>Total operation time (min)</td>
<td>50</td>
<td>30</td>
</tr>
<tr>
<td>Total anesthesia time (min)</td>
<td>70</td>
<td>90</td>
</tr>
<tr>
<td>Post-operative pain control method</td>
<td>Compound pain killer</td>
<td>Epidural PCA</td>
</tr>
<tr>
<td>Post-operative pain score (NRS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At arriving the recovery room</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>At leaving the recovery room</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>POD 1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>POD 2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>At discharge</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Hospitalization period after surgery (day)</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Complications</td>
<td>Nausea</td>
<td>Sore throat</td>
</tr>
<tr>
<td></td>
<td>Armpit pain</td>
<td>None</td>
</tr>
</tbody>
</table>

no drug administration before anesthesia, and patient monitoring in the operating room was applied as it was a year prior. The vital signs measured before anesthesia were as follows: blood pressure of 140/90 mmHg, heart rate of 65 beats/min, and pulse saturation of 100%. We provided pure oxygen via an oxygen mask. We inserted the epidural catheter at the T7-8 levels after the patient took the lateral decubitus position and infused with 20 mL of 0.2% ropivacaine. The level of epidural anesthesia was fixed at the T2 level, and dexmedetomidine was injected at 5 μg/kg/hr for 10 minutes for sedation, followed by applying a maintenance dose of 0.7 μg/kg/hr. Surgical operation was started after 1% lidocaine was infiltrated into the subcutaneous tissue and the pleura before incision. The patient maintained spontaneous breathing during surgery and did not complain of any pain or discomfort. The operation time was 30 minutes, the total anesthesia time was 90 minutes, and the NRS in the recovery room was 2 points. The epidural PCA (1,500 mg fentanyl, 0.18% ropivacaine, total volume 150 mL) was connected to the epidural catheter that was inserted preoperatively without special side effects. Eight hours after surgery, the pain score was marked as 2 points and decreased to 1 point a day after the operation (Table 1).

The patient rarely complained of pain so we discontinued oral compound analgesics (250 mg acetaminophen, 200 mg ibuprofen, 10 mg codeine phosphate hydrate in combination) and epidural PCA 2 days after the operation. The patient expressed subjective satisfaction that "this operation is less painful and more comfortable than before". He was discharged 3 days after surgery without any complications. To control pain after discharge, we prescribed 325 mg acetaminophen and 37.5 mg tramadol hydrochloride combination, and the NRS measured 0 points on the first outpatient visit 13th day after surgery.

Discussion

Recently, VATS is widely used as a substitute for thoracotomy that is less invasive and lower surgical stress [12]. In the past, general anesthesia with endotracheal intubation was a common anesthetic method for VATS, NIVATS, however, has recently been used as it is less invasive and has less complications than VATS, and is used widely due to advances in thoracic anesthesia techniques [13]. Compared with classical VATS, NIVATS has the advantages of shorter anesthesia time, postoperative pain reduction, faster recovery, and a shorter hospital stay [8]. It also minimizes side effects such as tracheal intubation damage and mechanical ventilation-induced lung damage [3-5]. However, NIVATS
VATS versus NIVATS in the same patient

requires adequate analgesia and sedation to prevent coughing and movement of the patient, which is important for maintaining adequate airway and spontaneous respiration [14]. Because of this, NIVATS was initially applied to relatively simple thoracic surgeries in low-risk patients. It has now been attempted in high-risk patients and major surgeries such as lung cancer resection, based on the safety reported in many case reports and studies [13,15].

An important point in anesthesia for NIVATS is to maintain stable spontaneous breathing, to minimize pain from irritation of the lateral and visceral pleura, and to secure a sufficient field of vision [13]. Epidural anesthesia, local anesthetic infiltration, an intercostal nerve block, or a thoracic spinal nerve block may be used to minimize patient movement due to pain and to maintain a constant breathing cycle and pattern during surgery. Proper sedation can also reduce mental discomfort caused by tension and stress during surgery. However, in the case of using propofol or midazolam, tracheal intubation may be necessary due to excessive sedation or respiratory depression. Therefore, the use of dexmedetomidine, which is less associated with respiratory depression, may be considered. Dexmedetomidine has a high selectivity for the α2-adrenergic receptor and is a sedative agent that can be cooperatively administered without respiratory depression. In NIVATS, maintaining stable spontaneous breathing during surgery is important to ensure surgical field of vision, and so dexmedetomidine is particularly useful for sedation in NIVATS.

Many studies have already shown the advantages of NIVATS compared to conventional VATS. However, this case is significant in that the patient’s satisfaction, postoperative pain, length of stay and prognosis were compared in the same patient who underwent the same surgery by the same surgeon. Consequently, this case showed that NIVATS had shorter surgical time, shorter hospital stay, and lower postoperative pain rating than VATS. Because of severe nausea after general anesthesia, the patient could not use the intravenous PCA. However, after NIVATS, the epidural PCA effectively controlled pain without severe side effects. Also, due to the shortening of the operation time, the postoperative pain itself was low, and the epidural PCA and oral analgesic could be stopped early. However, this may be an advantage of epidural PCA and not necessarily an advantage of NIVATS. In simple surgeries such as wedge resection, the insertion of an epidural catheter after general anesthesia may have greater loss than gain, so intravenous PCA is generally used for pain control. However, as epidural anesthesia is common in NIVATS, we see it as an advantage of NIVATS. The patient complained of sore throat and axillary pain in addition to the surgical site after VATS under general anesthesia. However, NIVATS did not have such side effects and the patient’s subjective satisfaction was higher.

However, the process of inserting and confirming the thoracic epidural catheter took more time than general anesthesia. Therefore, efforts are needed to shorten the procedure time and increase the success rate.

References