Case Report

Non-intubated Uniportal Video-Assisted Thoracoscopic Surgery (NIVATS): First Case Report in Thailand

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The authors reported the first patient who underwent non-intubated video assisted thoracic surgery (NIVATS) in Thailand. She was 66 years old when she had primary treatment for lung cancer 1 year ago. Left upper lung lobectomy and systematic lymph node dissection were performed without any adjuvant therapy. She was doing well until 1 year later when a new pulmonary nodule at right lower lung lobe (RLL) was incidentally found during her follow-up computed tomographic imaging (CT scan) of chest including upper abdomen. The imaging showed an 8-mm sub-solid nodule without any bony involvement, adrenal metastasis nor regional lymphadenopathy. Curative uniportal NIVATS wedge resection of RLL was performed after pre-operative CT-guided localization of the nodule using isosulfan blue. The operation was performed under intravenous anesthetic drug and nasal high flow oxygen without endotracheal intubation. The total operative time was 60 minutes: 25 mins for anesthetic induction process and 35 mins for actual operation. No Foley catheter nor intercostal drainage tube were inserted. Blood loss was negligible without any peri-operative complications. The patients was discharged 2 days after surgery and was doing well 2 months after surgery.

Keywords: Non intubated thoracoscopic lung surgery, Lung cancer, Surgery

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A conventional thoracoscopic procedures requires general anesthesia (GA) with mechanical one-lung ventilation through a double-lumen endotracheal tube or bronchial blocker[1,2]. The process of GA is time-consuming with approximately 45 mins to 1 hour before the operation could be started. Furthermore, there are several complications of GA, such as, intubation-related especially by double-lumen tube, transient hypoxemia as well as cardiac arrhythmia, cognitive deterioration, ventilator-associated lung injury, residual neuromuscular blockade, and etc[3-8].

With emerging technology of imaging study and advance in operative technique in recent years, a non-intubated video assisted thoracic surgery (NIVATS) has been introduced and advocated to be an alternative to the conventional intubated video-assisted thoracoscopic surgery (VATS)[9]. It can reduce the shortcomings and aforementioned side effects related to GA. However, NIVATS will induce an iatrogenic open pneumothorax which causes physiologic derangement of pulmonary and cardiovascular systems. These are the challenges to an anesthesiologist to monitor and manage its consequences. The authors reported the first patient who had successful NIVATS in Thailand.

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Case Report

A 66-year old non-smoking Thai female underwent left upper lung lobectomy for a 1.8-cm lung cancer and systematic lymph node dissection through an open thoracotomy procedure. The diagnosis was adenocarcinoma with acinar subtype which had no lymph node involvement (pT1bN0M0). No adjuvant therapy was given.

She was asymptomatic until 1 year after primary treatment when a new 8 mm sub-solid nodule was incidentally found at superior segment of right lower lung (RLL) from computerized tomogram (CT scan) of chest including upper abdomen. No evidences of bony or adrenal or lymphadenopathy were demonstrated. From CT imaging (Figure 1), metachronous lung cancer was highly suspicious. Her pre-operative pulmonary function test results showed minimal obstructive lung defect, with force expiratory volume in 1 minute of 1.56 L (99%) and force volume capacity of 1.94 L (102%). Curative resection was planned after informed consent with the patient and her family. She was scheduled for uniportal NIVATS with RLL nodule wedge resection using dye localization. The CT guided nodule localization using isosulfan blue (Figure 2) was immediately performed before transfer to operative room.

For anesthetic induction, glycopyrrolate was given to reduce saliva and airway secretion. Target controlled infusion of propofol was used for sedation keeping bispectal index (BIS score) of 40 to 50 during operation. High flow oxygen at flow rate of 10 to 30 L/min (FiO2 0.6 to 1) was maintained through nasal cannula. Intra-operative pain control was achieved with intercostal nerve block by using 0.5%

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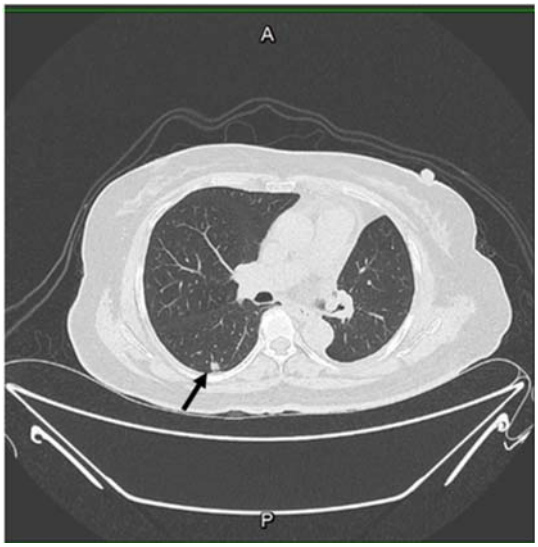

Figure 1. CT scan showed a 8-mm sub-solid nodule at superior segment of right lower lung (black arrow).

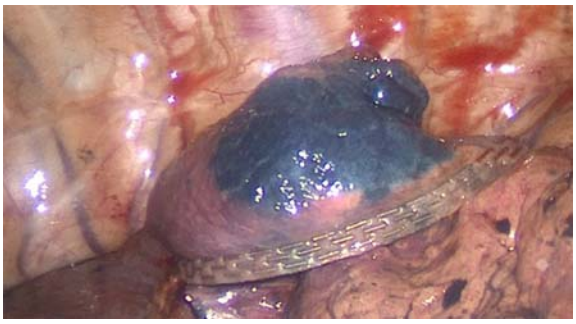

Figure 2. The figure showed lung area after isosulfan dye injection to localize the tumor nodule.

bupivacaine solution and intermittent dose of intravenous fentanyl. During the operation, the electrocardiography, pulse oximeter, arterial blood pressure, end-tidal capnography and BIS score were closely monitored. Of note, the patient was asked to void at ward without Foley catheter insertion.

For operative technique, a 2-cm skin incision was made between anterior and mid axillary lines over the fifth right intercostal space for a uniportal video-assisted thoracoscopic surgery (VATs). After entering pleural cavity, ipsilateral lung was gradually collapsed from iatrogenic pneumothorax. A 5-mm, 30-degree thoracoscope, endo-grasper and -stapler were then introduced into pleural cavity through the skin incision (Figure 3). Local anesthesia was given for pain control via nerve block over from 3rd to 8th intercostal spaces. Vagal nerve block also performed to inhibit cough reflex during the operation. Wedge resection of the nodule (Figure 4) was carried out using articulating endo-

Figure 3. This figure demonstrated uniportal skin incision. All instruments were inserted through this port.

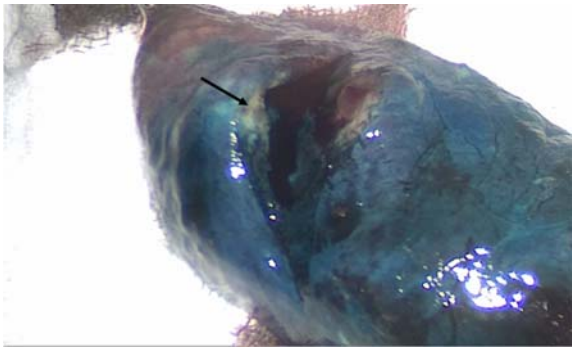

Figure 4. Partially cut section of right lower lung revealed an ill-defined 8 -mm tumor nodule (black arrow) which was totally resected with free margin.

stapler.

The peak PaCO2 (single-lung breathing) during the operation was 47 mmHg and returned to normal after wound closure. Oxygen saturation was maintained 95% to 98% by nasal high flow oxygen therapy. No thoracostomy tube was inserted postoperation. The total operative time was 60 minutes: 25 minutes for anesthetic induction process and 35 minutes for actual operation. Minimal blood loss was noted without any intra-and peri-operative complications.

Post-operative course of the patient was uneventful. Only oral analgesic drugs included acetaminophen, ibuprofen and gabapentin were given resulting in post-operative pain scores of only 1 to 2. She was discharged 2 days later. Post-operative chest x-ray at 2 weeks postoperation showed fully expanded lung without evidence of pneumothorax. The pathology report of the mass revealed minimally invasive adenocarcinoma with free resected margin.

Discussion

NIVATS refers to the thoracic operation that is

performed without tracheal intubation and mechanical ventilation; the patient had spontaneous breathing during the operation[10]. The principle of NIVATS is to create an artificial pneumothorax, compressing the target lung and providing space for the operative procedure.

The advantages of NIVATS have been described in many perspectives, such as, avoiding the adverse effects of tracheal intubation, mechanical ventilation and the use of muscle relaxants without negative impact on survival[9-11]. Several reports were described the outcome of NIVATS in lung surgery[10,12-15]. Tacconi and his colleague reported a meta-analysis comparing between NIVATS and VATS in lung surgery. They demonstrated the overall conversion rate of GA was 2.4%. Most common causes of conversion were severe adhesions, major bleeding, and excessive mediastinal movement. NIVATS could reduce postoperative complication especially in cardiopulmonary complication (6.7% vs. 16.7%; $p = 0.004$). The mean difference in hospital stay were also lower in NIVATS groups (-0.53 days; 95% CI; -0.74/-0.32; $p<0.001$). Despite peri-operative outcome, there was no effect in long-term outcome neither in both overall survival nor cancer specific survival rates for lung cancer patients[10].

This patient had NIVATS with successful outcomes in terms of: with no conversion to endotracheal intubation, complete resection, minimal blood loss and short hospital stay.

Aside from systemic analgesia, loco-regional drug administration also plays an important role to decrease opioids usage and better pain control. These include intercostal nerve block, paravertebral nerve block, thoracic epidural block or intrapleural analgesia[14]. Another issue that should be concerned during operation is to prevent cough triggered by surgical manipulation. Intrathoracic vagal or ipsilateral stellate ganglion block, and remifentanil infusion were reported to be useful in cough reflex reduction[11]. In this patient, control of cough reflex could be achieved with only vagal nerve block. Remifentanil was not given due to commercially unavailable in our country.

Nevertheless, a few minor drawbacks, which had been reported, were hypoxia, hypercapnia, inadequate analgesia and aspiration[10,14]. Adequate oxygenation during NIVATS could be maintained through face mask, laryngeal mask airway or high flow nasal cannula. The authors monitored end-tidal capnography to avoid hypercapnia and checked arterial blood sampling throughout the procedure.

One key to the success of NIVATS is good co-operation between surgeon and anesthesiologist. This should be initiated from pre-operative planning and throughout the operative procedure. Other keys of success in NIVATS are both patients and surgeons. Non-obese individuals with good performance status including adequate cardiopulmonary reserve are considered as good candidate for NIVATS[14]. On the other hand, a surgeon should recognize the physiologic impact of the procedure, be aware of limitations, possible complications and management in order to have an optimal outcome of surgery.

In conclusion, we reported on a patient who had NIVATS for lung cancer. Adequate sedation with spontaneous breathing along with loco-regional analgesia are contributing factors for a successful surgical outcome.

What is already known on this topic?

Video assisted thoracoscopic surgery (VATS) could be performed under spontaneous ventilation without tracheal intubation. The principle of non-intubation VATS surgery (NIVATS) is adequate sedation with effective analgesia. Despite its benefit, the procedure has been infrequently practiced in Thailand.

What this study adds?

This is the first case report of tubeless NIVATS in Thailand. An appropriate selection of a patient as well as his/her disease, experience of the surgeon as well as multidisciplinary team work are required for a successful outcomes.

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Potential conflicts of interest

The authors declare no conflict of interest.

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