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Video-assisted thoracic surgery micro pneumonectomy, a new approach

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Background: Video-assisted thoracic surgery (VATS) pneumonectomy is normally limited due to the difficulty to remove the whole lung via the utility incision. We present our technique of VATS pneumonectomy, this we call micropneumonectomy.

Methods: A 75-year-old male current smoker with a right hilar mass, invading both upper and lower lobe bronchi to segmental level on CT scan and PET scan, pathology from CT guided biopsy showed squamous cell carcinoma. The patient had a mediastinoscopy just prior to pneumonectomy, primarily to remove station 7 lymph nodes and to mobilize the carina to facilitate the VATS pneumonectomy.

Results: Smooth postoperative course, and patient was fit for discharge two and half days post operatively.

Conclusions: Our technique showed an effective way of doing pneumonectomy via VATS technique, which expands the use of VATS technique into pneumonectomies, with three intercostals incisions smaller than 5 mm, in addition to a single sub-xiphoid incision which can take 12 mm instruments.

Keywords: Video-assisted thoracic surgery (VATS); minimally invasive; micro lobectomy; micro-pneumonectomy

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Introduction

Pneumonectomy probably has the highest mortality and morbidity amongst lung resections (1). The assumed benefits from video-assisted thoracic surgery (VATS) over open technique includes: shorter hospital stay, less post operative pain, cosmesis, less blood loss, earlier resumption of daily activities, better tolerance to post-operative Chemotherapy (2-5). VATS pneumonectomy is limited due to difficulty to remove the whole lung via the utility incision. Our technique demonstrates an effective way of performing pneumonectomy through the micro incisions technique, with a subxiphoid utility incision. Current experience showed that VATS can be considered as a safe alternative for pneumonectomies (6). Pain is one of the most common problems post thoracotomies, preventing early mobilization and deep breathing. This is mainly due to the compression injury to the intercostal nerves from the port site during the operation; therefore it is not uncommon in the standard VATS technique. In our technique, using a 5 mm port in the intercostal space eliminates this problem.

In this video we present a case of a 75-year-old smoker with a right hilar mass (proven squamous cell carcinoma on the CT guided biopsy) invading both upper and lower lobe bronchi to segmental level on CT and PET scan.

Patient selection and workup

Patient selection for micropneumonectomy is the same as typical pneumonectomy i.e., patients with tumor involving more than one lobar bronchus, not amenable to sleeve

Figure 1 Micropneumonectomy (pneumonectomy using the video-assisted thoracic surgery microlobectomy technique) (7). Available online: http://www.asvide.com/articles/973

resection either from preoperative scans, or intraoperatively after video inspection.

Resectability of the tumor could be assessed by performing CT scan of the chest. CT guided biopsy or endobronchial ultrasound biopsy is helpful in providing pre-operative histology. Distant metastasis should be ruled out via PET scan and CT head.

Fitness for surgery could be assessed by lung function test and CPEX, as well as routine bloods (FBC, U&E, and coagulation profile). Echocardiogram is done to exclude pulmonary hypertension.

Pre-operative preparation

Following the above, all patients should have pre-operative blood test and baseline Chest X-ray. Cervical mediastinoscopy to sample and remove station 7 lymph nodes is key in micropneumonectomy in order to free up the carina. Surgicel could also be left to facilitate hemostasis. Cervical mediastinoscopy should be done immediately prior to the pneumonectomy, in the same sitting.

Equipment preference card

- CO_2 insufflation is helpful in pushing the diaphragm downwards hence giving plenty of room for maneuvering during the operation;
- Standard staplers and VATS instruments are used via the subxiphoid incision;
- Microcutter stapler, endodissector and a wide range of 5 mm VATS instruments including camera are used for the 5 mm ports.

Procedures

We start our micropneumonectomy by performing video assisted cervical mediastinoscopy with the patient lying supine. We remove all of the station 7 lymph node in order to completely free the subcarinal angle, which will facilitate mobilisation during pneumonectomy afterwards. We opt to leave surgicel behind for hemostasis.

Once the cervical mediastinoscopy is completed, we de-scrub and re-position the patient onto lateral decubitus position. Micropneumonectomy utilizes the anterior approach and therefore both the surgeon and his/her assistant will be standing in front of the patient, facing towards the patient.

The first port inserted is a 5 mm port at the anterior axillary line. This port is inserted into the chest with the camera positioned inside the port throughout the process and CO_2 attached to the port at the same time in order to push the lung away from the port as soon as it enters the chest, thereby preventing any lung injury. The CO_2 is kept running at 5–7 mmHg throughout the operation. This is vital to provide extra room for maneuvering (*Figure 1*).

The next port is the subxiphoid utility incision under direct vision of the camera. 15 mm vertical skin incision is made at the subxiphoid area followed by blunt finger dissection of the pleura and into the chest. A 12 mm port is then inserted into this subxiphoid incision. Another two 5 mm ports are placed in the intercostal spaces under direct vision. Note that the three 5 mm ports are placed in a conventional triangle fashion.

We start the operation by examining and confirming the tumor. Dissection of the inferior pulmonary ligament is then carried out to mobilize the lung. A fan retractor is used to retract the lung forward whilst dissecting and freeing up the hilum posteriorly. The hilum is then freed up at the inferior pulmonary vein and anteriorly using diathermy hook. Superior pulmonary vein is then dissected and we have opted to go intrapericadium in order to achieve a better margin. Using a standard vascular stapler from the subxiphoid port, the superior pulmonary vein is then divided. Following that the inferior pulmonary vein is dissected and divided using a vascular stapler via the subxiphoid port. We then continue to dissect the pericardium a little more before going around the main pulmonary artery. A vascular sling is then passed around the main pulmonary artery before dividing it with a vascular stapler. The pericardium is then dissected a little more before approaching the right main bronchus in order

to be able to divide it flush. Having done the cervical mediastinoscopy and station seven dissection immediately prior to this operation, the carina and the right main bronchus have mainly been freed from the surrounding tissues and therefore saving time and effort at this stage. The right main bronchus is divided using a Covidien purple 45 mm Endo-GIA (12 mm port) stapler flush at the carina. Avoid leaving a long bronchial stump in order to prevent breakdown of the stump.

The lung is placed in an endobag prior to removal from the chest to prevent seeding of tumours at the port site (8). At this stage we then extend the subxiphoid skin incision by a few centimeters prior to retrieving the endobag from the subxiphoid port.

Lymph node dissection of the remaining station 4R and 3 is done at the end of procedure. Hemostasis is then done in the usual manner. Intercostal injections are done under vision and a chest drain is inserted via the subxiphoid port prior to closure in layers.

Written informed consent was obtained from the patient for publication of this article. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Role of team members

All lung cancer patients are discussed in the Lung cancer multi-disciplinary team (MDT) meeting to reach a consensus about the best modality of treatment to be offered to each patient. Selected surgical patients are then reviewed in the outpatient clinic by thoracic surgeons and treatment options are discussed in details. Pre-operative assessment is run by the thoracic specialist nurses in parallel, for general examination of the patients and to ensure that all relevant investigations i.e., blood tests, CT scan, PET scan, etc. are in place and up to date.

On admission the patient and all investigations are reviewed again by the thoracic team. Our policy is to have the CT scan within six weeks of surgery date, this is to ensure that the tumor has not either spread or become inoperable.

Patients are seen by the anaesthetist on admission, to ensure they are fit for surgery and to ascertain whether special requirement is needed for intubation i.e., previous head and neck surgery.

Immediately prior to the operation the anaesthetist inserts arterial and central venous line. Double lumen endotracheal tube is used for intubation to achieve single lung ventilation for the pneumonectomy. Intra-operative monitoring of the patient is achieved through ECG, arterial line pressure monitoring, end tidal CO_2 level and pulse oximetry.

It is crucial that the surgeon is present in the anesthetic room during the intubation and positioning of the patient to ensure that satisfactory single lung ventilation could be achieved and the patient is positioned correctly for the operation.

The anaesthetist checks that the patient is pain free in the immediate post operative period, in the recovery room and the high dependency unit (HDU). For VATS micro pneumonectomy we ensure our patients receive IV PCA (patient controlled analgesia)

To rule out any immediate post-operative complications, all patients will have a post-op Chest X-ray which is checked by the surgical registrars. Daily review of the patient, pain score, chest drain and Chest X-ray is carried out by a team of specialist nurses and surgical registrar and the operating surgeon.

Physiotherapist plays a crucial role in the post-operative management to ensure early mobility and prevent respiratory complications. Deep breathing techniques and incentive spirometry are provided by the physiotherapists to patients.

After discharge from the hospital, patients are reviewed in the outpatient clinic by either the surgeon or specialist nurse after 6 weeks, where they have a Chest X-ray, surgical wounds are checked, post-operative histology and staging and result of the MDT discussion of the pathological staging (whether a chemotherapy/radiotherapy is required) is then delivered to the patient.

Post-operative management

Routine post-pneumonectomy management with 20 Fr intercostal drains attached to under water seal. The drain is clamped for 58 minutes and unclamped for 2 minutes every hour. Post-operative Chest X-ray is done to ensure there is no early complication. The patient is placed on fluid restriction (1.5 litres per 24 hrs) to prevent pulmonary edema. In this case we removed the chest drain on day 1 post-operative day. Intravenous patient controlled analgesia was used immediately post-op and converted to oral analgesia once the drain is removed. Early mobilization and adequate analgesia is key in the post-operative management of lung resection.

Tips, tricks and pitfalls

- Cervical mediastinoscopy should be done in the same sitting as the micropneumonectomy;

- It is essential to remove all of station 7 during the mediastinoscopy to free up the right main bronchus and subcarinal space as much as possible;
- The use of CO_2 insufflation during the insertion of the first port will help to push the lung away as soon as the chest cavity is entered thereby avoiding any lung injury from the sharp end of the port;
- Maintain the CO_2 at a rate of 5–7 mmHg throughout the operation—this will give more room for maneuvering your instruments and the lung during the operation. CO_2 could also be switched on and off intermittently during the case should the blood pressure be compromised at any stage;
- The use of appropriate 5 mm instruments that fits through the 5 mm ports are essential for freedom of movement and to avoid fencing of instruments;
- When entering the chest during the subxiphoid port insertion, use finger for blunt dissection first to enter the pleura instead of the port as to avoid any injury to the liver should you come below the diaphragm;
- Closure of the subxiphoid incision should be done meticulously and in layers, ensuring that the linea alba is approximated completely as to avoid hernia post-operatively.

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None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Informed Consent: Written informed consent was obtained from the patient for publication. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

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