Surgical Technique

Subxiphoid robotic-assisted right pneumonectomy

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Clinical vignette

A 70-year-old lady, an ex-smoker, was referred with a 3-month history of a non-productive cough. Her past medical history included hypertension, type II diabetes mellitus and marginal zone lymphoma of the skin in 2015. The computed tomography (CT) thorax reported a nodule posterior to the right bronchus intermedius measuring 28 mm with prominent sub carinal lymph nodes. Positron emission tomography (PET) scan showed the nodule to be FDG avid with no other sites of local or distant disease identified. Her lung function tests were satisfactory. The biopsy of the right peribronchial lymph node taken via endobronchial ultrasound (EBUS) showed no carcinoma but low-grade lymphoma was not excluded.

Surgical technique

Preparation

The patient underwent a flexible bronchoscopy 1 week prior to surgery which showed a large tumour eroding through the back of the right main bronchus, just next to the right upper lobe take off. A biopsy was taken which revealed squamous cell carcinoma. Preoperative mediastinoscopy was not performed to avoid the formation of adhesions. Perioperative bronchoscopy showed that the right upper lobe bronchus was clear of tumour. Based on the available information, the plan was to attempt a sleeve resection, which if failing the surgical team would then proceed with a right pneumonectomy with also the thought of possible abandonment of resection depending on the extension of the tumour.

Exposure/port placement

The patient was intubated with the VivaSight DL, a double lumen endotracheal (ET) tube which contains a camera at the distal end. The patient was placed in the left lateral decubitus position. The da Vinci robotic system (Intuitive Surgical, mountain view, CA, USA) (*Figure 1*).

Four-arm robot was draped and docked from the side of the patient's head. A 4-armed, 5-port approach was used. Four intercostal ports were created above the ninth rib using the Cerfolio's technique (2). The subxiphoid port (utility port) was created in the midline, 5 cm caudally from the xiphisternum. The first port was made 2 cm away from the midline, the second port was made another 10 cm away, and the third port (12 mm camera port) was created a further 10 cm away. The fourth and fifth (subxiphoid) ports were created under camera guidance. The subxiphoid port was created with a midline incision immediately below the xiphoid process. As such, the subxiphoid port remains under direct vision and entry/exit of the instruments/specimens by the assistant can be easily visualized and supervised (3).

Operation

A full fissure was observed. The right inferior pulmonary ligament was stripped off carefully and station R9 was sampled. The pulmonary artery was exposed and station R11 lymphadenectomy was carried out. As it was a proximal tumour, we dissected as close to the oesophagus as possible to fully mobilize the oesophagus off the back of the tumor and the bronchus. We exposed much of the trachea, the right main bronchus and the left main bronchus.

We then dissected the pleura off the oesophagus up

Figure 1 A subxiphoid robotic-assisted right pneumonectomy (1). This case was set up as a robotic sleeve resection but due to the extension of the tumour, it was converted to a robotic pneumonectomy. This shows that the strategy of the operation could be changed even to a pneumonectomy without the need to convert to open if the anatomy allows during the robotic approach.
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to the azygous vein. The dissection around the azygous vein was carried out to fully mobilize the oesophagus and expose the trachea and get access to the R2/R4 lymph node complex as well as the R10 lymph node.

The azygous was transected to get a good view of the trachea. It is ideal to make the stump on the superior vena cava (SVC) side as short as possible to avoid it getting in the way of your dissection and to leave the other end of the stump long enough so that it can be used to wrap around the bronchial stump. For the division of vascular branches, we use the Tri-stapler 2/0 curved tip intelligent reload and introducer stapler with the plastic strip (introducer) which allows us to direct the jaws of the stapler well. The right upper lobe branch of pulmonary artery was divided and then the right inferior pulmonary vein by using a tan 45 gold tip stapler. Next, we divided the anterior oblique fissure followed by the middle lobe vein, bronchus and artery.

When attempting to get around the pulmonary artery, we noted that the posterior segmental vein of the upper lobe was infiltrated by the tumour. Since the bronchus intermedius and the middle lobe bronchus were also infiltrated by the tumor, the sleeve resection was abandoned and the decision was made to proceed with a pneumonectomy. The right main pulmonary artery was divided. As the surgical margin of the right main bronchus was adequate, a carinal pneumonectomy was not required.

We sent the bronchial margin for frozen section which came back as free of tumour but with a very narrow tumour free margin. The specimen was put in a retrieval bag and the stump of the pulmonary artery was divided and allowed about 300–400 mL of blood to flow out into the bag to decompress the specimen to enable us to remove it via the subxiphoid port.

The bronchial stump was sutured with 4.0 V-lock sutures in 2 layers. We advise to avoid holding the stitch with the needle driver as it will fracture the suture and use Cadiere forceps instead. By using the VivaSight ET tube, we were able to visualize the stump from the inside during the suturing process. The stump can be wrapped using the azygous vein, pericardium, and thymic fat. However, we do not recommend using an intercostal strip to cover the stump in robotic cases. In our case, we did not cover the stump as there was no neo adjuvant chemotherapy given.

Closure

Air tightness of the stump was ensured by the water test at 30 cmH_2O pressure. No chest drains were left. Our practice is to withdraw 600 mL of air from the pleural cavity using a long needle on a syringe for decompression in all pneumonectomy once all the port incisions are closed. An extrapleural catheter was placed for analgesia.

Histology showed a 35–40 mm squamous carcinoma and staging pT4pN0M0R0.

No chemotherapy was required but radiotherapy was given to the stump.

Comments

This case was set up as a robotic sleeve resection but due to the extension of the tumour it was converted to a robotic pneumonectomy. The strategy of the operation could be changed even to a pneumonectomy without the need to convert to open if the anatomy allows during the robotic approach. In our institution, this was the first robotic pneumonectomy and we have done two pneumonectomy via video assisted thoracoscopic surgery. With the evidence that sleeve lobectomy offers better long-term survival than a pneumonectomy and that a pneumonectomy is not a more appropriate procedure even in higher stage tumours it is becoming less popular as a first line surgical option (2).

The position of the subxiphoid port enables a wider range of movement of the robot arms with less impingement and collision and the port remains under direct vision and entry/exit of samples or equipment can be clearly supervised. Most

importantly, the subxiphoid port facilitates the removal of the specimen with no rib spreading. This may result in decreased postoperative pain, enhanced recovery and reduced length of stay (3,4). Although there is a small risk of developing an incisional hernia at the subxiphoid port site, probably equivalent to the risk associated with a sternotomy, this is reduced by ensuring satisfactory closure (5).

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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 of this manuscript and any accompanying images.

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