Masters of Cardiothoracic Surgery

Uniportal three-arm robotic-assisted thoracic surgery right upper lobe and carinal sleeve resection

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Clinical vignette

A 43-year-old male patient, suffering from airway irritation for two months with no hemoptysis, was sent to our clinic center. Computed tomography (CT) scan suggested a 4 cm lesion on the right upper lobe which invaded the carina. Bronchoscopy revealed an invasive lesion from carina to the bronchus of the right upper lobe. A stent was placed in the right main bronchus for ventilation. Biopsy of the tumor was carried out and suggested a neuroendocrine tumor

Surgical technique

Double-lumen tube intubation was used and the patient placed in a lateral decubitus position. A 3 cm incision in the 4th intercostal space between the anterior and middle axillary line was made as the approach for the surgery. A 30-degree camera, left and right arms, were all placed in this incision (arm 4 was canceled, and the camera port was in the middle on arm 2). The instruments used on the right hand included the cautery hook, curved scissors and needle holder Suture Cut^{TM}. The instrument used on the left hand included the fenestrated bipolar forceps. Additionally, an assistant surgeon used oval forceps to retract the lung, or suction to optimize the operative view. The assistant placed instruments through the same 4 cm incision.

Right upper lobe and carinal sleeve resection

Surveillance of the pleural space showed the tumor had invaded the right main bronchus, right upper lobe, trachea and carina. Hilum exposure was achieved to perform the dissection of superior pulmonary vein, horizontal fissure and anterior pulmonary trunk. The endoscopic linear stapler (WEGO, YJHB-30M, 20162020068) triggered by assistants was used to divide the branches of the anterior pulmonary artery and pulmonary veins, and the horizontal fissure was completed. When triggering the stapler, only the camera arm was inserted for vision. The other two arms were removed. The azygos vein was dissected and transected by endoscopic linear stapler for better exposure of the trachea and carina. The dissection of the ascending pulmonary artery (A2a) and the posterior oblique fissure was completed with an endoscopic linear stapler. The intermediate bronchus, left main bronchus and the trachea were opened around the tumor with robotic scissors. A high-frequency ventilation tube was inserted into the left main bronchus for ventilation by the anesthesiologist. Systematic lymphadenectomy was performed in stations 2, 4, 7, 8, 9, and 10. The specimen was removed within a bag to avoid contamination. Additional proximal and distal bronchial margins were sent for frozen section analysis.

The anastomosis was then performed with two sutures of Stratafix (SXMD2B402, Spiral PGA-PCL, Tensile Strength Size 3-0, 16 cm × 16 cm). The running suture was started from the trachea (in-out), with the posterior wall of the left main bronchus (out-in), from 9 to 3 o'clock anticlockwise. With the other needle the running suture started from the posterior wall of the left main bronchus (in-out) with the trachea (out-in), from 9 to 11 o'clock

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clockwise, leaving the right half of the left main bronchus and trachea to form a new right half carina. Then with the other suture, the anastomosis of right intermediate bronchus (out-in) with the new right half carina (in-out) was performed continuously (1). The cavity was rinsed with saline, and the chest closed with a 28-Fr chest tube through the incision. Frozen section suggested the bronchial margin was free of tumor and pathological examination confirmed mesenchymal tumor without lymph node involvement.

The patient recovered uneventfully. The chest drainage was removed postoperative day (POD) 3 and the patient was discharged on POD 5. At six months follow-up, bronchoscopy indicated a patent anastomosis without tumor recurrence.

Comments

With improvements in robotic technology, robotic surgery has been increasingly accepted as a viable form of minimally invasive thoracic surgery (2). Robotic-assisted thoracic surgery (RATS) has been shown as feasible and safe, with proponents citing improved instrument control, ergonomics and improved intra-operative view. This is especially helpful for complicated procedures such as sleeve lobectomy and surgery after adjuvant therapy (3). A meta-analysis demonstrated that RATS had advantages over video-assisted thoracoscopic surgery (VATS) or open surgery with respect to less blood transfusion, reduced complications, length of inpatient stay, and 30-day mortality (4). Three-arm robotic carinal sleeve resection with four ports has been well described before. Hu reported the procedure with four incisions in 2020 (5). We present the uniportal robotic right upper lobe and carinal resection and share this technique with the readers. It suggests that uniportal RATS (U-RATS) could be applied to more complicated procedures. Presently we have performed thirteen cases of sleeve resection with U-RATS, including this case, and one for double sleeve lobectomy of the left upper lobe. Highlights that should be mentioned are firstly, the U-RATS procedure should be performed by an experienced RATS surgeon and with an experienced RATS assistant who can cope with complicated emergent situations. Since the staplers are inserted and triggered by the assistant, the assistant must be experienced with uniportal-VATS (U-VATS). Secondly, an experienced anesthesiologist is essential for this procedure to ensure patient safety. In this case, a high-frequency ventilation tube was inserted into the left main bronchus for ventilation by the anesthesiologist. If oxygenation cannot be maintained, a tracheal cannula would be intermittently inserted into the left main bronchus by the assistant with the help of the anesthesiologist on the operation table (5). In this situation, it would be more complicated than expected with U-RATS and we suggest conversion to biportal-RATS or U-VATS to carry on the procedure. Thirdly bleeding control is important for anastomosis. It provides clear vision of the trachea and bronchus and avoids the blood spreading to the left lung.

With the development of the instruments of robotic technology and the mastering of U-VATS technique, complicated procedures could be performed using U-RATS.

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Footnote

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

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