

Moving beyond the boundary: the emerging role of video-assisted thoracic surgery for bronchoplastic resections

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Abstract: Sleeve resections with parenchymal sparing should be attempted whenever possible when operating a central lung cancer rather than performing a pneumonectomy. Long-term results conclusively favored sleeve procedures in improved survival, quality of life, reduced loss in lung function, and improved operative mortality. Therefore, all surgeons should own this technique in their surgical *armamentarium*. In the last two decades, the minimally invasive surgical approach has slowly gained positions in Thoracic Surgery and now more and more patients ask for a minimally invasive procedure when surgery is required. This technical revolution in thoracic surgery advocates that almost every open procedure could be done in video-assisted thoracic surgery (VATS). Nevertheless, like all other minimally invasive procedures, VATS sleeve lobectomy has a long learning curve. With the skills and the experience derived from major VATS procedures, these demanding surgical operations may also be performed with a minimally invasive approach.

Keywords: Sleeve lobectomy; carinal resection; video-assisted thoracic surgery (VATS)

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In oncological lung surgery, the sleeve resection is indicated when the tumor arises or involves the origin of a lobar bronchus, precluding the possibility of a standard lobectomy, but is not infiltrating the main stem bronchus so far as to require pneumonectomy (1). In 1947, Thomas Price completed the first documented bronchial sleeve resection in a patient with a pulmonary carcinoid of the right main stem bronchus; subsequently, the patient could return to active flying in the Royal Air Force (2). Five years later, in 1952, Allison performed the first successful right upper lobe sleeve lobectomy for a high-grade thoracic malignancy (3). Although at the beginning indications for sleeve resections were for patients who could not tolerate a pneumonectomy and intended as a parenchyma-sparing procedure, sleeve lobectomy is nowadays the standard for all anatomically suitable tumors, regardless of pulmonary function (4). Abbott, in 1950, reported the case of a right pneumonectomy with en-bloc excision of the carina, lateral wall of the trachea, and part of the left main bronchus (5). Nine years later, Gibbon reported the first case of sleeve

pneumonectomy (6). In 1982, the era of carinal resection started with Grillo (7).

In a Best Evidence Topic evaluating whether a sleeve lobectomy results in a better survival rate than pneumonectomy, the results conclusively favored sleeve procedures in terms of an improved survival, quality of life, a reduced loss in lung function, and an improved operative mortality without, in most cases, difference in the loco-regional recurrence (8). The authors conclude that no more cohort studies should be performed, no more research should be done on this topic, and all surgeons should own this technique in their surgical *armamentarium*. Until recently, the sleeve lobectomy techniques were performed through a thoracotomy. Even in centers with wide experience in video-assisted thoracic surgery (VATS), the surgical indication to a sleeve resection usually precluded a minimally invasive approach (9). Only a few papers report about VATS sleeve resection; usually in the right upper sleeve lobectomy bronchial anastomosis is easier to complete compared with left lower sleeve lobectomy due to

the need of retraction of pulmonary artery, the presence of the left atrium and the left upper lobe vein (10).

Recently, Dr. He *et al.* from the Guangzhou Medical University published a paper about the surgical techniques and clinical outcome of thoracoscopic half carina resection and thoracoscopic bronchial sleeve resection for central lung cancer (11). In this remarkable paper, Authors describe a series of 20 entirely VATS bronchial sleeve lobectomy; none of the patients developed anastomotic leak and perioperative mortality was absent. The bronchial suture was initially performed with a modified interrupted suture and subsequently with a continuous suture during which the membranous posterior and the cartilage wall were anastomosed with single 3-0 or 4-0 Polypropylene suture.

The minimally invasive steps for sleeve lobectomy are similar to the open techniques. Once the camera was inserted, the pre-operative assessment should be confirmed intraoperatively by evaluation of hilum, lung parenchyma, pleural surfaces, lymph nodes, and other surrounding structures. If no major contraindications are encountered, mobilization of the lobe should follow, with a careful dissection of the pulmonary lobar branches at the hilum. The dissection should be carried out with respect for bronchial vessels for the remaining lung parenchyma. Airway dissection should be completed only after other hilar structures have been divided. Most anastomotic complications result from disruption of mucosal blood flow due to excessive skeletonization of the bronchial tissue. Frozen section histological examination of bronchial margins is recommended: the minimal requirements are 5 mm tumor-free margins in high-grade carcinomas and 3 mm margins in low-grade neoplasms (12).

The divided airways should be anastomosed in a tension free way. Most surgeons perform the anastomosis in an interrupted fashion; however also running suture is acceptable. Short and long-term results are comparable in both human series (13) and canine models (14). At the end of the procedure, a flexible bronchoscopy should be performed to evaluate anastomotic patency, orientation and to remove secretions and blood from the airway. The placement of the sutures is more important in VATS than in open thoracotomy as it is very important to keep tension and tie sutures once they are in place. From a technical point of view, the left lower sleeve anastomosis is the most difficult to perform as the posterior bronchial wall is deep and difficult to access (10).

In their paper, He *et al.* report the technique of thoracoscopic half carina resection for central lung cancer (11).

They stated that the side of the lower segment of trachea was sutured first to narrow the rim of proximal trachea to better match the caliber of the distal right intermediate bronchus; the entire operation was completed only by VATS.

The usual approach for carinal resection is the right thoracotomy. Several techniques for reconstruction the continuity of airways following a carinal resection have been proposed. For limited resections of the carina, the left, and the right main bronchus can be re-approached to form a new carina and then reanastomized to distal trachea. In carinal resection with extensive airway resection, the trachea can be anastomosed end to end with either right or left main bronchus (15).

In the last two decades, the minimally invasive surgical approach has slowly gained positions in thoracic surgery and now more and more patients ask for a minimally invasive procedure when surgery is required. This technical revolution in thoracic surgery advocates that almost every open procedure could be done in VATS. Nevertheless, when compared to thoracotomy, the VATS procedures result more technically challenging because of the transmission of a multi-angle operation field in direct-view to a two dimensional flat screen. Like all other minimally invasive procedures, VATS sleeve lobectomy has a long learning curve. The geometrical approach of VATS displays some potential advantages over conventional approaches. In particular, it could obtain an angle of view similar to that obtained in thoracotomy and a more natural direction of the instruments. As a result, the anastomosis can be accomplished from a straight perspective (16).

In conclusion, the sleeve resections with parenchymal sparing should be attempted whenever possible when operating a central lung cancer rather than performing a pneumonectomy. With the skills and the experience derived from major VATS procedures, these demanding surgical operations may also be performed with a minimally invasive approach. Follow-up of patients who underwent a bronchoplastic procedure through a minimally invasive way will tell us whether we are or not on the right way.

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