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Editorial

Robotic sleeve resections: new territory but not the final frontier

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Robotic-assisted surgery for anatomic pulmonary resection has rapidly progressed over the past decade introducing several technical advantages over video-assisted thoracoscopic surgery (VATS). These include improved visualization, scaled movements, tremor reduction, and instrumentation with seven degrees of freedom. In some centers, the robotic platform is now the preferred approach to routine lobectomies. However, it may be in the more complex operations that these advantages are truly realized. Dr. Luo and colleagues from the Shanghai Lung Tumor Clinical Medical Center (1) provide an excellent example in their description of a robotic-assisted thoracoscopic right upper lobe sleeve resection.

The lobectomy, anastomosis, and lymph node dissection are accomplished with the Da Vinci surgical system using a 3-port plus auxiliary port approach. Hook cautery and Cadiere grasper are used for a majority of the dissection. The supplementary video (2) demonstrates a bimanual technique where the left hand is used for both tissue retraction and spreading especially around vascular structures while the right-handed hook cautery is used for tissue cauterization and division. The bronchus intermedius is divided with the cautery just distal to the right upper lobe orifice followed by division of the right mainstem bronchus. The arterial and venous branches were then stapled completing the right upper lobectomy.

The anastomosis was performed with two running 3-0 Prolene sutures with the robotic needle driver. Again, the video exhibits excellent control and a smooth technique utilizing the robot's wristed movements. The sutures are tied down and an irrigation leak test confirms the integrity of the reconstruction. Throughout the procedure a systematic complete lymph node dissection is performed accomplishing all necessary oncologic requirements.

While this article describes robotic sleeve resection with relative ease, this is still a technique that requires significant familiarity with the robotic controls and mastery of anatomy. There may be several different ways to approach this complex operation depending upon the surgeon. As an alternative to the 3-arm approach used by the authors, a 4-arm totally endoscopic technique may offer some advantages (3). The Da Vinci Xi system comfortably allows 4 arms as it reduces collisions while maximizing flexibility as compared to older systems. The fourth arm is used as an internal retractor that is controlled by the surgeon eliminating the need for a skilled bedside assistant. With time, switching between arms becomes second-nature and preferred for the retractor's stability. In addition, a totally portal approach allows not only CO_2 insufflation for smoke evacuation but also for pleural pressurization. This internal pressure depresses the diaphragm and shifts the mediastinum away from the camera providing additional space for maneuvering. It also facilitates achieving rapid atelectasis in the operated lung. Occasionally, the pressure will have to be reduced if venous return is impaired resulting in hypotension.

The hook cautery is used throughout the dissection in the technique described in this article. As an alternative, a long bipolar cautery can be used to precisely divided tissues with minimal risk of thermal injury to the surrounding structures. The bipolar can also be used as a grasper and retractor when the left-handed instrument has a better angle for the dissection. The bronchus can be cut sharply without cautery using the hot shears instead of divided with the hook cautery. This allows for a cleaner edge not only for reconstruction but also avoids cautery artifact when performing a frozen section of the margin. Any bleeding vessels can be controlled either by cauterizing with the tip of the shears or with the bipolar cautery. The anastomosis can be accomplished with many different techniques and sutures whether running or interrupted. A barbed suture may also be useful for helping to keep the bronchial edges approximated since suture management can be difficult without an assistant (4). However before suturing it is critical that the airway is properly aligned and with minimal tension. Dividing the inferior pulmonary ligament and dissecting the superior mediastinal and subcarinal nodes prior to reconstruction will allow the bronchus intermedius to meet the right mainstem bronchus. If additional length is needed then freeing the space between the inferior pulmonary vein and bronchus may help. Note the distance to the middle lobe bronchial orifice so as to not narrow it while suturing. In this procedure, the suture is tied via an external knot-pusher however intracorporeal knot-tying is certainly an option. With practice, attention to visual cues such as suture tension in additional to physical resistance in arm movement while tying will minimize suture fraying and breakage. If additional reinforcement is desired, vascularized tissue such as pleura, thymus, pericardial fat, or intercostal muscle (5) can be mobilized with the robot for coverage.

This article is instructive in the robotic techniques used to perform a complex pulmonary resection. While this is not the first report of a robotic sleeve resection (6,7), the authors should be congratulated on their pioneering work and contribution to the growing thoracic robotic literature. They show mastery of a complicated surgical technique with risk of major complication if not executed to perfection. These advanced skills can be applied to other operations such as bronchoplastic lobectomy (8), vascular and double sleeve resections (9), and tracheobronchoplasty (10). Robotic surgery is an enabling and inclusive technology, allowing more surgeons to perform minimally-invasive procedures and push the boundaries. As technology and experience progress, complex operations such as sleeve lobectomies may not seem so complex and new challenges will arise. Robotic sleeve resections are certainly new territory in thoracic surgery but not yet the final frontier.

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Footnote

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