Robotic lobectomy: an essential addition to the minimally invasive armory

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As the only robotic system approved by the United States Food and Drug Administration for lung surgery, the Da Vinci System (Intuitive Surgical, Sunnyvale, CA, USA) is gaining popularity worldwide as an important alternative to the conventional minimally invasive surgical approach of video-assisted thoracic surgery (VATS). The robotic system is considered a significant evolution in the development of surgical tools, allowing the surgeon to view the surgical site in three dimensions and perform the operation via a console located near the operating table. The endo-wrist instruments attached to the robotic arms provide a wide range of precision movements with greater dexterity. Moreover, the hand tremor of the surgeon can be filtered out by using a 6-Hz motion filter, which guarantees precise micro-movement around vital structures.

Many researchers believe that the robotic system will reduce the number of procedures needed to master a skill compared with traditional thoracoscopic surgery, especially for experienced VATS surgeons (1). By creating a regression trend-line and defining the learning curve as the change in slope corresponding to the beginning of the plateau, Meyer et al. (2) found that the learning curves for robotic assisted lobectomy were 15, 20, and 19 cases for operating time, mortality, and surgeon comfort, respectively. Subsequently, Veronesi et al. (3) reported the first study comparing musclesparing thoracotomy and robotic assisted lobectomy using propensity score matching. The conversion rate to thoracotomy was 13% with the robotic arm. The two groups had similar postoperative complications and numbers of lymph nodes resected (robotic, 17.5 vs. open, 17). The hospital stay was longer with the thoracotomy arm (6 vs. 4.5 days) after excluding the initial 18 cases that underwent robotic lobectomy, whereas the robotic (n=36) operating time was approximately 60 minutes longer. The authors also note that the operation duration decreased by 43 minutes after the initial stage, indicating that the surgeons’ proficiency led to better performance with the robotic surgery.

Nevertheless, clinicians may be more interested in the technical aspects of the two minimally invasive approaches. The recent Annals of Thoracic Surgery article by Louie et al. (4) compares VATS and robotic lobectomy for stage I and II lung cancer using the Society of Thoracic Surgeons General Thoracic Surgery Database. The study included 1,220 robotic lobectomies performed from 2009 to 2013 and these patients had more comorbidities (e.g., coronary heart disease, hypertension) compared with the VATS group (n=12,378). Operative measurements were similar, except for the significantly longer operating times needed for robotic lobectomy (186 vs. 173 minutes). The postoperative complications and 30-day mortality were equivalent in the two modalities, and concurred with the rate of nodal upstaging defined as clinical N0 to pathological N1. Interestingly, the median postoperative length of hospital stay was 4 days for each group, although a lower proportion of the cases undergoing VATS lobectomy had hospital stays of less than 4 days (39% vs. 48%). One possible explanation, as stated by the authors, is that centers with high volumes of robotic surgery would have mature protocols regarding early discharge.

Despite the growing number of studies showing perioperative measurements similar to those of VATS, one of the major concerns preventing widespread adoption of robotic-assisted lobectomy is the lack of adequate long-term survival data. The first large cohort study was that of
Park et al. (5), in which 325 robotic lobectomies achieved a 5-year overall survival (OS) up to 91% for stage IA, and 88% for stage IB, with a median follow-up of 27 months. In a recent study, the same group found that the results of robotic, VATS, and open lobectomy were equivalent from an oncologic perspective (6). The median follow-up time was 52.7 months for all participants and 39.8 months for the robotic approach. The 5-year OS was 77.6%, 73.5%, and 77.9% (P>0.05) for the robotic (n=172), VATS (n=141), and thoracotomy (n=157) patients, respectively. Interestingly, slightly longer disease-free survival (DFS) was observed with the robotic arm (72.7%), as compared with 65.5% and 69.0% in the VATS and open groups, respectively (P=0.047). However, the surgical approach failed to demonstrate a significant association with a better OS and DFS; therefore, the minimally invasive approaches achieved similar survival to thoracotomy in stage I lung cancer following lobectomy. In another study (7), it was also concluded that robotic and VATS approaches had similar R0 resection rates and postoperative survival in comparison with thoracotomy for treating locally advanced lung tumors, although the strength of this result was limited as only 17 robotic procedures were enrolled.

Robotic lung surgery has the advantage of visualizing and dissecting lymph nodes around delicate vessels, resulting in the removal of more lymph nodes stations (6). However, for those who play “devil’s advocate” regarding robotic lobectomy, the absence of haptic/tactile feedback raises concerns regarding hemostatic control, especially when the assistant rather than the surgeon passes the stapler across the pulmonary vessels. The latter for example has been addressed by the industry by providing their robot’s own surgeon instrumentation may lower the surgeon’s willingness to use the surgical team and modifications of the techniques, the cost of robotic surgery will be decrease gradually.

Despite efforts to promote minimally invasive surgery in recent decades, a thoracotomy was still used in 56.5% of the lung resections performed in the United States in 2010 (17). The camera tremor and reduced dexterity of instrumentation may lower the surgeon’s willingness to use the VATS approach. In terms of robotics, Louie et al. (4) found that the majority of robotic cases were performed by only 22 groups, and one third of them were done at four centers. Since the current evidence indicates that the robotic approach is equivalent, or at least not inferior, to VATS lobectomy, one may foresee that the true value of robotic surgery is in increasing the proportion of surgeons who use a minimally invasive approach.

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Footnote
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References


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