



Thoracoscopic or robotic surgery? No matter, as long as they have good results

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Despite the encouraging results, minimally invasive thoracic surgery is still used in a minority of non-small cell lung cancer (NSCLC) patients, currently in about one third of all major pulmonary resections (1). Since the 1990s video-assisted thoracic surgery (VATS) has gradually become more and more popular and, over the past two decades, it has been gradually accepted as an alternative option to open thoracotomy for selected patients. Compared with thoracotomy, VATS lobectomy is associated with less pain, shorter chest tube duration, fewer cardiac complications (especially atrial fibrillation), lower rate of infectious complications (i.e., pneumonia), lower incidence of blood transfusion, shorter length of hospitalization and faster recovery (2-4). Another significant advantage of VATS has been reported in high risk patients, particularly in those with preoperative poor pulmonary function (5). It has been also argued that the lower impact on the immunity system with reduction of cytokines relapse during minimally invasive thoracic surgery may avoid postoperative immunosuppression, consequently decreasing the risk of complications (6). However, some authors raise concerns about oncologic results, reporting that VATS approach may prejudice oncologic principles of anatomic resection. A retrospective analysis of The Society of Thoracic Surgeons—General Thoracic Database by Boffa *et al.* reported a lack of the completeness of the surgical lymph node evaluation of peribronchial and hilar lymph node dissection by VATS in the decade 2001–2010 (7). However, this study contradicts numerous studies that have showed that open and VATS approaches result in a similar number of sampled lymph nodes. A further previous

concern, according to Mathisen, was that to be the gold standard treatment for patients with early stage NSCLC VATS lobectomy should be broadly applicable and not the domain of few experts (8). The spread of dedicated teaching programs of this technique carried out by scientific societies, teaching hospitals and academia, should have passed this concern.

Since early 2000s robotic lung lobectomy had been increasingly reported as a feasible and safe technique in single center series (9-12); however, its widespread adoption remained controversial and the so called robotic-assisted thoracic surgery (RATS) is currently ten-fold less performed than VATS (13). Questions have been raised regarding the safety of robotic techniques when compared with VATS or open lobectomy, and a recent national study showed that the robotic approach was associated with a higher rate of intraoperative vessel injury when compared with VATS (14).

Importantly, according to the robotic surgeons, compared with thoracoscopic approach RATS may provide a more precise control and maneuverability of the instruments both through the three-dimensional view, with an increased depth, and by the wrist-like movement and rotation (9). However, these advantages are significant when operating into the mediastinum, but relatively useful in lung lobectomy where the surgical field is generally wide.

Furthermore, RATS efficacy as a cancer operation should not be questioned. In 302 patients Wilson *et al.* reported that compared with VATS the robotic approach improved pathologic nodal upstaging, which is considered a surrogate for completeness of nodal evaluation and of quality of

surgery (15). However, limitation in the use of robotic technology may be associated with the still significant impact on costs (16). Robotic lobectomy had higher related costs than VATS, primarily attributed to the dedicated instrumentation, operative time and personnel (17). This issue is likely the most important barrier to an increased use of this technique especially in public national health care systems.

Finally, it is debatable if proficient thoracoscopic surgeons should invest time and resources to learn the robotic approach, because they are already practicing an effective minimally invasive technique.

In patients with early stage lung cancer the use of robotics could be a viable alternative to the VATS if the above concerns are clearly exceeded with at least equivalent results to VATS in terms of perioperative complications, oncologic outcomes and costs.

In lung cancer patients the keys of the success are early diagnosis and radical resection of cancer to obtain the long-term survival outcome. These keys highlight the importance of looking at the long-term benefit of patient life expectancy rather than at the short-term benefits of a treatment when reviewing and interpreting comparisons of different surgical techniques.

From a methodological point of view, confirmation of the oncologic effectiveness of minimally invasive surgery would be best demonstrated by a large, prospective, randomized series, which will not be forthcoming (18). Although not randomized, the registry design may allow comparisons of important variables in appropriately matched patients, as stated by D'Amico ten years ago (18).

In the 2000s several scientific societies started to develop databases and registries of lung cancer surgery that are currently precious source of data and benchmark for the future. We must be cautioned, however, about the analysis due to possible relevant bias as the retrospective nature of the vast majority of these datasets. Also the selection bias may have a relevant role in misinterpreting the results of these studies.

The registry design method has been adopted in studies comparing minimally invasive approaches to open lobectomy. Yang *et al.* used the population-based National Cancer Data Base, which includes oncologic and survival data from a range of academic and community centers across the United States. The purpose of this study was to measure and compare perioperative outcomes, nodal evaluation, and short-term survival between open and minimally invasive surgery (VATS and robotic) lobectomy

and between VATS and robotic lobectomy for clinical T1-2, N0, M0 NSCLC from 2010 to 2012 (1). Importantly, the outcomes were evaluated using an intent-to-treat analysis. In this large database VATS and robotic approaches were used respectively in 26% and 7% of all lobectomy cases. Interestingly, the percentage of minimally invasive cases increased over the study period, reflecting the global trend. Propensity-score matching was used to create comparable groups. The VATS group was found to have a higher conversion rate, and slightly more nodes removed when compared with the robotic group. VATS patients did not differ significantly from the robotic ones with regard to 30-day mortality and 2-year survival. With regard to nodal upstaging, there were no differences between open versus minimally invasive surgery and VATS versus robotic approaches. The authors concluded that the data were consistent with high-quality results of both minimally invasive techniques suggesting the need for the broader implementation.

In a recent study Louie and colleagues analyzed The Society of Thoracic Surgeons General Thoracic Surgery Database to assess quality outcomes of VATS and RATS lobectomy performed in the subset of clinical early stage NSCLC prospectively collected patients, over a five-year period [2009–2013] (13). The use of a large national database of general thoracic surgery including contributes from 128 centers is certainly one of the strength of the study, as well the high volume of patients. Another strong point is the standardized prospective collection of data which makes comparison easier to perform. The study results provide evidence that VATS and RATS approaches are equivalent in terms of all measures of quality, including postoperative complications, length of stay, 30-day postoperative mortality, and nodal up-staging. However, it must be underlined that the data are from high quality thoracic services in United States, as shown by the low overall complication rate, by the rare use of blood products intraoperatively and by the infrequent admission to intensive care unit after surgery. Secondly, study exclusion criteria were conversions, induction chemotherapy or radiation therapy and cases from low volume centers (<20 cases/center); the consequent possible selection bias might impact on the generalizability of the results. The authors conclude that robotic approach might be an acceptable alternative to VATS for lobectomy, although with slightly longer intraoperative times. It is still debatable if such a small difference (13 minutes) in the operative time may significantly affect clinical course of the patients and

the overall costs of hospitalization.

The conclusions of the study by Louie *et al.* are substantially consistent with the current National Comprehensive Cancer Network (NCCN[®]) Guidelines that strongly propose minimally invasive surgery (including either VATS or robotic-assisted approach) for lung resection of early stage NSCLC since there is no compromise of standard oncologic and dissection principles of thoracic surgery (19). Nevertheless, the authors recommend prospective studies to define the role of RATS for anatomic lung resections.

The use of robotic approach to perform lobectomy remains of great interest for the thoracic surgical community. While waiting for a further simplification and reduction of costs of robotic surgery, which is currently equivalent to VATS, we should guarantee more widely high quality procedures to our patients from an oncologic point of view. Moreover, as already stated by experts (20), we should widely spread the VATS lobectomy technique so that more patients might benefit the advantages of minimally invasive thoracic surgery.

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