Editorial

Transition from multiple-port to single-port video-assisted thoracic surgery pulmonary lobectomy: a technical evolution?

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Minor and major anatomic pulmonary resections performed by a video-assisted thoracoscopic approach have been proved to be safe and feasible as demonstrated from the first multi portal video-assisted thoracic surgery (VATS) experiences published in early 1990s.

Over the years, VATS lobectomy have been chosen as the standard treatment of early stage non-small-cell lung cancer (Stage I or II) showing similar long-term oncological results comparing with those of open lobectomy, guaranteeing an adequate lymph node dissection, improved tolerance and reduced time to start adjuvant chemotherapies (1).

Furthermore, literature evidences have shown that minimally invasive thoracic surgery compared to thoracotomy significantly reduces postoperative pain, morbidity and length of hospital stay, providing a better quality of life for patients undergoing lobectomy for lung cancer (2,3).

From the initial VATS lobectomy reports, technical and surgical issues have been implemented during the years. Differences in number (4, 3 or 2) and site (anteriorly or posteriorly, intercostal level) for the surgical port incisions and the service thoracotomy have been described by the authors experiencing over the time (4-6).

However, reducing the number of surgical incisions aimed to decrease the invasiveness, offering less postoperative pain and a better esthetic results to the patient. A paper from Rocco and colleagues published in 2004 (7) reported the first single port video-assisted pulmonary wedge resection ever performed. These instances combined with the foresighted idea of using a single minimally invasive incision leaded to the first case series reporting VATS lobectomy performed trough an uniportal approach (8). In a few years away, Gonzalez-Rivas also showed the safety and effectiveness of uniportal VATS (U-VATS) for lobectomies and pneumonectomy with a low rate of conversion (less than 5%) (9).

Nevertheless, the potential increased technical complexity of this endoscopic approach raised a fast wide acceptance among the same minimally invasive thoracic surgeons community. This aspect was highlighted powerfully also from the paper by French and colleagues (10), reporting their first uniportal lobectomy experience after a long transition between multiple port video-assisted lobectomies.

Uniportal VATS was developed from two-ports approach, with two main advantages: only one intercostal space is damaged and the direct view to the target tissue. The parallel instrumentation achieved during the single port approach mimics the inside maneuvers performed during open surgery, together with the direct view facilitates the dissection and division of the hilar structures and the fissure. This could make possible the direct transition from open surgery to uniportal VATS, as Gonzalez-Rivas stated (11).

The introduction of new technologies such as 3D and HD lens cameras, extremely fine needlescopic and flexible thoracoscopes, thinner and ergonomic surgical instruments and smaller mechanical staplers allowed a real development of single port technique. This is even more true after the complex bronchovascular operations safely performed through a single-port incision reported in the last five years. However, these are few limited experiences demonstrating the feasibility of complex surgical procedures such as bronchoplasty, pulmonary artery reconstruction, double-sleeve and carinal resections in U-VATS (12).

As already extensively described (13), the basic principles of the technique requires the use of a single

access (3 to 5 cm wide) in the 5th intercostal space along the anterior axillary line for both upper and lower lobectomies. The thoracoscope is placed at the posterior end of the wound in order to avoid the overlap of multiple endoscopic instruments. The operation axis is rotated posteriorly and the perspective is more vertical compared to the conventional multiportal VATS. The geometric configuration of the classic three-port approach (baseball diamond) determines the convergence of endoscopic instruments from the left and the right hand on the target lesion leading potentially to intraoperative interference with the optical source. Several authors agree with the issue that the uniportal anterior incision allows greater freedom of movement, provides a direct exposure of the target issue and preserves the depth of intraoperative visualization similar to that experienced during open surgery (14). Moreover, some recently published series reported experiences of a direct transition from open surgery to uniportal video-assisted thoracoscopic surgery with good perioperative morbidity results (15).

As a result of technological innovations, thinner high definition thoracoscopes have been recently proposed. In particular, the new generation flexible 5 mm 0° videoscope with a 85-degrees rotating tip could allow a better and safer exposure of the posterior hilum, providing a potential further improvement during U-VATS dissection and lymphadenectomy, as reported in some latest series (16).

The adequacy of lymph node clearance performed by a video-assisted approach has already been extensively discussed (17). An interesting comparative study from Watanabe *et al.* (18), including 37 VATS lobectomy and 32 open lobectomy cases of patients underwent surgery for cN0 to pN2 NSCLC, show no differences regarding the number of nodes removed between the two groups, and similar 3-year and 5-year recurrence-free survival rates (60.9% *vs.* 49.6% and 60.9% *vs.* 49.6%). More recently the capability to achieve a complete mediastinal lymph node dissection through the uniportal technique has been demonstrated. Delgato Roel and colleagues published in 2015 their early experience about the feasibility of lymphadenectomy during U-VATS (19), reporting a greater number of lymph nodes resected in the single-port group compared to the multiple-port group (14.5±7 *vs.* 11.9±6.7). In step with the literature data, surgical results from the paper by French and colleagues confirm the suitability of an accurate lymphadenectomy with an equivalent number of nodes available for pathologic analysis after uniportal and standard VATS lobectomy procedures (P=0.93).

An oncological benefit has been already demonstrated in favor of VATS lobectomy comparing to lobectomy via thoracotomy because of the less inflammatory response after a minimally invasive approach. An interesting paper published in 2007 by Whitson and colleagues (20) proposed that the less traumatic surgical stimulus during video-assisted procedures could lead to a lower depression of immunological surveillance compared to that observed after open surgery with potentially fewer recurrence rates. This advantage generally showed for minimally invasive surgery could be theoretically even more important performing a single small thoracoscopic incision. Nevertheless, literature data relating to this technique reporting mild to long-term oncological outcomes (locoregional and distant recurrence rates and survival rates) are poor and rough.

From the very first experiences many studies have tried to define the best method for a safe transition from conventional surgery to U-VATS approach, with divergent conclusions (11,21,22). French and colleagues suggest a favorable learning curve and a steep and low risk transition for those surgeons with a previous experience in multiportal video-assisted pulmonary resections with similar morbidity rate and postoperative outcomes, despite, experiences of a straight evolution from open to uniportal video-assisted surgery have been successfully reported. Training at centers with major experience or in WET labs, and the proper patient selection are the best recommendations for the learning curve, gaining experience with the approach starting initial stages and easy cases.

A systematic review from Harris *et al.* (23) including eight large observational studies recently highlighted that, compared with multiportal VATS lobectomy, the uniportal approach has shown a reduction of overall rate of complications, median length of stay and postoperative chest drainage persistence, all statistically significant. No differences were found in mortality, perioperative bleeding, median operative time and conversion rate, as also reported by French *et al.*

Nevertheless, the expected benefit in reduction of postoperative pain in the U-VATS group was not confirmed in the study by French and colleagues, in contrast with results reported in some previous small series (24). To date, a clear evidence of postoperative pain score reduction in patients undergoing a single-port approach compared to those undergoing multiple-port operations is still awaited. A review of 255 paper about this topic published by Young and colleagues in early 2015 (25) show that about around one-third of the chosen papers did not report any statistically

significant results.

Uniportal VATS lobectomy has been proved to be a safe and effective approach, with a favorable learning curve for an experienced surgeon. Randomized trials are needed to confirm the advantages of the single-port approach with regard to the conventional multiple-port technique, before recommend U-VATS as a less invasive painful option. Further long-term observational studies are still expected in order to evaluate oncological outcomes.

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