Editorial Commentary

Prolonged air leaks after vats lobectomy: do we need another risk score?

Angelo Carretta

Department of Thoracic Surgery, San Raffaele Hospital, Vita-Salute San Raffaele University, Milan, Italy

Correspondence to: Angelo Carretta, MD. Department of Thoracic Surgery, San Raffaele Hospital, Vita-Salute San Raffaele University, Via Olgettina, 60-20132 Milan, Italy. Email: angelo.carretta@hsr.it.

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Video-assisted thoracoscopic (VATS) lobectomy has become the standard surgical approach for the treatment of early-stage lung cancer. Equivalent oncological results and significant advantages in terms of postoperative pain control and reduced length of stay have been reported in comparison with open surgical approaches (1). One of the main issues that may limit the widespread use of mini-invasive techniques concerns the cost-effectiveness of this approach, and a reduction of postoperative hospital stay is essential to balance the higher operative costs of VATS procedures. Protocols for enhanced recovery after surgery (ERAS) have focused on this point, and some Authors have even described the possibility of a discharge from the hospital the day after surgery (2,3).

However, the possibility of obtaining a reduction of the hospital length of stay may be limited by postoperative complications, and in particular by prolonged air leaks (PAL), which still have a high incidence after open and VATS pulmonary resections (4). Strategies to prevent and reduce the impact of PAL by preoperatively identifying the subset of patients at risk for this complication are therefore of great importance for the success of a VATS program. Moreover, since materials and devices used to control intra- and postoperative air leaks are relatively expensive, risk assessment is mandatory to optimize the allocation of clinical and financial resources and improve the cost-effectiveness of the treatment.

A first point to be analyzed concerns the definition and quantification of PAL, which has varied along the years. According to the present Society of Thoracic Surgeons (STS) and European Society of Thoracic Surgeons (ESTS) guidelines, postoperative air leaks are considered as prolonged when lasting more than 5 days (5). The most frequently used classification to quantify intraoperative air leaks is the one developed by Macchiarini *et al.*, which categorizes intraoperative air leaks in four classes (6). However, intraoperative assessment of air leaks with this method may be difficult during VATS lobectomy, since visualization of the operative field may be limited by lung inflation. Brunelli *et al.* therefore developed a system to evaluate intraoperative air leaks by using ventilator parameters during surgery, and identified an air leak cut-off of 500 mL/min to identify patients with a higher risk of PAL (7). Cerfolio *et al.* proposed another classification to measure postoperative air leaks, evaluated in the water seal chamber during inspiration, expiration and cough (8). However, variability between different observers may be present with this method. Digital devices, introduced in clinical practice in recent years, allow an objective measurement of air leaks, and their efficacy in reducing postoperative length of stay has been demonstrated in a meta-analysis performed by French *et al.* In fact, the main advantage of digital draining devices is related to a reduction of interobserver variability, allowing a better

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management of chest tubes after surgery (9).

Another important issue concerns the efficacy of intra- and perioperative strategies in limiting the incidence and duration of PAL. Mayor *et al.* analyzed the results of a comprehensive program with intra-and postoperative measures. It included intraoperative actions as pre-compression of lung staple lines, performing VATS lobectomy with a fissureless technique and use of sealants. In the postoperative period air leaks were monitored with digital drainage systems and pleurodesis or endobronchial valve placement were used in selected patients with long lasting air leaks. A significant reduction of the length of stay and duration of PAL was observed with this program in comparison with historical controls (10).

The impact of using sealing materials during surgery on the incidence of PAL has also been also analyzed by Malapert *et al.* In this meta-analysis the use of sealants, surgical patches or buttressing was associated with a reduction of PAL. However, significant heterogeneity concerning the type of operation, materials used to control air leaks and patient selection was present among the trials included in the study (11). Furthermore, since materials and devices used intra- and postoperatively to reduce PAL are relatively expensive, resource allocation should be established on the basis of a risk assessment, identifying patients with a higher risk of developing PAL, in whom their use may be justified. Different risk scoring systems for PAL have been proposed. Orsini *et al.* analyzed the data of a national French thoracic database including VATS lobectomy and segmentectomy and developed a model with six variables correlated with the risk of PAL (gender, dyspnea score, type of lung resection, location of resection, pleural adhesions and body-mass index) (12).

Pompili *et al.* also developed a scoring system based on the ESTS database to predict PAL, specifically addressing patients undergoing VATS lobectomy. Three variables were identified as risk factors for PAL: male gender, forced expiratory volume in 1 s lower than 80% and a body mass index of less than 18.5 kg/m^2. A risk score was defined assigning individual scores to the variables, allowing to allocate accurately the patients in four classes according to the risk of developing PAL (13). Brunelli *et al.* subsequently validated the ESTS PAL risk score from a financial point-of-view, and demonstrated that it correctly stratified the patients according to the hospital costs (14). Other Authors have developed similar risk scoring systems, as the one subsequently reported by Viti el al, who identified in a smaller group of patients five preoperative variables associated with the risk of PAL: forced expiratory volume in 1 s below 86%, body mass index lower than 24 kg/m^2 and active smoking. They also found that intraoperative factors as incomplete fissures and pleural adhesions were also risk factors for postoperative PAL (15). Despite the efficacy of these scoring systems other points still need to be assessed, in particular the identification of patients in whom standard measures to control air leaks may not be adequate.

Murakami *et al.* evaluated the role of grading of emphysema in the prediction of PAL, defined in this study as air leaks lasting for more than 7 days, in patients submitted to VATS lobectomy. PAL were also associated with a higher incidence of infectious complications as pneumonia and empyema. Emphysema index was defined as the proportion of the emphysematous lung volume to the total lung volume assessed by a computer-assisted histogram analysis on preoperative computed tomography scans. Previous reports described a role of emphysema index in predicting postoperative cardiopulmonary morbidity and hypoxemia, and in identifying emphysematous patients in whom an improvement of respiratory function may be observed after lung resection due to a lung volume reduction effect (16-18). The results of the study by Murakami show that the emphysema index was the best predictor of PAL and that an index value of 35% was the best cut-off to predict this complication.

One of the most relevant points of this study concerns the fact that intraoperative measures to control air leaks as the use of fibrin glue and polyglycolic acid (PGA) reinforcement had been systematically used in the patients included in the study, and therefore the emphysema index allowed to identify a subset of patients in whom standard measures to control PAL were inadequate. On the basis of the results of the study, the Authors developed further intraoperative measures to prevent PAL, by using thick pieces of PGA mesh as pledgets to suture the site of air leaks, followed by placement of thin-type PGA mesh over the stitched site. This method, according to the Authors, could provide better results in comparison with the previous approach that consisted in covering the site of air leaks with PGA mesh without suturing. Further strategies, considering the fragile emphysematous lung tissue, may include the use of collagen sponge coated with the human coagulation factors fibrinogen and thrombin, and buttressing with biologic materials (19).

In conclusion, currently available scoring systems as the

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one developed on the ESTS database allow an adequate risk assessment of PAL after VATS lobectomy, which nevertheless remain the main factor limiting the cost-effectiveness of mini-invasive approaches. Other risk factors as the emphysema index may allow to identify a specific subset of patients with emphysematous lungs with a relatively higher risk of developing PAL, in whom the use of further intraoperative measures may be indicated. Future development of materials to control air leaks could also contribute in reducing the incidence of PAL.

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Footnote

Conflicts of Interest: The author has no conflicts of interest to declare.

Ethical Statement: The author is accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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