



Non-intubated thoracic surgery: the European perspective

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In the last few decades, innovations in thoracic surgery have moved constantly towards lesser invasive surgical approaches. Nowadays, video-assisted thoracic surgery (VATS) lung resection is the standard of care for lung cancer treatment in early stages (1). VATS techniques have evolved from multi-portal approaches (2 and 3-port techniques) to uni-portal technique, in order to reduce the surgical trauma for the patient (2). In recent times, anaesthesiologic aspects of surgery-related trauma have gained growing attention. In this setting, non-intubated thoracic surgery has become the cutting edge in current advances in thoracic surgery. Its rationale is simple: general anaesthesia carries non-negligible risk of postoperative complications, mainly related to orotracheal intubation, mechanical one-lung ventilation and use of neuro-muscular blocking drugs (3); risk is higher especially for patient with respiratory and cardio-vascular comorbidities. To perform thoracic surgical procedure in spontaneous ventilation with mild sedation and loco-regional analgesia, avoiding invasive ventilation, could reduce perioperative risk for the patient (4). Even though these concepts are relatively new in our field, non-intubated thoracic surgery is actually an old idea: the initial reports of thoracoscopic procedures emerged decades before the introduction of double-lumen orotracheal intubation (5). The true novelty consists in its application for surgical procedures such as lung resections for lung cancer. Non-intubated VATS lung resections have become rapidly popular especially in Asia and their early analysis has shown promising results, attracting worldwide attention: complication incidence and conversion rate to thoracotomy proved to be comparable to similar procedures performed under general anaesthesia in different series (6-8), and in some reports non-intubated surgery was related to a shorter anaesthesia time and

postoperative length of stay (6). In European countries non-intubated anaesthesia remains employed in thoracic surgery mostly for minor operations like pleural biopsy/pleurodesis, lung biopsies and pleural decortication for empyema (9), nevertheless it is considered an ideal strategy for patients with multiple comorbidities and poor lung function that have to undergo thoracic procedures. An interesting work from Pompeo *et al.* (10) on lung volume reduction surgery demonstrated comparable outcome between intubated and non-intubated procedures, with the latter resulting in a shorter in-hospital length of stay. In some clinical categories, the advantage is quite evident. In interstitial lung disease, surgical lung biopsies have been historically associated with high risk of postoperative morbidity and mortality, especially given the limited degree of a procedure; this increased risk is mainly related to general anaesthesia manoeuvres application in patients with such a compromised respiratory function. Thoracoscopic lung biopsies under locoregional anaesthesia and maintaining spontaneous ventilation have indeed a much lower complication rate and very low mortality (11), overcoming the need of an “invasive” anaesthesia for a minimally invasive procedure.

Non-intubated anaesthesia application for more complex intervention like anatomical lung resections is a more complicated and debatable issue. The surgeon has to manage pulmonary hilum dissection and division of broncho-vascular elements coping with ventilating parenchyma and a constantly moving surgical field due to mediastinal shifting and unparalysed diaphragm. Bronchial manipulation itself is a strong trigger of cough reflex but can be efficiently managed with intraoperative vagus nerve block. Moreover, both the surgeon and the anaesthetist must

be ready to promptly manage the need for a conversion, either from VATS to thoracotomy or from spontaneous ventilation to general anaesthesia. For these reasons it would be advisable that only surgeons with full experience in VATS and anaesthetists comfortable with intubation on lateral position would undertake a non-intubated lung resection program. Additionally, along with single professional's skill level, the whole operative room team must be trained and well-organized in order to manage any intraoperative crisis (12). Not all patients are considered fit for non-intubated lung resection. Common exclusion criteria (13) are: tumours >6 cm, stage I or II disease with invasion, American society of anaesthesiologists physical status (ASA) >3, body mass index >30 kg/m², impaired lung function tests and unfavourable airway or spinal anatomy (in case of possible urgent orotracheal intubation); previous thoracic surgery, as a predictor factor of diffuse pleural adhesion, can also be considered a contraindication. Despite these premises, different studies on non-intubated lung resection for lung cancer have shown its feasibility and safety in both anatomical and non-anatomical resection (14-16). Advantage is clear over intubated technique in postoperative length of stay and clinical recovery from general anaesthesia (fasting time, mobilization) (13). In terms of postoperative complication rate, the superiority of non-intubated VATS is less clear (6,7), but results are still at least comparable to intubated cases (13,17). Bearing in mind the importance of oncological outcome in lung cancer surgical treatment, Alghamdi *et al.* (17) raised some question about the completeness of mediastinal lymphadenectomy in non-intubated VATS but in other series there were no differences in the number of lymph node harvested (15). On the other hand, in a retrospective study published by Furák *et al.* (18), patients who underwent non-intubated lobectomy for lung cancer showed a better compliance to adjuvant oncological treatment.

In spite of the increasing number of scientific reports on the topic, more robust evidence is still needed to fully understand what the future role of non-intubated thoracic surgery in our daily surgical practice will be. The need for a robust and experienced surgical team with extended experience on large numbers must be stressed, to preserve patient safety. In experienced groups, even conversion to thoracotomy has been carried out maintaining non-intubated anaesthesia (19). The feasibility of more complex operations including bronchial sleeve resection (20) and tracheal surgery (21) without general anaesthesia has been described in some case reports, pushing forward the technical boundaries of surgery. In our opinion,

even though non-intubated thoracic surgery would probably not be the definitive answer for surgical eligibility of every high-risk patient, it is undoubtedly a highly valuable tool. Its low invasiveness on both surgical and anaesthetic sides, associated with a careful and appropriate patient selection, will make surgical treatment a reliable possibility for patients who would have been otherwise deemed excluded for surgery and its benefits. Moreover, once a more robust knowledge and a clearer evidence of the technique are available, further expansion of its application will be expected, for example in emergent trauma surgery. As we said, non-intubated procedures are a cutting-edge advance in thoracic surgery; wise and skilful hands together with careful sharpening will define its future in our practice.

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