

# Non-intubated tracheal surgery: is it worthwhile?

Andrea Zuin, Marco Mammana, Federico Rea

Thoracic Surgery Unit, Department of Cardiology, Thoracic and Vascular Sciences, University of Padua, Padua, Italy

Correspondence to: Andrea Zuin, MD. Department of Cardiology, Thoracic and Vascular Sciences, University of Padua, Via Giustiniani 2, 35100 Padua, Italy. Email: andrea.zuin@unipd.it.

Provenance: This is an invited Editorial commissioned by Section Editor of Jianfei Shen (Department of Cardiothoracic Surgery, Taizhou Hospital of Zhejiang Province, Wenzhou Medical University, Taizhou, China).

Comment on: Liu J, Li S, Shen J, *et al.* Non-intubated resection and reconstruction of trachea for the treatment of a mass in the upper trachea. *J Thorac Dis* 2016;8:594-9.

Submitted Aug 23, 2017. Accepted for publication Aug 26, 2017.

doi: 10.21037/jtd.2017.08.154

View this article at: <http://dx.doi.org/10.21037/jtd.2017.08.154>

The birth of modern thoracic surgery coincided with the development of double-lumen endobronchial tubes permitting single-lung ventilation, which allowed surgeons to operate on a totally collapsed lung. So far, this type of anesthesia is considered mandatory for most thoracic surgery procedures.

Recent years, however, have been characterized by an ever growing development and adoption of minimally invasive approaches, with the aim of reducing surgical trauma and allowing a faster recovery to the patients (fast-track surgery). The most notable of these new approaches is uniportal thoroscopic surgery. Initially reserved to minor thoroscopic procedures, such as sympathectomy (1) and wedge pulmonary resections (2), uniportal thoracic surgery has experienced a rapid development, and it is currently applied to almost the whole spectrum of pulmonary resection procedures; including lobectomy, pneumonectomy, bronchial and pulmonary artery sleeve resections and lobectomy with en bloc chest wall resection (3). Concurrently with surgical approaches, anesthesia and ventilation techniques have seen developments aimed at further decreasing surgical stress and post-operative recovery. In this scenario, non-intubated thoracic surgery has found application, particularly as an ideal anesthetic technique for uniportal thoroscopic surgery (4).

Non-intubated thoracic surgery entails procedures performed through thoracic epidural or local anesthesia in fully awake or mildly sedated, spontaneously ventilating patients. Its rationale is the avoidance of the side-effects of intubated general anesthesia with single-lung mechanical

ventilation and maintenance of a more physiologic muscular, neurologic, and cardiopulmonary status (5). Some centers, especially in Asia, adopt non-intubated anesthesia for a variety of major thoracic procedures, including lobectomy, segmentectomy and lung volume reduction surgery, and have acquired a remarkable level of expertise with this anesthesia technique, based on a high volume of cases (6).

Recently, Liu *et al.*, from Guangzhou Medical University, published a case-report in which non-intubated anesthesia was used to perform a tracheal resection and reconstruction for a tumor of the upper trachea (7).

The patient was a 44-year-old female presenting with an endotracheal mass at the level of T2. Prior to surgery, the lesion was resected endoscopically for palliation of dyspnea, leaving about 1 cm of residual tumor inside the trachea. Pathologic report revealed the diagnosis of adenoid cystic adenocarcinoma. Surgical resection was performed under spontaneous ventilation, with 40% oxygen administered through a laryngeal mask. Anesthesia was delivered intravenously plus local anesthesia via cervical plexus block. After identifying the exact location and length of trachea to be resected with flexible bronchoscopy, by the aid of a video mediastinoscope inserted through a small cervical collar incision, a 2 cm-long segment of trachea was resected and subsequently reconstructed with a continuous 2-0 Prolene suture. The operation lasted 120 minutes, patient was started on oral diet 3 hours later and discharged on postoperative day 3. According to the authors, the non-intubated approach was selected as a result

of tumor location, high chance of recurrence from residual tumor, and the non-intubated anesthesia experience of their institution. They conclude that tracheal resection and reconstruction under spontaneous breathing anesthesia via a transcervical surgical method is feasible and could constitute a valid alternative for the treatment of upper tracheal tumors (7).

This report is of particular interest because tracheal surgery is a field where the use of non-intubated anesthesia has been scarcely reported, and, at a first glance, it might seem difficult to understand. In fact, in tracheal resection and reconstruction, control of the airway is considered fundamental, and a close cooperation between surgeon and anesthesiologist is traditionally required, to switch between different modes of ventilation throughout the succeeding phases of the procedure (e.g., cross-field ventilation, jet ventilation, nasotracheal intubation). In non-intubated surgery on the other hand, there is no direct control on the airway and on gas exchange; when the trachea is cut open, the patient's own physical needs drive the intercostal muscles and diaphragm to move, and ambient air at the level of the surgical field is inhaled with the distal part of the open airway.

Despite this, cervical tracheal resection and reconstruction under spontaneous ventilation has already been reported by other authors before.

Macchiarini *et al.* in 2010 first reported 20 cases of tracheal resection and anastomosis in awake patients with benign tracheal and laryngotracheal stenoses. Cervical epidural anesthesia was used for pain control and oxygen was administered via face mask. Patients maintained verbal contact with surgeon and anesthesiologist throughout the procedure. Based on the satisfying outcomes of this case-series, the authors concluded that airway surgery in awake patients is feasible, safe, and has a high level of patient satisfaction, and that this method could change the way airway stenosis surgery is approached (8).

After him, Loizzi *et al.* reported a case of upper airway reconstruction for resection of a tracheal hamartoma with patient under local anesthesia and conscious sedation. In this case, the procedure was started with spontaneous ventilation because the lesion occluded almost the entire tracheal lumen and the airway was not secured for general anesthesia. Pain control was obtained through local infiltration of anesthetic sequentially at the level of the cervicotomy, strap muscles, on the lateral tracheal walls and inside the trachea, to reduce cough reflex; resection of 3 tracheal rings and anastomosis were successfully performed with the patient under

conscious sedation, which allowed intraoperative voice monitoring (9).

Another interesting report describes the use of non-intubated cervical tracheal resection and anastomosis for the treatment of a patient with post-tracheostomy tracheomalacia. Similarly to the report of Macchiarini, a cervical epidural catheter was placed for regional anesthesia, and the patient was able to talk during the procedure. The authors explain that in this case spontaneous ventilation was critical for precise identification of the tracheal lesion, characterized by the dynamic collapse with respiratory movements; furthermore, the maintenance of verbal communication with the patient aided in decreasing the risk of injury to recurrent laryngeal nerves during their dissection (10).

Finally, in addition to the paper of Liu *et al.* (7), two other reports from Guangzhou Medical University, have described the use of non-intubated anesthesia to successfully perform resection and reconstruction of the middle trachea and of the carina, through a right triportal thoracoscopic approach (11,12).

Among the various advantages of non-intubated surgery, the first and most consistently reported is the possibility to perform the operation without intraoperative tubing, speeding up the procedure, leaving a clearer surgical field and decreasing the risk of hemorrhage and airway edema following tracheal intubation. Secondary, no muscle relaxants are required, thus avoiding the slow recovery of lung function and respiratory complications. Third, as shown in a previous study from the same group of the Guangzhou Medical University, non-intubated anesthesia is associated with lower levels of inflammatory cytokines, which can cause an increase in permeability of blood vessel and tissue edema (6). Fourth, continuous communication with the patient allows intraoperative assessment of laryngeal nerve function and, supposedly, to get closer to vocal cords (8). Fifth, with spontaneous ventilation it is possible to assess the tracheal range of motion, leading to a more anatomical airway reconstruction. Sixth, as exemplified by the case-report of Loizzi *et al.*, spontaneous ventilation is valuable when the airway is not secure, for example, because of an endoluminal mass occluding the airway, since the use of muscle relaxants needed for general anesthesia might precipitate a critical stenosis (9). This latter feature is well known to the interventional pulmonologists, who have been performing rigid bronchoscopies for many years under spontaneous ventilation for laser resection of benign or malignant obstructive airway lesions, stent insertion, large airway dilatation or foreign body removal (13,14).

Lastly, spontaneous ventilation can be useful in the surgical management of segmental tracheomalacia, since it allows recognition of a dynamic obstruction of the trachea, as reported by Vachhani and colleagues (10).

On the other hand, there are also several potential disadvantages associated with this technique. The main one concerns the management of hypoxia and/or hypercarbia. As a matter of fact, it is unknown to what extent oxygenation and carbon dioxide removal is possible with spontaneous ventilation when the trachea is cut open. And for this reason, as described in the paper of Liu and coworkers, it is of uttermost importance that the anesthesia team be ready to switch to general anesthesia when hypoxia ensues, with devices for orotracheal or cross-field intubation ready for use (7). When a thoracoscopic approach is adopted, however, compared with cervicotomy, switching to general anesthesia can be more problematic, since it requires training in orotracheal intubation from the lateral decubitus position, or thoracoscopic intubation (15). Other potential disadvantages include: risk of airway fire when electrocautery is used, impossibility to use positive pressure for the air leak test after completion of the anastomosis, limitations in the use of suction to remove blood and secretion from the airway, and risk of serious complications with coughing. For this latter reason, Li and Peng have described the use of right vagus nerve block through the thoracoscopic approach (11,12).

To conclude, the paper by Liu *et al.* (7), along with the other similar articles herein reported, propose a revolutionary approach to tracheal surgery, both for the surgeons and anesthesiologists. The feasibility of this technique on a routine basis, its benefits, limitations and potential complications need to be better clarified by further studies, possibly performed in centers with experience in non-intubated surgery. We believe that, currently, there's no evidence suggesting that it is preferable to perform tracheal resection and reconstruction under non-intubated conditions rather than under standard general anesthesia, since the supposed benefits are surpassed by the inherent risks of this approach. In fact, being tracheal resection a relatively uncommon and technically challenging procedure, fast-track protocols are not so relevant in this field as they are in the field of minimally invasive surgery for major pulmonary resections. On the other hand, there are some features of spontaneous ventilations which are extremely appealing, and could make it a potentially useful tool in the armamentarium of the tracheal surgeon, provided that switching to general anesthesia is always possible in a safe

and expeditious way, such as when a cervical approach is adopted (7).

### Acknowledgements

None.

### Footnote

*Conflicts of Interest:* The authors have no conflicts of interest to declare.

### References

1. Neshar N, Galili R, Sharony R, et al. Videothoracoscopic sympathectomy (VATS) for palmar hyperhidrosis:summary of a clinical trial and surgical results. *Harefuah* 2000;138:913-6,1008.
2. Rocco G, Martin-Ucar A, Passera E. Uniportal VATS wedge pulmonary resections. *Ann Thorac Surg* 2004;77:726-8.
3. Gonzalez-Rivas D. Uniportal thoracoscopic surgery: from medical thoracoscopy to non-intubated uniportal video-assisted major pulmonary resections. *Ann Cardiothorac Surg* 2016;5:85-91.
4. Rocco G. Non-intubated uniportal lung surgery†. *Eur J Cardiothorac Surg* 2016;49 Suppl 1:i3-5.
5. Pompeo E. State of the art and perspectives in non-intubated thoracic surgery. *Ann Transl Med* 2014;2:106.
6. Liu J, Cui F, Li S, et al. Nonintubated video-assisted thoracoscopic surgery under epidural anesthesia compared with conventional anesthetic option: a randomized control study. *Surg Innov* 2015;22:123-30.
7. Liu J, Li S, Shen J, et al. Non-intubated resection and reconstruction of trachea for the treatment of a mass in the upper trachea. *J Thorac Dis* 2016;8:594-9.
8. Macchiarini P, Rovira I, Ferrarello S. Awake upper airway surgery. *Ann Thorac Surg* 2010;89:387-90;discussion 390-1.
9. Loizzi D, Sollitto F, De Palma A, et al. Tracheal resection with patient under local anesthesia and conscious sedation. *Ann Thorac Surg* 2013;95:e63-5.
10. Vachhani S, Tsai JY, Moon T. Tracheal resection with regional anesthesia. *J Clin Anesth* 2014;26:697-8.
11. Li S, Liu J, He J, et al. Video-assisted transthoracic surgery resection of a tracheal mass and reconstruction of trachea under non-intubated anesthesia with spontaneous breathing. *J Thorac Dis* 2016;8:575-85.
12. Peng G, Cui F, Ang KL, et al. Non-intubated combined

- with video-assisted thoracoscopic in carinal reconstruction. *J Thorac Dis* 2016;8:586-93.
13. Alfille P. Anesthesia for tracheal surgery. In: Grillo HC, editor. *Surgery of the trachea and bronchi*. Hamilton: BC Decker Inc., 2004;453-70.
  14. Perrin G, Colt HG, Martin C, et al. Safety of interventional rigid bronchoscopy using intravenous anesthesia and spontaneous assisted ventilation. A prospective study. *Chest* 1992;102:1526-30.
  15. Okuda K, Nakanishi R. The non-intubated anesthesia for airway surgery. *J Thorac Dis* 2016;8:3414-9.

**Cite this article as:** Zuin A, Mammana M, Rea F. Non-intubated tracheal surgery: is it worthwhile? *J Thorac Dis* 2017;9(10):3663-3666. doi:10.21037/jtd.2017.08.154