

COMMENTARY

Tubeless minimally invasive treatment: taking a new step in enhanced recovery after surgery (ERAS)

To the editor:

We read with great interest the paper by Cui and colleagues¹ where the authors compared the results of the application of two different chest tube management systems after video-assisted thorascopic (VATS) lobectomy. This proved that chest tube management plays a key role in enhanced recovery after lobectomy surgery (ERAS) and also showed a significant impact on patients treated with a minimally invasive surgical approach by using a drainage ball with negative pressure compared with the commonly used chest tube. Here, we summarize the new approaches used in ERAS with a perioperative regime optimization including the new suggested chest tube drainage.

The concept of ERAS is well known by physicians and its implementation requires a combination of minimally invasive surgical techniques. Over the past three decades, the collaboration between the clinical practice of the ERAS concept and minimally invasive surgery has been greatly developed through collaboration with multidisciplinary teams. Tubeless minimally invasive treatment includes no intraoperative tracheal intubation during patient anesthesia, no urinary catheter placement during the operation and no chest tube after the operation. If these aspects of perioperative care regime optimization and all-in-one model in medical care were linked-up, minimally invasive treatment with ERAS could be realized.

Thorascopic surgery was a milestone in thoracic surgery. The concept of ERAS in thorascopic surgery involves the foundation of pain and risk-free wards during the perioperative period and improving the patient's quality of life post discharge, including multimodal analgesia, minimizing the perioperative period to avoid the placement of excessive drainage tubes and patient transfusion, at the same time strengthening postoperative care and rehabilitation which is the goal of tubeless minimally invasive treatment.

Nonintubated anesthesia

Intraoperative anesthesia for double-lumen intubation in patients with lung disease is considered by most anesthesiologists to be necessary, especially for VATS surgery. During long-term surgical anesthesia, it has been confirmed that double-lumen intubation can ensure a safe airway and adequate lung ventilation.² The report by Pompeo *et al.* was one of the first to introduce nonintubated VATS.³

Several studies have subsequently shown the feasibility of this approach.^{4–8} which includes patients with small pulmonary nodules (SPN) less than 2 cm in diameter,⁶ patients with pulmonary tuberculoma⁴ and those with interstitial lung diseases.⁵ All the results showed that patients operated upon under spontaneous ventilation had a shorter postoperative recovery time when compared with the conventional VATS approach. The other two clinical trials also observed a more encouraging response in patients after using this method.^{9,10} In patients where muscle relaxants were not used during surgery, the most obvious advantage of nonintubated anesthesia was that it could reduce postoperative respiratory complications, promote early postoperative activities and earlier oral feeding. However, all clinical thoracic surgeons should be aware that this type of operation requires an experienced and highly specialized anesthesiologist because it may be necessary to intubate the patient in the event of intraoperative complications² (Table 1).

Uniportal VATS

Minimally invasive surgery represented by VATS has become the mainstream and consensus of lung cancer resection which has potential advantages, including less postoperative pain, faster recovery and a better cosmetic outcome.¹³ However, further improvisation of the precise treatment in VATS, reducing patient suffering and improving patient satisfaction remain a challenge for all thoracic surgeons.

The first uniportal VATS of lung cancer resection was reported by Gonzalez *et al.* in 2011.¹⁴ The feasibility of this approach has been demonstrated in even very advanced pulmonary resections.¹⁵ With the clinical popularity and application of the ERAS concept, this approach has advanced the technical development of the single-port VATS procedure in the field of conventional VATS surgery. In the study reported in 2018, patients in the ERAS group had better results on the third day after surgery than on the first day in the visual analog scale (VAS), whilst the length of hospital stay in the ERAS group was shorter than in the control group. The results are probably due to a beneficial aspect of the reduction in trauma caused by uniportal VATS¹⁶ (Table 1).

Table 1 Summary of articles reporting on tubeless VATS for thoracic surgery

Author	YOP	Study period	Study type	Total patients	Nonintubated anesthesia	Uniportal	Nonchest tube drainage	Nonurinary catheter	Age (years)	Operative time (minutes)	PLS (days)
Liu <i>et al.</i> ¹⁰	2018	2016–2017	Retrospective: Case series	50	36	36	31	36	53.6 ± 18.0	45.2 ± 12.3	2.5 ± 0.8
Yang <i>et al.</i> ⁹	2017	2015–2016	Retrospective: Comparative	60	30	30	30	30	55.5 ± 8.4	72.0 ± 21.3	3.1 ± 0.7
Peng <i>et al.</i> ⁵	2017	2014–2015	Retrospective: Case series	43	43	43	40	40	49.6 ± 10.7	22 ± 5	—
Li <i>et al.</i> ⁶	2017	2012–2014	Retrospective: Case series	34	34	34	34	34	58 ± 19	42 ± 10	1 ± 1
Mineo <i>et al.</i> ¹¹	2016	2000–2016	Retrospective: Case series	1000	848	848	—	—	—	—	—
Gonzalez-Rivas <i>et al.</i> ¹²	2016	2015–2016	Retrospective: Case series	3	3	3	3	3	Median 60 (50–68)	—	Median 3 (2–4)
Cui <i>et al.</i> ⁸	2016	2012–2015	Retrospective: Comparative	90	89	0	89	—	Median 24 (22–38)	Median 44 (28–65)	1.5 ± 0.5

The literature search revealed that only some publications on tubeless and VATS provided original clinical data. Key words and MeSH terms searches were conducted for two groups: “Tubeless” and “VATS”. The two groups were combined with the Boolean operator “AND”. PLS, postoperative length of stay; YOP, year of publication.

Nonchest tube drainage

The chest drainage tube is a scaled and flexible plastic tube which is inserted from the outside of the chest through the chest wall into the pleural cavity, or in the mediastinum for drainage. It can be used to drain gas (pneumothorax), fluid (pleural effusion, blood, chyle) or pus (empyema in the chest). For patients who do not have a thoracic drainage tube after surgery, the thoracic surgeon needs to carefully identify and observe potential leaks or hemothorax.

The optimal application of chest tube drainage has been shown to be conducive to ERAS in recent years. The diameter of the chest tube drain has gradually become smaller. In a single center study reported by Lai *et al.*,¹⁷ they used a Foley catheter (*n* = 441 patients) instead of a 28-F chest tube (*n* = 223 patients) after VATS lobectomy resulting in a statistically significant reduction in pain, shortened mean days until chest tube removal after lobectomy and a smaller proportion of disordered wound healing at the drainage site. The potential benefits of avoiding chest drains are reduced pain, discomfort, and incidence of respiratory complications^{10,18} (Table 1).

Nonurinary catheter

Using a urinary catheter in thoracic surgery is necessary to monitor liquid input and prevent bladder distension if surgical time is increased, or in case of haemodynamic instability. Patients with a urinary catheter in situ recovering from general anesthesia induction often exhibit severe urinary tract irritation symptoms including an increase in abdominal cramps, urgency and dysuria, especially in male patients. It is often difficult to effectively offer relief for patients, even with sedative pain medications.

Qiu *et al.*¹⁹ reported a prospective cohort study in which they recruited 100 patients who were scheduled for pulmonary lobectomy under general anesthesia in a single institution. There was no statistical difference in incidence of postoperative urinary retention or urinary tract infection between the two groups (indwelling urinary catheter group and no indwelling urinary catheter group). However, the degrees of comfort and postoperative hospitalization time in the no indwelling urinary catheter group was better than the other group. With the application and development of the ERAS in the perioperative period, the no indwelling urinary catheter will become an important part of the tubeless process of VATS.⁶ In the research by Sihoe *et al.*²⁰ a total of 22 articles on uniportal VATS were included in the discussion, and the original clinical data of each article extracted for research. These articles included nine case series and 13 comparative studies and combined with the final data, the conclusion was that single-port VATS may be superior to multiportal VATS in reducing postoperative pain and shortening hospital stay (Table 1).

Conclusion

The concept of tubeless VATS (i.e., a combination of no intraoperative tracheal intubation, postoperative chest tube and urinary catheterization) is to improve a patient's experience and postoperative care by minimizing the problems and discomfort associated with these interventions.⁶ ERAS is the result of the development of medical theory and surgical technology and not only does it pay more attention to reducing patient stress response but also takes into account assessment and intervention of the surgical conduct risk. ERAS is a series of optimization measures using perioperative management with evidence-based medical evidence to reduce the physiological and psychological traumatic stress to surgical patients in order to achieve rapid rehabilitation.

In future, it appears predictable that investigators may wish to further compare the relative value of uniportal VATS with other approaches such as robot-assisted resection and various multiportal VATS techniques with ERAS.²⁰ As suggested, this should be followed-up by prospective randomized controlled trials producing high-level evidence in order to improve clinical aims. For our thoracic surgeons, the most ideal clinical goal is to provide patients with the highest quality and most suitable surgery in order to achieve rapid and safe recovery with the lowest possible morbidity and mortality, and to improve the quality of life after surgery.

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Disclosure

The authors declare that they have no competing interests.

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