Contralateral Spontaneous Rupture of the Esophagus Following severe Vomiting After Non-intubated Pulmonary Wedge Resection

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Case report

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Abstract

**Background:** Non-intubated thoracoscopic lung surgery has been widely applied as it is technically feasible and safe. Spontaneous rupture of the esophagus, also known as Boerhaave's syndrome (BS), is rare after chest surgery.

**Case Presentation:** A 60-year-old female non-smoker underwent non-intubated uniportal thoracoscopic wedge resection assisted with a laryngeal mask for a solitary pulmonary nodule. Ultrasound-guided serratus anterior plane block was utilized for analgesia. The patient complained of hyperemesis followed by chest pain and acute dyspnea 6 hours after the surgery. Emergency chest x-ray revealed the right-sided hydropneumothorax. BS was confirmed by further chest tube drainage and computed tomography. The patient refused surgical intervention; therefore, conservative procedures including pleural evacuation through a naso-leakage drainage tube, antibiotics and tube feeding were administered. The healing of the esophagus was recorded 40 days later.

**Conclusions:** Perioperative antiemetic is an indispensable item of tubeless thoracic surgery. BS should be kept in mind when the patients suffer from sudden chest distress following severe vomiting after tubeless lung surgery.

**Background**

Spontaneous rupture of the esophagus (Boerhaave's syndrome, BS), firstly described in 1724, is defined as the complete disruption of the esophageal wall, typically occurring after severe vomiting [1]. BS accounts for 15% of esophageal perforations, and the tear is usually located on the lower third of the esophagus [2]. Contrast esophagram and computed tomography (CT) are usually sufficient for the diagnosis of BS. Non-intubated or tubeless video-assisted thoracoscopic surgery (VATS) under intravenous/local anesthesia can be utilized to avoid the potential adverse effects of mechanical ventilation; whereas the complications of non-intubated procedure include intraoperative hypoxia, hypercapnia, and cough. A consensus recommendation regarding the preparation, surgical techniques, and postoperative management during non-intubated VATS has been established [3].

To the best of our knowledge, the onset of contralateral esophageal rupture after limited lung resection without mediastinal lymph node dissection is rare. Herein we presented a case of BS following severe vomiting after non-intubated lung surgery. Meanwhile, an updated review of the current evidence regarding the safety profile of non-intubated/tubeless thoracic surgery was conducted briefly.

**Case Presentation**

The clinical data was treated anonymously for privacy concern. A 60-year-old previously healthy female non-smoker was admitted because the CT during the health examination revealed a ground-glass nodule about 0.5 cm in diameter in the left upper lobe (Fig. 1A), in suspicious of malignancy. The serum neuron-
specific enolase, cytokeratin-19 fragment, carcinoembryonic antigen, and squamous cell carcinoma were all in normal range. According to the multi-disciplinary consultation after a preoperative workup, the patient was assigned to a timely pulmonary wedge resection. Fast-track protocol was introduced individually. Three-dimensional CT angiography of the target lung was established using the free OsiriX for non-invasive location of the nodule [4], and the mechanical labeling by microcoil or hook-wire was avoided. Then non-intubated uniportal VATS pulmonary wedge resection was performed using internal intercostal nerve block, vagal block, and targeted sedation as reported [5, 6]. The operation time was 30 minutes, without significant blood loss. Mediastinal lymph node dissection or sampling was avoided because the frozen-section reported atypical adenomatous hyperplasia (AAH). Ultrasound-guided serratus anterior plane block (SAPB) using a bolus of 0.2% bupivacaine was utilized for postoperative analgesia.

Next-day discharge was scheduled because air leak or fistula was not recorded. However, the patient complained nausea and severe vomiting about 3 h after the operation, which was alleviated gradually after the injection of ondansetron (4 mg, once). However, the patient developed sudden tachycardia, tachypnea, acute dyspnea, and hypotension after oral feeding 6 h after the surgery. Emergency x-ray revealed hydropneumothorax in the right pleural space (Fig. 1B). The turbid yellow fluid from the chest tube and the identification of the perforation site in CT images confirmed the diagnosis of BS. The patient declined a timely surgical intervention for personal reasons; therefore, conservative procedures including pleural evacuation, antibiotics and tube feeding were administered. Endoscopy-guided naso-leakage drainage insertion was performed as reported [7], with the aim to rinse the vomica effectively. The healing of the esophageal perforation was recorded 40 days after the treatment (Fig. 1C). Then the patient was discharged from the hospital. During the follow up of a year, she demonstrated satisfactory quality of life.

**Discussion And Conclusions**

For the present case, postoperative severe vomiting is presumed to be the reason for the onset of BS. BS mainly results from severe vomiting (forceful emesis) which is one of the most stressful complications of general anesthesia. The incidence of post-discharge vomiting after ambulatory surgery is approximately 30% [8]. Pain and vomiting always suggest the diagnosis of BS, but the patients don't always present with typical clinical features. A retrospective review showed that surgery should be considered regardless of the time after onset [9], especially for those who were admitted within 24 hours of perforation [10, 11]. Endoscopic management plays a vital role in the treatment of transmural defects [12], but evidence-based recommendation is still lacking to date. Moreover, naso-esophageal extraluminal drainage has been reported to be effective for the treatment of anastomotic leaks and subsequent mediastinal abscess [13].

Non-intubated VATS under minimal sedation with local or regional anaesthesia is useful to avoid postoperative nausea and vomiting [14]. However, the evidence supporting non-intubated VATS as the preferred approach for lung surgery is still limited. Previous meta-analyses reported that non-intubated procedure attenuated the inflammatory response and stress, followed by fewer postoperative
complications as compared with the intubated VATS [15, 16]. Moreover, the indications for VATS could be extended by this less-invasive procedure. For example, patients with impaired lung function or chronic obstructive pulmonary disease are considered as high-risk for intubated general anesthesia; whereas the non-intubated VATS may be applied in these cases [17]. On the other hand, non-intubated VATS may be a better alternative to intubated surgery owing to its advantages [18]. However, given the potential emergencies including but not limited to the persistent hypoxemia, carbon dioxide retention, and extensive pleural adhesions, non-intubated anesthesia in lung resection surgery requires extra vigilance to ensure the safety of the patients [19]. Moreover, the other disadvantages of non-intubated thoracic surgery include cough and poor maneuverability due to the movements of the diaphragm and lung [20].

Although it is still premature to declare the superiority of non-intubated lung surgery versus the intubated procedure, there is an obvious trend for more and better studies to be introduced. The updated evidence in terms of the feasibility and safety of non-intubated thoracic surgery should be clarified. We searched PubMed, Web of Science, Scopus, Embase, Europe PMC, Cochrane Library and Google Scholar for randomized controlled trials (RCTs) up to June 2020 based on Population, Intervention, Comparator, and Outcomes framework according to the PRISMA Protocol. Key words and MeSH terms in title or abstract including “non-intubated” or “tubeless” or “awake” and “pulmonary” or “lung” and “surgery” were used. No restriction was made regarding the publication language. Finally a total of 13 reported RCTs were summarized in Table 1, which covered 627 patients who underwent non-intubated or tubeless VATS. Among them, 11 (1.8%) morbidities due to gastrointestinal reactions were recorded. Based on the findings from the literature review, non-intubated VATS is technically feasible with a satisfactory safe profile; however, the results should be interpreted with caution due to the potential bias and small samples. Further studies are warranted to elucidate the specific indications of conversion from sedation to intubated general anaesthesia as well as the reliable management of perioperative emergencies such as persistent hypoxemia, and carbon dioxide retention. The registered trials regarding non-intubated thoracic surgery were listed in Table 2.
Table 1  
The reported randomized clinical trials regarding non-intubated thoracoscopic lung surgery

| First author, year | Sample | Age, year | Anaesthesia method | Surgical procedure | Conversion to intubation | Postoperative analgesia | Morbidity due to gastrointestinal reactions |
|-------------------|--------|-----------|--------------------|--------------------|--------------------------|-------------------------|----------------------------------------|
| Pompeo, 2004 [21]| 30     | 60 (45–68)| TEA at T4-T5       | Pulmonary nodule resection | 4 (13.3%)                | TEA                     | NA                                     |
| Pompeo, 2007 [22]| 21     | 28 ± 14   | Locoregional anaesthesia | Bullectomy          | 0                        | TEA                     | 1 (4.8%)                               |
| Vanni, 2010 [23]  | 25     | 57 (51–62)| TEA                | NA                 | 0                        | PCIA                    | 0                                      |
| Tacconi, 2010 [24]| 11     | 48 (43–55)| TEA                | Lung nodule resection, bullectomy, pleural-lung biopsy | 0                        | PCIA                    | 0                                      |
| Pompeo, 2011 [25]| 32     | 64 ± 9    | TEA at T4-5        | Lung volume reduction | 2 (6.3%)                | NA                      | 0                                      |
| Pompeo, 2013 [26]| 20     | 67 ± 12   | TEA at T4          | Pleurodesis         | 0                        | NA                      | 0                                      |
| Cai, 2013 [27]    | 30     | 23.5 ± 10.6| Laryngeal mask anesthesia | Bullectomy          | 0                        | PCIA                    | 3 (10.0%)                             |
| Wang, 2014 [28]   | 50     | 43.2 ± 14.7| General anesthesia; laryngeal mask | Bullectomy, lobectomy, biopsy, mediastinal mass excision | 0                        | NA                      | 0                                      |
| Liu, 2015 [29]    | 167    | NA        | TEA                | Wedge resection, lobectomy | 0                        | NA                      | 4 (2.4%)                               |

Abbreviations: TEA, thoracic epidural anesthesia; PCIA, patient controlled intravenous analgesia; NA, not available.
| First author, year | Sample | Age, year | Anaesthesia method | Surgical procedure | Conversion to intubation | Postoperative analgesia | Morbidity due to gastrointestinal reactions |
|--------------------|--------|-----------|--------------------|-------------------|------------------------|------------------------|-----------------------------------------------|
| Chen, 2016 [30]    | 85     | 23.3 ± 6.8 | Intravenous anaesthesia | Sympathectomy       | 0                      | NA                     | 0                                             |
| Mao, 2018 [31]     | 30     | 21 ± 3.2  | General anaesthesia + laryngeal mask | NUS procedure        | 0                      | PCIA                   | 3 (10.0%)                                      |
| Hwang, 2018 [32]   | 21     | 17 (17–45) | Sedation anaesthesia | Bullectomy          | 0                      | Local analgesia         | 0                                             |
| Mogahed, 2019 [33] | 35     | 42.9 ± 9.6 | General anaesthesia | Lung resection, excision/biopsy of mediastinal mass, foreign body extraction and pericardial window. | 0 | Intramuscular ketoprofe | NA                                          |
|                    | 35     | 43.5 ± 10.5 | General anaesthesia + TEA |                    |                        |                        |                                               |
|                    | 35     | 44.0 ± 9.3  | General anaesthesia + intercostal block infiltration |                    |                        |                        |                                               |

Abbreviations: TEA, thoracic epidural anesthesia; PCIA, patient controlled intravenous analgesia; NA, not available.
| Registration identifier | Year | Disease | Anaesthesia method | Estimated enrolment | Major outcomes | Status | Country |
|-------------------------|------|---------|--------------------|---------------------|---------------|--------|---------|
| NCT00566839             | 2007 | Emphysema | TEA                | 60                  | Mortality, FEV1, dyspnea index | Complete | Italy    |
| NCT01469728             | 2011 | NA      | TEA                | 40                  | Grade of medical care | Complete | Italy    |
| NCT01677442             | 2011 | NA      | TEA at the T5/T6  | 500                 | Recovery time | Unknown | China    |
| NCT01533233             | 2012 | Lung cancer | NA                | 100                 | Complication and morbidity | Unknown | China    |
| NCT02109510             | 2014 | Pneumothorax | Sedation anaesthesi a + intercost al nerve block | 40                  | Postoperative discomforts | Complete | Korea    |
| NCT02123173             | 2014 | Lung neoplasms | NA (one lung ventilation) | 71                  | Cardiac output | Complete | China    |
| NCT02393664             | 2015 | Lung neoplasms | General anaesthesi a + intercost al/vagal blocks | 300                 | Quality of recovery | Unknown | China    |
| NCT02817048             | 2016 | Solitary lung nodule | NA (Tubeless ) | 100                 | Postoperative hospital stay | Not yet recruiting | China    |
| NCT03275428             | 2017 | Lung nodule | Intravenous sedation | 40                  | Arterial oxygen pressure | Unknown | China    |
| NCT03083080             | 2017 | NA      | Intercost al nerve plane block | 30                  | Pain, time to lose skin sensation | Unknown | China    |

TEA, thoracic epidural anaesthesia; FEV1, Forced expiratory volume in one second; NA, not available.
| Registration identifier | Year | Disease | Anaesthesia method | Estimate enrollment | Major outcomes | Status | Country |
|-------------------------|------|---------|---------------------|---------------------|----------------|-------|---------|
| NCT03086213            | 2017 | NA      | Paravertebral/intercostal nerve block | 48                 | The change of stress response markers | Unknown | China   |
| NCT03016858            | 2017 | Bulla   | Intravenous anesthesi a | 320               | Complications | Recruiting | China   |
| NCT03137576            | 2017 | Lung neoplasms | Erector spinae plane block/paravertebral block and sedation | 172                | Percentage of sedation escalation | Recruiting | Italy   |
| ChiCTR-INR-17012747    | 2017 | Thoracic diseases | General anesthesi a | 30                 | Length of hospital stay | Recruiting | China   |
| ChiCTR-IPR-17013325    | 2017 | Lung nodule | Intravenous anesthesi a | 120                | CD3+, CD8+, CD4+, CD19+, NK cell concentration | Not yet recruiting | China   |
| NCT03711461            | 2018 | NA      | NA                  | 32                 | Impedance changes (swallowing) | Recruiting | China   |
| NCT03432637            | 2018 | Lung cancer | Spontaneous ventilating anesthesi a | 450                | Hypoxemia or hypercapnia | Recruiting | China   |
| NCT03471884            | 2018 | Lung cancer | General anesthesi a | 82                 | Lung function | Recruiting | China   |

TEA, thoracic epidural anaesthesia; FEV1, Forced expiratory volume in one second; NA, not available.
| Registration identifier | Year | Disease | Anaesthesia method | Estimated enrollment | Major outcomes | Status | Country |
|-------------------------|------|---------|--------------------|----------------------|----------------|--------|---------|
| NCT03469323             | 2018 | NA      | NA (one-lung spontaneous breathing) | 30                  | Quality of lung collapse | Recruiting | China   |
| ChiCTR1800018198        | 2018 | NA      | Paravertebral nerve block + laryngeal mask | 110                 | Glottal injury, sore throat | Recruiting | China   |
| NCT03653494             | 2018 | NA      | General anesthesia + paravertebral block + surface spray anesthesia + vagus block with or without phrenic block | 80                  | Anesthetic drugs needed | Enrolling by invitation | China   |
| ChiCTR1800018204        | 2018 | NA      | Serratus anterior plane/erector spinae plane/paravertebral block | 90                  | Nerve block time | Not yet recruiting | China   |
| ChiCTR1800017854        | 2018 | T1a (≤2 cm) peripheral lung adenocarcinoma | NA (Tubeless) | 200                  | Complications | Not yet recruiting | China   |
| NCT03874403             | 2019 | NA      | Intercostal nerve block | 60                  | The density spectral array | Recruiting | China   |

TEA, thoracic epidural anaesthesia; FEV1, Forced expiratory volume in one second; NA, not available.
| Registration identifier | Year | Disease                      | Anaesthesia method                                                                 | Estimate enrollment | Major outcomes                                                                 | Status          | Country   |
|-------------------------|------|------------------------------|--------------------------------------------------------------------------------------|---------------------|---------------------------------------------------------------------------------|-----------------|-----------|
| NCT04057586             | 2019 | NA                           | NA (one lung ventilator)                                                             | 240                 | Intraoperative cerebral oxygenation                                              | Recruiting      | China     |
| ChiCTR1900027350        | 2019 | Lung cancer                  | Intercostal/paravertebral nerve block + general anaesthesia using laryngeal mask     | 80                  | Hemodynamics, general anesthetic dose, recovery time                            | Recruiting      | China     |
| ChiCTR1900022020        | 2019 | Thoracic disease             | General anaesthesia                                                                | 120                 | Glottal injury incidence, lung collapse score                                   | Recruiting      | China     |
| NCT03958162             | 2019 | Interstitial lung disease    | NA (tubeless)                                                                        | 60                  | Diagnostic yield after biopsy                                                   | Not yet recruiting | China     |
| NCT03902470             | 2019 | Lung cancer                  | TEA                                                                                  | 30                  | Recovery time                                                                   | Not yet recruiting | Egypt     |

TEA, thoracic epidural anaesthesia; FEV1, Forced expiratory volume in one second; NA, not available.

In summary, perioperative antiemetic should be considered as an indispensable item of fast-track thoracic surgery; meanwhile, a strict supervision is necessary in the ongoing trials. BS should be kept in mind when the patients report severe vomiting after non-intubated lung surgery.

**List Of Abbreviations**

CT, computed tomography; BS, Boerhaave’s syndrome; VATS, video-assisted thoracoscopic surgery; AAH, atypical adenomatous hyperplasia; SAPB, serratus anterior plane block; RCTs, randomized controlled trials

**Declarations**
Ethics approval and consent to participate

This report was approved by the Institutional Review Board of Xuzhou Central Hospital, and written informed consent was obtained from the patient.

Consent for publication

Written informed consent was obtained from the patient for publication of this report and any accompanying images.

Availability of data and materials

The data of the present case is available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

MZ performed the surgery and wrote this paper. LL contributed to the preparation of the figures and tables. All authors contributed to preparation of the paper and to the perioperative treatment of the patient. All authors approved the final manuscript.

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Figures

Figure 1

The radiographic examinations of the patient. (A) The CT on admission revealed a nodule in the left upper lobe, as indicated by arrow. (B) The chest x-ray showed right-sided hydropneumothorax. (C) The CT images confirmed the healing of the esophagus.

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