**Scholars Journal of Medical Case Reports**
Abbreviated Key Title: Sch J Med Case Rep
ISSN 2347-9507 (Print) | ISSN 2347-6559 (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

Surgery

# Bursting the Bubble: Uniportal VATS for Recurrent Pneumothorax in a Young Vaper

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**DOI:** https://doi.org/10.36347/sjmcr.2025.v13i04.022 | **Received:** 11.03.2025 | **Accepted:** 18.04.2025 | **Published:** 21.04.2025

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**Abstract** | **Case Report**

A 29-year-old male with a history of vaping and a prior right pneumothorax in 2022, managed conservatively with chest tube insertion, presented with persistent left-sided pneumothorax. Preoperative contrast-enhanced computed tomography (CT) confirmed a tension pneumothorax with mediastinal shift but no evidence of bronchopleural fistula. The patient underwent uniportal VATS bullectomy, pleural abrasion, and talc pleurodesis, resulting in full lung expansion. This case highlights the utility of minimally invasive surgical intervention in recurrent pneumothorax associated with vaping-related lung disease.

**Keywords:** Pneumothorax, Vaping, Uniportal VATS (Video-Assisted Thoracoscopic Surgery), Bullectomy, Pleurodesis.



## INTRODUCTION

Spontaneous pneumothorax is a well-documented complication in young adults, with a higher incidence observed among smokers and vapers. The underlying pathophysiology is often attributed to the development of subpleural blebs or bullae, which may rupture and introduce air into the pleural space. Emerging evidence suggests that vaping may contribute to alveolar instability and lung parenchymal damage, further predisposing individuals to secondary spontaneous pneumothorax. Given the increasing prevalence of vaping, its role as a potential risk factor warrants further investigation.

Initial management of pneumothorax typically involves chest tube insertion to facilitate lung reexpansion and evacuate intrapleural air. However, in cases of recurrent pneumothorax or persistent air leaks, further imaging modalities such as computed tomography (CT) are essential to assess underlying pathology. Patients with ongoing air leaks or incomplete lung expansion despite adequate drainage often require definitive surgical intervention, such as video-assisted thoracoscopic surgery (VATS) bullectomy and pleurodesis, to prevent recurrence and restore pulmonary integrity.

Uniportal video-assisted thoracoscopic surgery (VATS) has emerged as an effective, minimally invasive approach for bullectomy and pleurodesis, promoting rapid recovery and reducing recurrence rates. This case report describes a young vaper who underwent uniportal VATS for persistent left pneumothorax.

## CASE PRESENTATION

A 29-year-old male, with a history of chronic vaping and a prior right-sided pneumothorax in 2022 that was successfully managed with chest tube drainage presented 2 years later with acute onset of dyspnea and left-sided pleuritic chest pain at rest. On admission, he was comfortable under room air, hemodynamically stable without signs of respiratory distress and saturation of 100% on room air. Physical examination revealed reduced air entry over the left lung field.

A chest radiograph (CXR) confirmed a spontaneous left-sided pneumothorax, prompting immediate chest tube insertion. However, serial CXRs demonstrated persistent lung collapse despite continuous drainage with suction with continuous bubbling. A contrast-enhanced computed tomography (CECT) scan of the thorax subsequently revealed a left-sided tension pneumothorax with rightward mediastinal shift and segmental lung collapse but no evidence of a bronchopleural fistula. Laboratory investigations were within normal limits. Preoperative transthoracic echocardiography demonstrated a preserved left

ventricular ejection fraction (60–65%) with normal chamber sizes and no structural cardiac abnormalities.

**Surgical Procedure**

The patient was placed in the right lateral decubitus position under general anesthesia with single-lung ventilation. A single 4 cm incision was made at the 5th intercostal space in the mid-axillary line. Upon entry into the pleural cavity, multiple bullae measuring 1-2 cm were identified at the left upper lobe, along with minimal seropurulent pleural fluid but no adhesions.

Apical bullectomy was performed using an Echelon Flex 45 mm stapler to excise the affected areas. Mechanical pleurodesis was achieved through pleural abrasion using a diathermy scratch pad, followed by the administration of chemical pleurodesis using talc. A 32Fr chest drain was placed apically to ensure adequate postoperative drainage. Hemostasis was secured, and the incisions were closed in layers.

**Postoperative Course**

Postoperatively, the chest drain demonstrated intermittent bubbling in the water seal chamber, indicative of an ongoing air leak and failure of complete lung re-expansion. The drain was connected to Medela drain with continuous suction of 20cmH20 and to precisely monitor the amount of air leak throughout the postoperative period. The patient remained stable postoperatively with full lung expansion and chest drain was removed as soon as drainage was minimal and bubbling resolved. A chest radiograph was performed postoperatively to confirm & monitor lung expansion.

Prophylactic intravenous antibiotics were continued to mitigate the risk of surgical site and pleural infections, particularly given the presence of seropurulent pleural fluid intraoperatively. The patient was initiated on empirical cefuroxime 1.5 g IV every 8 hours, with plans for de-escalation based on pleural fluid culture and sensitivity results. Inflammatory markers were monitored, and no signs of infection were observed. The antibiotic regimen was discontinued on postoperative day three, in accordance with institutional protocols for VATS procedures with no evidence of active infection.

A multimodal analgesic approach was employed postoperatively to optimize pain control while minimizing opioid use. This included intravenous acetaminophen with opioids such as morphine and fentanyl reserved for breakthrough pain. Non-pharmacological strategies, including early mobilization and incentive spirometry, were integrated into postoperative care to enhance recovery and reduce pulmonary complications. The patient reported adequate pain control with this regimen and did not require patient-controlled analgesia.

Postoperatively, the patient demonstrated excellent pulmonary effort, achieving an incentive spirometry volume of 4500 mL, indicative of good lung expansion and diaphragmatic function. This suggests effective postoperative pulmonary rehabilitation, adequate pain control, and minimal restrictive impairment following uniportal VATS. The patient was encouraged to perform regular incentive spirometry exercises to maintain optimal lung recruitment and prevent atelectasis.

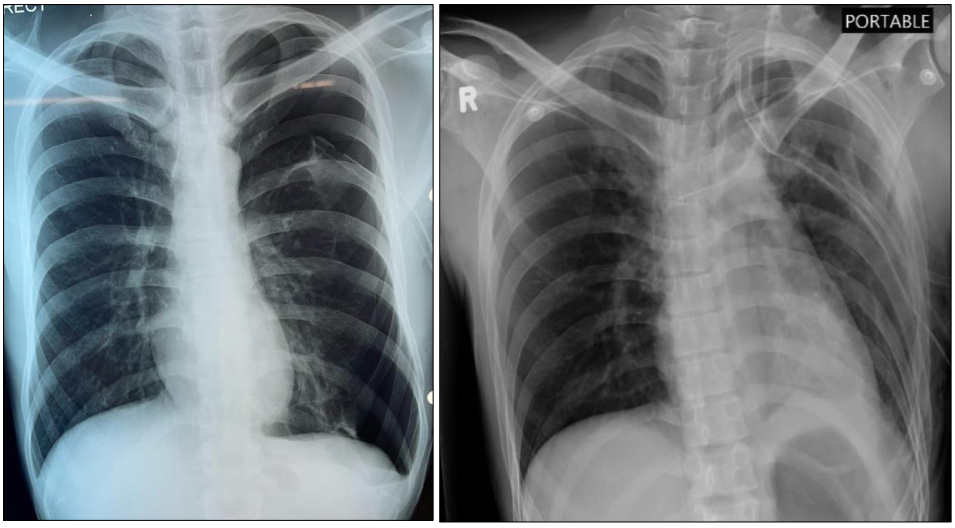


**Figure 1: Serial chest radiographs (CXR) demonstrating the progression of the patient's pulmonary condition. The initial posteroanterior and subsequent portable anteroposterior films reveal evidence of a right-sided pneumothorax, with partial lung collapse and visible pleural line. Interval imaging illustrates post-operative CXR changes in the lung fields following chest tube insertion and resolution of the pneumothorax**

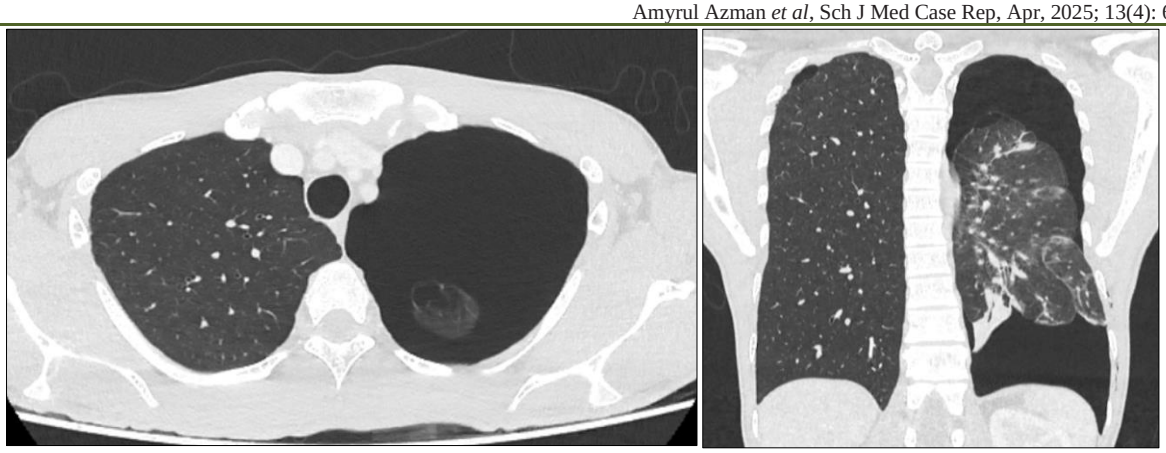

**Figure 2: High-resolution computed tomography (CT) scan images of the thorax in axial and coronal planes. These images clearly demonstrate the presence of apical subpleural blebs in the right upper lobe, consistent with the etiology of the patient's spontaneous pneumothorax. The CT axial cut (left) localizes multiple small air-filled blebs adjacent to the pleural surface, while the coronal reconstruction (right) highlights the distribution and extent of these lesions along the upper lobe periphery**

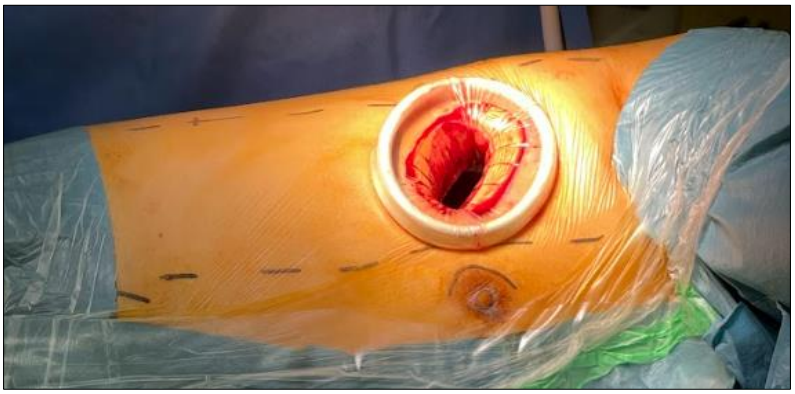

**Figure 3: Intraoperative photograph captured during thoracotomy, demonstrating the uniportal VATS incision with visible lung parenchyma and chest wall structures. The exposure reveals the apical region of the right lung, with the surgical field prepared for wedge resection of the subpleural blebs and pleurodesis. This image illustrates the operative approach undertaken for definitive management of the patient's recurrent pneumothorax**


**Figure 4: Intraoperative photograph of the bullectomy specimen obtained during VATS. The image demonstrates resected lung tissue containing apical subpleural bullae, excised en bloc. The specimen measures approximately 9 cm in maximum length, with visible thin-walled, air-filled cystic spaces characteristic of bullae formation. This confirms the intraoperative finding of subpleural bullae as the underlying cause of the patient's recurrent spontaneous pneumothorax**

## DISCUSSION

Pneumothorax is defined as the presence of air within the pleural space, located between the parietal and visceral pleura [1], leading to partial or complete lung collapse due to the loss of negative intrapleural pressure. This condition disrupts the normal adherence of the lung to the chest wall, impairing pulmonary mechanics and gas exchange. It is a recognized complication in young adults, particularly among smokers and vapers. The increasing prevalence of vaping-related lung disease raises concerns regarding its role in predisposing individuals to secondary spontaneous pneumothorax.

Pneumothorax can be classified based on its pathophysiology and etiology into several categories [1]. It may be categorized as closed (air enters the pleural space without an external wound) or open (air enters through a penetrating chest injury). Additionally, it can be classified as simple (without significant hemodynamic compromise) or tension (progressive accumulation of air leading to increased intrathoracic pressure, mediastinal shift, and cardiovascular instability). Etiologically, pneumothorax is further divided into spontaneous (occurring without an external trauma, either primary or secondary to underlying lung disease) and traumatic (resulting from blunt or penetrating chest trauma, iatrogenic injury, or barotrauma).

A primary spontaneous pneumothorax (PSP) is traditionally defined as a pneumothorax which presents without a precipitating external event in the absence of clinical lung disease. PSP is more common in males than females (roughly three to six times higher). The incidence of PSP in males ranges from 7.4 per 100,000 population per year in the United States to 37 per 100,000 population per year in the United Kingdom [2].

This case highlights the occurrence of spontaneous pneumothorax in a young adult vaper, emphasizing the potential role of vaping-related lung injury in the development of subpleural blebs and bullae. The patient had no known underlying lung disease but had a history of vaping, a growing risk factor for spontaneous pneumothorax.

Subpleural blebs, which are small, air-filled cystic structures beneath the pleural surface, are prone to rupture, leading to air leakage into the pleural space [2] Pathologic assessment of resected specimens in one study by M Ohata in 1980 suggests disrupted areas of mesothelial cells, inflammation, and pores with diameters of 10 to 20 microns and not a breach in the visceral pleural membrane [3]. In this case, intraoperative findings revealed multiple bullae at the left upper lobe, which were likely responsible for the persistent air leak and failure of lung re-expansion despite chest tube drainage. The presence of minimal seropurulent pleural fluid without adhesions further suggests that the underlying pathology was likely related to alveolar instability rather than infection or pleural inflammation.

The increasing incidence of secondary spontaneous pneumothorax in young adults, particularly among vapers, raises concerns about the long-term pulmonary effects of vaping. The presence of bullae in this case suggests vaping-induced lung damage, contributing to the risk of recurrent pneumothorax. According to the Centers of Disease Control (CDC), a total of 2807 hospitalized E-cigarette or vaping associated lung injury (EVALI) cases or deaths have been reported as of February 18, 2020 [4]. While the long-term adverse health effects of vaping are still unknown, the acute events (e.g., pneumonitis, acute respiratory distress syndrome) that have occurred are of great concern [5]. Conservative management is typically the first-line treatment; however, surgical intervention becomes necessary in cases of persistent air leaks or recurrent pneumothorax.

Computed tomography (CT) of the chest can be used to detect patients with small pneumothoraces (less than 15% area of hemithorax) [6]. Additionally, CT imaging provides detailed information to guide subsequent management by assessing the number, size, and location of bullae or blebs (whether ipsilateral or contralateral). It also helps identify the presence of pleural adhesions, pleural fluid accumulation, and any underlying pulmonary disease.

In a journal article published by Rajwinder *et al*., in 2005, which compares uniportal video-assisted thoracic surgery (VATS) with the conventional three-port VATS for spontaneous pneumothorax, focusing on post-operative pain, paraesthesia, and neurological complications [7]. Both techniques had similar efficacy in terms of lung resection, drainage time, and hospital stay. The uniportal group experienced significantly lower postoperative pain scores compared to the three-port group (median VAS score: 0.4 vs. 0.8, $P = 0.06$). Neurological complications were notably higher in the three-port group, with only 42% of patients being symptom-free compared to 86% in the uniportal group. Some three-port patients reported lifestyle-limiting paraesthesia, including altered breast sensitivity leading to sexual dysfunction. No recurrence was observed in the uniportal group, whereas one patient in the three-port group had a pneumothorax recurrence. It has demonstrated that uniportal VATS is a safe and effective alternative to the three-port technique, offering lower post-operative pain and reduced neurological complications without compromising surgical efficacy [7].

Uniportal VATS has demonstrated efficacy in managing spontaneous pneumothorax, offering advantages such as reduced postoperative pain, shorter hospital stays, and improved cosmetic outcomes

compared to traditional multiport VATS or open thoracotomy. The combination of bullectomy and pleurodesis significantly reduces the risk of recurrence by addressing the underlying pathology and reinforcing pleural adhesion.

Chang *et al*., (2023) conducted a systematic review and meta-analysis comparing pleural abrasion and apical pleurectomy in the surgical management of primary spontaneous pneumothorax [8]. The review demonstrated pleural abrasion was associated with reduced hospital length of stay, shorter postoperative chest tube duration, decreased operative time, and lower intraoperative blood loss. The study concludes that pleural abrasion minimizes perioperative burden without compromising efficacy, making it a preferable first-line surgical option.

In a study by S. Györik *et al*., (2007), evaluated the long-term outcomes of thoracoscopic talc pleurodesis in patients with primary spontaneous pneumothorax (PSP) treated for prolonged air leaks (>48 hours) or recurrence [9]. The success rate was 95% (56/59 patients achieved successful pleurodesis), while recurrence rate was 5% (3/56 patients had recurrent pneumothorax, all were smokers). It had concluded that thoracoscopic talc pleurodesis is a highly effective, long-term solution for PSP recurrence prevention. Patients who do not smoke maintain normal lung function after the procedure. Smokers had worse lung function outcomes and a higher risk of recurrence [9].

Endobronchial valve (EBV) placement is a minimally invasive treatment option for patients with giant bullae, offering lung volume reduction by promoting bulla deflation and re-expansion of surrounding functional lung tissue, particularly in those who are poor surgical candidates. Erdoğan Çetinkaya *et al*., (2015) discussed key criteria for selecting EBV candidates. EBV is a viable treatment option for patients with large bullae who are poor surgical candidates due to severe COPD, hyperinflation, or the risk of prolonged air leak. Ideal candidates include those with a giant bulla compressing functional lung tissue, poor surgical fitness, minimal collateral ventilation, and sufficient potential for target lobe collapse [10].

The optimal duration of chest tube suction for managing post-lung resection air leaks remains debated. Studies suggest that early transition from suction (-20 $cmH_2O$) to water seal, typically within 48 hours, may promote faster resolution of air leaks compared to prolonged suction (72 hours or more). Cerfolio *et al*., demonstrated that patients randomized to water seal at 48 hours had a significantly higher rate of air leak cessation compared to those remaining on suction. Similarly, Marshall *et al*., found that water seal resulted in shorter air leak duration (1.5 vs. 3.3 days). However, in cases of persistent pneumothorax on water seal, low-level suction (-10 $cmH_2O$) may be beneficial to facilitate lung re-expansion [11].

## CONCLUSION

This case underscores the potential link between vaping and recurrent pneumothorax, necessitating definitive surgical intervention. Uniportal VATS serves as an effective minimally invasive approach for managing secondary spontaneous pneumothorax, offering reduced morbidity and enhanced recovery. Further studies are needed to explore the pathophysiological mechanisms underlying vaping-associated lung disease and its impact on pneumothorax incidence. Clinicians should consider vaping as a potential risk factor in young patients presenting with spontaneous pneumothorax, and appropriate counseling on smoking cessation should be provided.

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