Congenital Tracheal Stenosis Repair: A 10 years Review Of Tracheoplasty In A Single Tertiary Institution

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Congenital tracheal stenosis (CTS) is a rare but life-threatening condition in children. Slide tracheoplasty has been advocated as the preferred technique for most cases of CTS, particularly the long segment type. With advancements in surgical techniques, the in-hospital mortality after slide tracheoplasty has decreased chronologically.

Our study describes the results of surgical slide tracheoplasty (STP) in infants and children with long-segment tracheal stenosis and low birth weight (range of 1.4 to 2.9 kg). A retrospective review of tracheal surgery from 2012 to 2022 was performed. Demographic data, operative details, perioperative data, and clinical outcomes were collected.

There were six patients with a median age of 6.5 months and a median weight of 2.44 kg. Slide tracheoplasty was performed on all six patients, and one patient underwent additional tracheoaortopexy. Three patients (50%) had a pulmonary artery sling, and one patient had an aberrant right subclavian artery. Bronchomalacia was present in 3 patients. Simultaneous intracardiac repairs requiring cross-clamp and cardioplegia were performed in 2 patients (33%). All patients required cardiopulmonary bypass support with a mean bypass time of 237 minutes. No pre-operative or post-operative usage of extracorporeal membrane oxygenator (ECMO) support. Complications included tracheostomy in 3 patients (50%) and in-hospital death in 2 patients (33%). Four patients had transient acute renal impairment requiring peritoneal dialysis and five patients were complicated with sepsis. However, there was no incidence of airleak or anastomosis breakdown post tracheoplasty. Both median intubation time (5 days) and the median length-of an intensive care unit (ICU) stay (15 days) were shorter than literatures.

Slide tracheoplasty is an effective operative strategy and could be performed safely for infants of low birth weight who suffered from tracheal stenosis, with good outcomes and relatively low risk of mortality and morbidity.

Catamenial Pneumothorax Surgical Management With Uncommon Pathology Anatomy Presentation: A Case Report

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Background: Catamenial pneumothorax (CP) was generally considered a rare condition and its diagnosis is often delayed or overlooked by clinicians. Treatment combines methods of thoracic surgery, together with hormonal substitution therapy by gynecologist.

Case Presentation: We describe a 29-year-old woman with CP and diaphragmatic fenestrations. Her clinical course and operative findings show that diaphragmatic fenestrations are commonly present and involved in the pathophysiology of CP. The patient initially underwent Video-Assisted Thoracoscopic Surgery (VATS), but due to poor surgical field exposure, it was decided to convert to a thoracotomy. During the operation, many black pores were found on the diaphragm and lung apex, wedge resection was performed at the lung apex and suturing was performed on the diaphragm defect. In the diaphragm pathology anatomy examination, no stroma and endometrial gland were found. Although endometrial cells are not found which can be caused by several possibilities, the patient is menstruating so that endometrial cells tend to decay or the preparation taken is too thin. However, there should be signs of chronic bleeding even though endometrial cells were not found. Considering the case of CP in these patients have recurred in recent years, there are no hemosiderophage cells found which suggest long-standing bleeding, this is the uniqueness of this case.

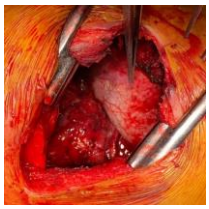

Figure: intraoperative thoracotomy found of black pores on diaphragmatic tissue, and the apex of the lung.

Conclusion: Good management and collaboration between cardiothoracic surgeons, pulmonologist, and gynecologists is needed to prevent recurrence. The diagnosis of CP must be established based on clinical considerations from clinical history, physical, and support examination. Do not rule out the possibility if the results of clinical presentations are not in accordance with CP.

A New Paradigm? Neoadjuvant Tyrosine Kinase Inhibitor For Advanced Metachronous Lung Adenocarcinoma Habouring Distinct EGFR Mutation Status

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Background: The incidence of having a new primary lesion after radical therapy is rare in non-small-cell lung cancer (NSCLC) which is around 1-2% per patient per year. We describe a case of metachronous lung adenocarcinoma harbouring distinct EGFR mutation expressions.

Case Presentation: A 66 years old gentleman, ex-smoker who was initially presented with Stage IA (T1N0M0) right middle lobe adenocarcinoma with no EGFR mutation in March 2018. He underwent VATS middle lobectomy and subsequently under routine surveillance. He presented with hemoptysis after 13 months and diagnosed with Stage IIIB (T1aN3M0) in right upper lobe. EBUS showed adenocarcinoma with positive EGFR mutation. He was started on neoadjuvant targeted therapy with Gefitinib in view of advanced disease and the tumor down-staged to Stage IA. He then underwent redo-VATS with upper lobectomy. HPE showed 2 lesions: I. Adenocarcinoma, acinar subtype 6mm (ypT1a), II. Microinvasive adenocarcinoma, 2mm (ypT1mi). Surveillance CT showed no evidence of recurrence.

Discussion: Multiple primary lung cancer (MPLC) is classified into synchronous (sMPLC) and metachronous (mMPLC). The incidence between 0.2-20% among the lung cancer. According to International Agency for Research on Cancer (IARC), mMPLC is defined as appearance of new lesion in different sites with an interval of more than 6 months. Early presentation of mMPLC (<2years) represents lower survival rate. Neoadjuvant Tyrosine kinase inhibitors (TKI) therapy in positive EGFR mutation allows radiological down-staging and resectable in those deemed inoperable at diagnosis. Contralateral mMPLC shows better survival than ipsilateral. Lobectomy shows better 5-year overall survival (75%) than sublobar resection (59%). The recurrence rate is higher within 4 years after surgery. Hence, mMPLC requires close and life-long surveillance.

Conclusion: Diagnosis of mMPLC poses a challenge to clinicians. Neoadjuvant TKI and chemotherapy have similar profile in term of overall survival, tumour response and progression-free survival in Stage IIIB disease. However, TKI has fewer toxicity side effect. It improves the prognosis of the patient with the aim for curative resection.

Thymectomy In Myasthenia Gravis: A Case Series

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Myasthenia gravis (MG) is autoimmune disease targeting acetylcholine receptors in neuromuscular junction, leading to muscle weaknesses and causing morbidity and mortality. The role of thymectomy in improved MG is still controversion, especially in Indonesia. Therefore, this study was hedl to observe outcomes of thymectomy in patients with MG. This was a case series involving 6 patients with MG performed thymectomy. The research resulted 5 women and a man with median age of 33 (20-44) years old, having Class 1-IIa MG according to Osserman classification. After having thymectomy, all the patients consumed less pyridostigmine. However, 2 patients experienced different or more symptoms and a patient started to consume methylprednisolone after the surgery. In conclusion, thymectomy in general resulted in improvement in MG. However, further controlled research with higher level of evidence should be performed to represent more objectively the role of thymectomy in MG.

Perioperative Outcomes Of Anatomic Lung Resections In Patients Who Recovered From Coronavirus Disease 2019 (COVID-19): A Two-Year Retrospective Case Series

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Background*:* Coronavirus disease 2019 (COVID-19) has chronic multiorgan sequelae which may affect the outcomes of anatomic lung resections.

Objectives*:* This study seeks to describe the perioperative outcomes of anatomic lung resections in patients who recovered from COVID-19 in terms of major and minor complications, mortality and length of postoperative hospital stay.

Methodology*:* This was a unicenter retrospective case series implemented by chart review. Patients confirmed to have recovered from documented COVID-19 were selected from those who underwent anatomic lung resections from June 2020 to May 2022.

Results*:* Sixteen patients were included. Majority (56.3%) had asymptomatic COVID-19 infection. The mean interval between the onset of infection and surgery was 133.8 days. Primary lung malignancy (50%) and inflammatory lung disease (37.5%) were the most common indications for surgery. Video-assisted thoracic surgery (87.5%) was the most common surgical approach, and right upper lobectomy (43.8%) was the most common resection done. The overall complication rate was 37.5%, and the overall mortality rate was 6.3%. The rates of major and minor complications were 18.8% and 31.3%, respectively. Prolonged air leak (25%) was the most common complication overall. Pneumonia (12.5%) was the most common major complication, and it resulted in the death of one patient. The mean duration of postoperative hospital stay was 7.3 days. *Conclusion:* This was the first study to report perioperative morbidity and mortality of anatomic lung resections in patients who recovered from COVID-19. Further studies are needed to determine the association between previous COVID-19 and complications of anatomic lung resection.

Background: The emergence of the coronavirus disease 2019 (COVID-19) in December 2019[1] resulted in a global pandemic that has affected millions of lives. The field of thoracic surgery was profoundly affected by the COVID-19 pandemic. Perioperative mortality rates of anatomic lung resections were as high as 58.3% in patients with active COVID-19 infection.[2-4] In response, international and local guidelines recommended the delay of surgery until acute infection has resolved.[5-7]

Recently, COVID-19 was found to have chronic multiorgan sequelae which may involve the cardiovascular, hematologic, pulmonary and renal organ systems in more severe cases.[8,9] Direct viral damage was cited as a possible pathophysiological mechanism for the systemic effect of COVID-19, with the angiotension-converting enzyme-2 (ACE-2) receptor acting as entry receptor for the coronavirus into cells.[10,11]

Our knowledge on the possible effects of COVID-19 sequelae on the outcomes of lung resection is still evolving. This study seeks to initiate the registry of the Thoracic Surgery and Anesthesia Department on anatomic lung resections in patients who recovered from COVID-19, and to standardize the data collection for the said registry in preparation for future analytic studies.

The objective of this study is to describe the perioperative outcomes of anatomic lung resections in patients who recovered from COVID-19 in terms of major and minor complications, mortality and length of postoperative hospital stay.

Methodology: This study was conducted at the Lung Center of the Philippines, a tertiary referral center for chest diseases and one of the four designated national referral centers for COVID-19. The study design was a retrospective case series. Online and written inpatient and outpatient records were reviewed to determine the baseline characteristics and perioperative outcomes of patients. The perioperative period was defined as up to 30 days after surgery. The study was in accordance with the Helsinki Declaration, and was approved by the institutional Ethics as well as Technical Review Boards. Consent was waived since the design was based on chart review. This was registered in ClinicalTrial.gov (NCT05513248) prior to the selection of patients.

The patients were selected from all who underwent anatomic lung resections from June 1, 2020, when elective surgical procedures resumed after moratorium, to May 31, 2022. Patients with previous COVID-19 documented by reverse transcription polymerase chain reaction (RT-PCR) or GeneXpert nasopharyngeal swab and with negative preoperative COVID-19 RT-PCR or GeneXpert were included in the study. Patients with incomplete records were excluded.

The severity of previous COVID-19 was classified as asymptomatic, mild, moderate, severe or critical, in accordance with the National Institutes of Health guidelines.[12] The onset of COVID-19 was determined by the date of the nasopharyngeal swab in asymptomatic patients or by the date of the onset of symptoms in symptomatic patients. Vaccination status was determined by the number of doses received prior to lung resection, with two doses considered as fully vaccinated. Anatomic lung resection was defined as resection of the involved lung parenchyma according to the extent of perfusion of pulmonary vessels and aeration of bronchi, such as segmentectomy, lobectomy, bilobectomy and pneumonectomy.[13] Video-assisted thoracic surgery (VATS) was defined by an access incision of four to eight centimeters without rib spreading, visualization by video equipment as well as individual dissection of the artery, bronchus and vein.[14]

Mortality was defined as disease-specific death due to perioperative complications. Minor complications after lung resection included atrial fibrillation, pneumothorax and prolonged air leak.[15] Atrial fibrillation was defined as absence of distinct P waves, irregular atrial activations and irregularly regular R-R intervals on electrocardiography.[16] Pneumothorax was defined as intrathoracic air on the operative side, with a distance of at least two centimeters between the parietal and visceral pleura at the level of the hilum.[17] Prolonged air leak was defined as the presence of air per chest tube for five days or longer.[18] Air leak was further classified as grade one if present on forced expiration, grade two if present on tidal expiration, grade three if present on inspiration and grade four if continuous.[19]

Major complications after lung resection included acute kidney injury, acute myocardial infarction, acute respiratory distress syndrome (ARDS), acute respiratory failure, atelectasis requiring intervention, bronchopleural fistula, empyema thoracis, hemothorax, pneumonia, stroke and venous thromboembolism.[18] Acute kidney injury was defined as an absolute increase in serum creatinine of 0.3 milligram per deciliter, a percent increase in serum creatinine of 50% from baseline or oliguria of less than 0.5 milliliter per kilogram for more than six hours within 48 hours.[20] Acute myocardial infarction was defined as ST elevation, T-wave inversion or ST depression on electrocardiography and elevated cardiac markers.[21,22] ARDS was defined as bilateral pulmonary infiltrates and arterial oxygen tension-fraction of inspired oxygen (PaO_2:FiO_2) ratio of less than 200 millimeters mercury, in the absence of cardiogenic pulmonary edema.[23] Acute respiratory failure was defined as PaO_2 of less than 60 millimeters of mercury (type 1), arterial carbon dioxide tension ($PaCO_2$) of more than 45 millimeters of mercury (type 2) or both.[24] Atelectasis was defined as lobar or segmental opacification ipsilateral to the postoperative site that warranted bronchoscopy.[25] Bronchopleural fistula was defined as communication between the lobar or segmental bronchus and the pleural space, definitively diagnosed by bronchoscopy.[26] Empyema thoracis was defined as frank pus or purulent effluent per chest tube.[25] Hemothorax was defined as bloody chest tube output amounting to 100 milliliters or more per hour, requiring surgical drainage.[27] Pneumonia was defined as new and persistent lung infiltrates on chest radiograph. Symptoms may include fever, increasing oxygen requirements or purulent sputum production, and ancillary tests may reveal leukocytosis or bronchoalveolar lavage culture of more than 100,000 colony-forming units per milliliter.[27] Ischemic stroke was defined as infarction in the central nervous system or retinal cell death based on pathologic imaging in a defined vascular distribution or symptoms persisting for more than 24 hours.[28] Venous thromboembolism was defined as blood clot or thrombus within the venous system on computerized tomography (CT), duplex ultrasound or venogram.[29] Length of postoperative hospital stay was defined as time duration from surgery until the discharge order.

Descriptive statistics was done to analyze data on patient characteristics and perioperative outcomes. For nominal variables, frequency and proportion were used. For ordinal variables, median and range were used.

Results: A total of 103 anatomic lung resections were performed from June 1, 2020 to May 31, 2022. Eighty-seven patients were excluded: 86 patients never tested positive for COVID-19, while the previous COVID-19 status of one patient could not be determined by chart review or correspondence. Sixteen patients who recovered from documented COVID-19 infection were included in this study (Figure 1).

The mean age of the patients was 60 years, and 56.3% were male. Majority were nonsmokers (62.5%) and had one or more comorbidities (75%). Hypertension (50%) and diabetes mellitus type II (43.8%) were the most common preexisting medical conditions.

More than half (56.3%) had asymptomatic COVID-19. The mean interval between lung resection and onset of COVID-19 was 133.75 days, and 75% underwent surgery after seven weeks. At time of procedure, 93.8% were fully vaccinated.

On chest CT, the most common primary pathologies were lung masses (56.3%) and bronchiectasis (37.5%). Consolidations, infiltrates and ground-glass opacities in other lobes were found in 37.5% of patients, majority of whom had inflammatory conditions with hemoptysis. The mean preoperative forced expiratory volume in one second (FEV-1) in 14 patients was 2.1 liters, and the mean diffusing capacity of lung for carbon monoxide (DLCO) in 12 patients was 14.8 milliliters per minute per millimeter of mercury. Two patients with massive hemoptysis did not undergo FEV-1 and DLCO testing, while two other patients did not undergo DLCO testing for undetermined reasons.

The most common indication for lung resection was primary lung malignancy (50%) followed by inflammatory lung disease with secondary hemoptysis (37.5%). Majority (87.5%) of the lung resections were performed via VATS. Conversion to thoracotomy was done in 12.5% for dense chest wall adhesions and iatrogenic pulmonary artery injury. Right upper lobectomy (43.8%) and right lower lobectomy (18.2%) were the most common anatomic lung resections performed. The mean operative blood loss was 450 milliliters, and the mean operative time was 390 minutes (Table 1).

The overall perioperative complication rate was 37.5%, and the overall mortality rate was 6.3%. Minor complications developed in 31.3% of patients. Prolonged air leak (25%) was the most common complication overall. It had a mean duration of 10.5 days. Three patients had air leak on forced expiration (grade one), and one patient had air leak on tidal expiration (grade two). Minimal loculated pleural effusion occurred in 12.5% on follow-up consult. Major complications developed in 18.8% of patients. The most common major complication was pneumonia (12.5%), which resulted to the death of one patient. Atelectasis requiring bronchoscopy occurred in 6.3%. The mean length of postoperative hospital stay was 7.3 days (Table 2).

Discussion: This study was the first to report on perioperative complications and mortality of anatomic lung resections in patients who recovered from COVID-19. At time of writing, there were few publications on COVID-19 survivors who underwent lung resection, and all of which had no cases of morbidity or mortality[30-33] (Table 3).

In our study, the overall complication rate was 43.8%, and the overall mortality rate was 6.3%. Perioperative complications and mortality may arise due to patient and technical factors. Risk factors for prolonged air leak include emphysematous lungs, pleural adhesions and upper lobectomy or more extensive resections.[34-35] Loculated pleural effusion may occur due to infected pleural space or progression of malignancy. Diaphragm dysfunction, inadequate pain control, increased bronchial secretions and poor cough reflex may cause atelectasis.[36,37] Predictors for pulmonary complications such as pneumonia and pulmonary insufficiency include atelectasis, chronic obstructive pulmonary disease, high risk surgery, obesity and smoking.[27,37] The specific risk factor for the lone mortality in our study was pneumonia, the leading cause of perioperative death after lung resection.[38] The association between COVID-19, with its chronic multiorgan sequelae, and perioperative morbidity and mortality of lung resection cannot be determined at this time and warrants further studies with more rigorous methodology.

In our study, the mean length of postoperative hospital stay was 7.3 days. In the case reports of Nefedov et al, Sakai et al and Testori et al, patients were discharged within three to eight days after lung resection.[30-32] Perioperative complications prolong hospital stay. The mean length of postoperative hospital stay in our patients with and without complications were 10.1 days and five days, respectively. Again, the association between previous COVID-19 and length of postoperative hospital stay after lung resection cannot be determined at this time and warrants further research.

According to current recommendations, major elective surgery should be delayed for seven weeks after COVID-19 infection.[17,18] In the international prospective cohort study across surgical specialties by the COVIDSurg Collaborative and GlobalSurg Collaborative, perioperative mortality in patients who recovered from COVID-19 was higher in surgeries performed within seven weeks after infection (4.1% in less than two weeks, 3.9% in three to four weeks and 3.6% in five to six weeks) compared to surgeries performed after seven weeks (1.5%), which was similar to non-COVID patients.[39] In the studies specific to anatomic lung resections by Diaz et al, Nefedov et al, Sakai et al and Testori et al, no perioperative complications occurred in procedures performed before or after seven weeks.[30-33] In our study, patients who underwent lung resection in less than seven weeks after acute infection had an overall complication rate of 50% and mortality rate of 25%, while the patients who underwent surgery after seven weeks had an overall complication rate of 41.7% and no mortality (Table 4). It is also currently recommended to delay surgery in patients with persistent symptoms and more severe previous infections.[17,18] Among the general surgical population, mortality rate was higher in symptomatic patients (6%) compared to those whose symptoms had resolved (2.4%) or those who had been asymptomatic (1.3%).[39] In the studies of Diaz et al, Nefedov et al, Sakai et al and Testori et al, no perioperative complications occurred after lung resection in patients who experienced moderate to severe COVID-19 infection.[30-33] In our study, no patients experienced severe to critical infection. One patient had moderate infection, and he developed pneumonia and minimal loculated effusion after surgery. The associations between perioperative complications and the timing of lung resection after COVID-19 as well as the severity of previous COVID-19 cannot be determined at this time and warrant further studies that will account for such variables.

The primary limitation of this study was the limited number of patients due to multiple institutional moratoriums on non-COVID admissions and to the relative short duration since the outbreak of COVID-19. Additionally, patients with undocumented COVID-19 may have been excluded, and long-term postoperative complications may have been missed due to the short duration of follow-up.

In conclusion, patients who recovered from COVID-19 may have complicated perioperative courses after anatomic lung resection. Further studies are warranted to determine the association between previous COVID-19 and complications of anatomic lung resections. Future research should also account for the timing of surgery after COVID-19 and the severity of previous infection.

References

1. Wu F, Zhao S, Yu B, et al. A new coronavirus associated with human respiratory disease in China. *Nature* 2020; 579:265-269.
2. Pages P, Cottenet J, Bonniaud P, et al. Impact of the SARS-CoV-2 epidemic on lung cancer surgery in France: a nationwide study. *Cancers* 2021; 13(24):6277.
3. Scarci M, Raveglia F, Bortolotti L, et al. COVID-19 after lung resection in Northern Italy. *Semin Thorac Cardiovasc Surg* 2021; 34(2):726-32.
4. Cai Y, Hao Z, Gao Y, et al. Coronavirus disease 2019 in the perioperative period of lung resection: a brief report from a single thoracic surgery department in Wuhan, People's Republic of China. *J Thorac Oncol* (2020); 15(6):1065-72.
5. Philippine Association of Thoracic, Cardiac and Vascular Surgeons. PATACSI COVID-19 Crisis-Driven Recommendations on Thoracic Surgery. https://patacsi.org.ph/publications/tcvs-covid-19-guidelines. (5 August 2022 last accessed)
6. American Society of Anesthesiologists and Anesthesia Patient Safety Foundation. ASA and APSF Joint Statement on Elective Surgery and Anesthesia for Patients after COVID-19 infection. https://www.asahq.org/about-asa/newsroom/news-releases/2022/02/asa-and-apsf-joint-statement-on-elective-surgery-procedures-and-anesthesia-for-patients-after-covid-19-infection (5 August 2022 last accessed)
7. El-Boghdadly K, Cook TM, Goodacre T, et al. Timing of elective surgery and risk assessment after SARS-CoV-2 infection: an update. A multidisciplinary consensus statement on behalf of the Association of Anaesthetists, Centre for Perioperative Care, Federation of Surgical Specialty Associations, Royal College of Anaesthetists, Royal College of Surgeons of England. Anesthesia 2022; 77(5):580-587.
8. Center for Disease Control and Prevention. Post-COVID Condition. https://www.cdc.gov/coronavirus/2019-ncov/long-term-effects/index.html. (5 August 2022 last accessed)
9. Huang C, Huang L, Wang Y, et al. 6-month consequences of COVID-19 in patients discharged from hospital: a cohort study. *Lancet* 2021;397(10270):220-32.
10. Gupta A, Madhavan MV, Sehgal K, et al. Extrapulmonary manifestations of COVID-19. *Nat Med* 2020; 26(7):1017-1032.
11. Ziegler CGK, Allon SJ, Nyquist SK, et al. SARS-CoV-2 receptor ACE2 is an interferon-stimulated gene in human airway epithelial cells and is detected in specific cell subsets across tissues. *Cell* 2020; 181(5):1016-1035.
12. National Institutes of Health. COVID-19 Treatment Guidelines Panel. Coronavirus Disease 2019 (COVID-19) Treatment Guidelines.
13. Yang CJ, D'Amico T. Segmentectomy and lesser pulmonary resections. In: Shields' General Thoracic Surgery. 8th ed. Wolters Kluwer; 2019: 947-70.
14. Swanson SJ, Herndon JE, D'Amico TA, et al. Video-assisted thoracic surgery lobectomy: report of CALGB 39802 – a prospective, multi-institution feasibility study. *J Clin Oncol* 2007; 25(31):4993-7.
15. Ginsberg RJ. Lung cancer surgery: Acceptable morbidity and mortality, expected results and quality control. *Surg Oncol* 2002; 11(4):263–6
16. Hindricks G, Potpara T, Dagras N, et al. 2020 ESC guidelines for the diagnosis and management of atrial fibrillation developed in collaboration with the European Association for Cardio-Thoracic Surgery (EACTS): the Task Force for the diagnosis and management of atrial fibrillation of the European Society of Cardiology (ESC) developed with the special contribution of the European Heart Rhythm Association (EHRA) of the ESC. *Eur Heart J* 2021; 42(5):373-498.
17. MacDuff A, Arnold A, Harvey J. Management of spontaneous pneumothorax: British Thoracic Society pleural disease guideline 2010. *Thorax* 2010; 65(2):18-31.
18. Wright C. Management of air leaks and residual pleural spaces. In: Shields' General Thoracic Surgery. 8th ed. Wolters Kluwer; 2019:1160-70.
19. Cerfolio RJ, Tummala RP, Holman WL, et al. A prospective algorithm for the management of air leaks after pulmonary resection. *Ann Thorac Surg* 1998; 66(5):1726-31.
20. Mehta RL, Kellum JA, Shah SSV, et al. Acute Kidney Injury Network: report of an initiative to improve outcomes in acute kidney injury. *Crit Care* 2007; 11(2): R31.
21. O'Gara PT, Kushner FG, Ascheim DD, et al. 2013 ACCF/AHA Guideline for the management of ST-elevation myocardial infarction. A report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *Circulation* 2013; 127(4):e362-425.
22. Amsterdam EA, Wenger NK, Brindis RG, et al. 2014 AHA/ACC Guideline for the management of patients with non-ST-elevation acute coronary syndromes. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Circulation* 2014; 64(24):2713-4.
23. ARDS Definition Task Force; Raneiri VM, Rubenfeld GD, Thompson BT, et al. Acute respiratory distress syndrome: the Berlin Definition. *JAMA* 2012; 307(23):2526-33.
24. Roussos C and Koutsoukou A. Respiratory failure. *Eur Resp J* 2003; 22(47): 3s-14s.
25. Kozower BD. Complications of thoracic surgical procedure. In: Shields' General Thoracic Surgery. 8th ed. Wolters Kluwer; 2019:1211-35.
26. York EL, Lewall DB, Hirji M, Gelfand ET, Modry DL. Endoscopic diagnosis and treatment of postoperative bronchopleural fistula. *Chest* 1990; 97(6):1390–2.
27. Stephan F, Boucheseiche S, Hollande et al. Pulmonary complications following lung resection: a comprehensive analysis of incidence and possible risk factors. *Chest* 2000; 118(5):1263-70.
28. Sacco RL, Kasner SE, Broderick JP, et al. An updated definition of Stroke for the 21st century. A statement for healthcare professionals from the American Heart/American Stroke Association. *Stroke* 2013; 44(7): 2064-89.
29. Christensen TD, Vad H, Pedersen S, et al. Venous thromboembolism in patients undergoing operations for lung cancer: a systemic review. *Ann Thorac Surg* 2014; 97(2):394-401.
30. Sakai T, Azuma Y, Aoki K, et al. Elective lung resection after treatment for COVID-19 pneumonia. *Gen Thorac Cardiovasc Surg* 2021; 69(7):1159-62.
31. Testori A, Perroni G, Voulaz E, Crepaldi A, Alloisio M. Pulmonary lobectomy after COVID-19. *Ann Thoracic Surg* 2021;111(3):e181-2.
32. Nefedov A, Mortada M, Novitskaya T, Patsyuk A, Kozak A, Yoblonskii P. Lobectomy with pathological examination in lung cancer patients who recovered from COVID-19. *Gen Thorac Cardiovas Surg 2021*; 69(8):1258-60.

33. Diaz A, Bujnowski D, McMullen P, et al. Pulmonary parenchymal changes in COVID-19 survivors. *Ann Thoracic Surg* 2021; 114(1):301-10.
34. Stolz AJ, Schützner J, Lischke R, Simonek J, Pafko P. Predictors of prolonged air leak following pulmonary lobectomy. *Eur J Cardiothorac Surg* 2005; 27(2):334–336.
35. Liang S, Ivanovic J, Gilbert S, et al. Quantifying the incidence and impact of postoperative prolonged alveolar air leak after pulmonary resection. *J Thorac Cardiovasc Surg* 2013; 145(4):948-54.
36. Massard G, Wihlm JM. Postoperative atelectasis. *Chest Surg Clin N Am* 1998; 8(3):503–528.
37. Brooks-Brunn JA. Postoperative atelectasis and pneumonia: risk factors. *Am J Crit Care* 1995; 4(5):340–349.
38. Wada H, Nakamura T, Nakamoto K, Maeda M, Watanabe Y. Thirty-day operative mortality for thoracotomy in lung cancer. *J Thorac Cardiovasc Surg* 1998; 115(1):70–3.
39. COVIDSurg Collaborative, GlobalSurg Collaborative. Timing of surgery following SARS-CoV-2 infection: an international prospective cohort study. *Anaesthesia* 2021; 76(6):748-58.

Figure 1**.** Selection of Patients

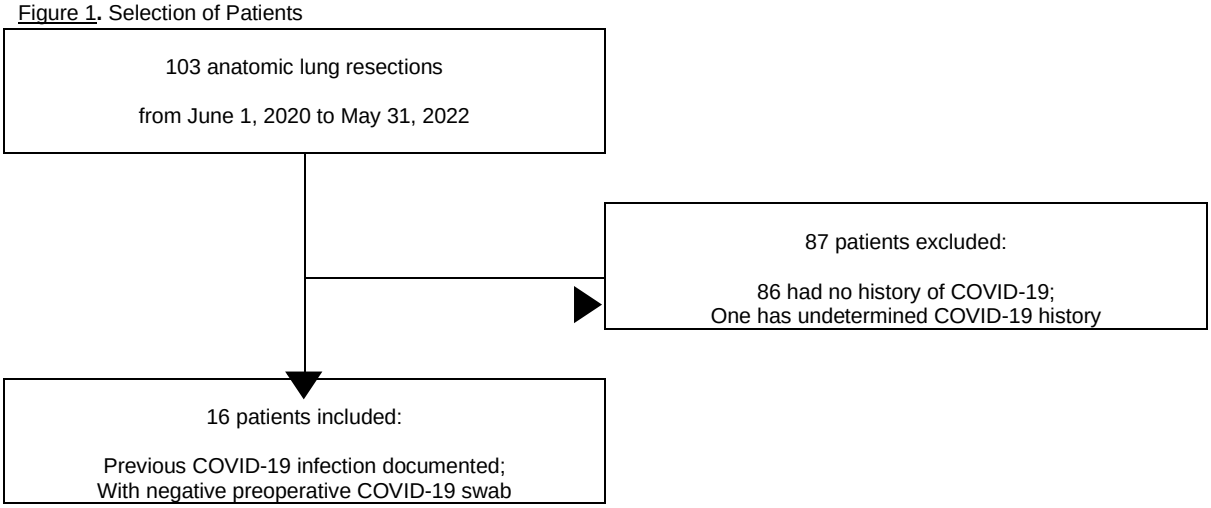

Table 1**.** Baseline Characteristics of Patients

CLINICAL CHARACTERISTICS	Frequency (proportion), median (range) N=16
Age (years)	60 (23-79)
Sex (male)	9 (56.3%)
Smoking history	
Nonsmoker	10 (62.5%)
Previous smoker	6 (37.5%)
Medical comorbidities	12 (75.0%)
Hypertension	8 (50.0%)
Diabetes mellitus type II	7 (43.8%)
Azotemia	2 (12.5%)
Obesity	2 (12.5%)
Stroke	2 (12.5%)
Bronchial asthma	1 (6.3%)
Coronary artery disease	1 (6.3%)
Multinodular nontoxic goiter	1 (6.3%)
Obstructive sleep apnea syndrome	1 (6.3%)
Pulmonary tuberculosis	1 (6.3%)
Right bundle branch block	1 (6.3%)
None	4 (25.0%)
Severity of COVID-19	
Asymptomatic	9 (56.3%)
Mild	6 (37.5%)
Moderate	1 (6.3%)
Severe	0
Critical	0
Interval between COVID-19 and surgery (days)	133.8 (11 to 331)
Seven weeks or longer	12 (75%)
Less than seven weeks	4 (25%)
Vaccination status	
Fully vaccinated	15 (93.8%)
Not vaccinated	1 (6.3%)
Indications for surgery	
Primary lung malignancy	8 (50.0%)
Inflammatory lung disease	6 (37.5%)
Benign tumor	1 (6.3%)
Ground glass opacity suspicious for malignancy	1 (6.3%)
Chest CT findings	
Primary pathology	
Mass	9 (56.3%)
Bronchiectasis	6 (37.5%)
Ground-glass opacity	1 (6.3%)
Other findings on other lobes	
Ground-glass opacities	3 (18.8%)
Consolidations	2 (12.5%)
Infiltrates	1 (6.3%)

Pulmonary function	
FEV-1 (L)	2.1 (1.4-2.9) (n=14)
DLCO (mL/min/mmHg)	14.8 (7.3 to 24.5) (n=12)
Surgical approach	
VATS	14 (87.5%)
VATS converted to thoracotomy	2 (12.5%)
Lung resection	
Right upper lobectomy	7 (43.8%)
Right lower lobectomy	3 (18.2%)
Right bilobectomy†	2 (12.5%)
Left upper lobectomy	2 (12.5%)
Left lower lobectomy	1 (6.3%)
Left segmentectomy‡	1 (6.3%)
Operative blood loss (mL)	450 (30-1,200)
Operative time (minutes)	390 (187-720)

Abbreviations: FEV-1, forced expiratory volume in one second; DLCO, diffusing capacity of lung for carbon monoxide; VATS, video-assisted thoracic surgery

†upper and middle lobectomy, as well as middle and lower lobectomy

‡trisegmentectomy of upper division of left upper lobe

Table 2**.** Perioperative Outcomes of Anatomic Lung Resection

OUTCOMES	**Frequency (proportion), median (range) N=16**
Overall complication	6 (37.5%)
Overall mortality	1 (6.3%)
Major complications	3 (18.8%)
Pneumonia	2 (12.5%)
Atelectasis	1 (6.3%)
Acute respiratory distress syndrome	0
Bronchopleural fistula	0
Empyema thoracis	0
Hemothorax	0
Kidney injury	0
Myocardial infarction	0
Respiratory failure	0
Stroke	0
Venous thromboembolism	0
Minor complications	5 (31.3%)
Prolonged air leak	4 (25.0%)
Pleural effusion	2 (12.5%)
Atrial fibrillation	0
Pneumothorax	0
Postoperative hospital stay (days)	7.3 (4-17)

Table 3**.** Anatomic Lung Resections in Patients Who Recovered From COVID-19

AUTHOR	AGE SEX	SEVERITY OF PREVIOUS COVID-19	INTERVAL BETWEEN COVID-19 AND SURGERY	INDICATION FOR SURGERY	PROCEDURE	OUTCOME
Sakai et al.[30]	65/M	Severe	112 days	Adenocarcinoma	Right lower lobectomy	Recovered
Testori et al.[31]	46/M	Moderate	45 days	Adenocarcinoma	Right upper lobectomy	Recovered
Nefedov et al.[32]	65/F	Moderate	42 days	Adenocarcinoma	Right lower lobectomy	Recovered
	60/M	Mild	42 days	Squamous cell carcinoma	Right lower lobectomy	Recovered
Diaz et al.[33]	67/M	Asymptomatic	24 days	Malignant neoplasm	Right middle lobectomy	Recovered
	51/F	Asymptomatic	27 days	Nodule	Left upper lobectomy, right upper lobectomy	Recovered
	68/M	Asymptomatic	103 days	Nodule	Right upper lobectomy	Recovered
	53/F	Moderate`	125 days	Adenocarcinoma	Right lower lobectomy	Recovered
	72/F	Moderate	30 days	Adenocarcinoma	Right lower lobectomy	Recovered
	65/F	Moderate	30 days	Nodule	Right lower lobectomy	Recovered
	65/F	Severe	96 days	Nodule	Right upper lobectomy	Recovered
	69/F	Severe	94 days	Nodule	Right lower lobectomy	Recovered

Table 4. Perioperative Outcomes According to Interval Between COVID-19 and Lung Resection

OUTCOMES	INTERVAL BETWEEN COVID-19 AND SURGERY	
	Less than seven weeks	Seven weeks or more
	Frequency (proportion), median (range) n=4	Frequency (proportion), median (range) n=12
Overall complication	2 (50%)	5 (41.7%)
Overall mortality	1 (25%)	0
Major complications	2 (50%)	2 (16.7%)
Pneumonia	2 (50%)	0
Atelectasis	0	1 (8.3%)
Minor complications	2 (50%)	3 (25%)
Prolonged air leak	1 (25%)	3 (25%)
Pleural effusion	1 (25%)	1 (8.3%)
Postoperative hospital stay	9.3 days (5-17 days)	6.6 days (4-12 days)

Case Report: Successful Retrieval Of Fractured Chemoport Catheter From Left Pulmonary Artery Via Left Video-assisted Thoracoscopic Surgery (VATS)

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Introduction: Totally implantable port device or chemoport, is a central venous assess device commonly used in oncology patients for the ease of long-term intravascular access “Pinch-off" syndrome (POS)- fracture of worn chemoport catheter secondary to long term distortion when it passed through the first rib in subclavian vein. Herein we are describing a case of successful removal of fractured chemoport catheter (6.5cm) likely secondary to POS that embolized into left pulmonary artery via left video assisted thoracoscopic surgery (VATS) approach.

Case presentation: Patient is a 47-year-old lady with underlying advanced leiomyosarcoma of retroperitoneum on regular chemotherapy. She has a chemoport inserted via right subclavian vein. During her last course of chemotherapy, she developed sudden pain of right shoulder associated with unusual resistance upon flushing of chemoport. Chest radiograph (CXR) showed evidence of distal chemoport catheter fractured and migrated. Portogram and contrast-enhanced computed tomography (CECT) thorax showed fractured distal portion of the chemoport catheter had dislodged into the left lower lobe pulmonary artery. Interventional radiology team had concluded that it was not feasible to retrieve the fractured catheter via endovascular approach in view of difficult position of fractured catheter. Surgical retrieval of fractured chemoport catheter via left VATS approach was offered to patient. Patient recovered well and chest drain removed day 3 post operatively. She was discharged home on day 4 post-operation.

Discussion: In this case report, we have demonstrated minimal invasive surgery provides safe extraction, smaller aesthetic scar with better wound healing, minimal blood loss, shorter hospital stays, and recovery time in retrieving fractured chemoport catheter from pulmonary artery.

Conclusion: This case has portrayed that VATS technique is indeed a safe and feasible surgical technique in retrieving fractured, migrated chemoport catheter in pulmonary artery, allowing short hospitalization and rapid resumption of subsequent treatment.