Radiology Case Reports 16 (2021) 3655–3658

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/radcr

Case Report

Spontaneous pneumomediastinum: A collaborative sequelae between COVID-19 and self-inflicted lung injury - A case report and literature review

Abdul Rahman Al Armashi, MD[a,], Francisco J. Somoza-Cano, MD[a], Kanchi Patell, MD[a], Mohamed Homeida, MD[a], Omkar Desai, MD[b], Anas Al Zubaidi, MD[c], Basel Altaqi, MD[a], Keyvan Ravakhah, MD[a]*

[a] *St. Vincent Charity Medical Center, Cleveland, OH, USA*
[b] *Yale University School of Medicine, New Haven, CT, USA*
[c] *Baptist Health North Little Rock North Little Rock, North Little Rock, AR, USA*

ARTICLE INFO

Article history:
Received 23 August 2021
Accepted 30 August 2021

Keywords:
COVID-19
Sars-cov-2
Spontaneous Pneumomediastinum
Patient Self-Inflicted Lung Injury (PSILI)
Pneumomediastinum

ABSTRACT

Spontaneous pneumomediastinum is an infrequent complication of COVID-19. The mechanism is still unknown and thought to be related to patient self-inflicted lung injury. Our patient is a 49-year-old male who presented with shortness of breath and cough. A COVID-19 Polymerase Chain Reaction was positive. He required a high-flow nasal cannula, but he did not demand mechanical ventilation. Computed tomography angiography scan of the chest revealed pneumomediastinum. He was managed conservatively, and a complete recovery was achieved. This case highlights the emerging association of COVID-19, patient self-inflicted lung injury, and pneumomediastinum. Furthermore, spontaneous pneumomediastinum should be suspected even in patients who were not mechanically ventilated.

Introduction

Coronavirus Disease 2019 (COVID-19) has an extensive array of pulmonary complications due to the aggressive damage to the lung parenchyma and pulmonary vessels. These manifestations range from mild pneumonia to severe acute respiratory distress syndrome (ARDS), venous thromboembolism, and rarely, pneumothoraces [1,2]. Pneumomediastinum is an infrequent condition in which gas is present within the mediastinal space. In COVID-19, Zantah et al. reported an incidence rate of 0.66% in a retrospective review when unrelated to mechanical ventilation (MV) [3]. However, the specific mechanism is still unclear. It is deemed to be related

* Corresponding author.
E-mail address: Abd.armashi@gmail.com (A.R. Al Armashi).

https://doi.org/10.1016/j.radcr.2021.08.076

to patient self-inflicted lung injury (P-SILI), where the lung damage is caused by increased intra-alveolar pressure [4]. We are presenting a 49-year-old male with COVID-19 pneumonia complicated by a spontaneous pneumomediastinum.

Case presentation

Our patient is a 49-year-old male with a past medical history of childhood asthma, hypertension, morbid obesity, and prostate cancer in remission. He visited his primary care physician for shortness of breath, cough, and chills, where a COVID-19 Polymerase Chain Reaction (PCR) test was positive. He was initially managed as an outpatient with oral prednisone and azithromycin, but his symptoms worsened after a few days of treatment. His home pulse oximetry showed an oxygen saturation of 86% on room air. On admission, the review of systems was positive for pleuritic chest pain, and change in the mouth taste. On physical examination, he was tachycardic, and saturating 87% on room air. Lung exam was remarkable for decreased air entry bilaterally. Further examination revealed an unremarkable cardiovascular exam and extremities with no edema or calf tenderness. Laboratory work showed lymphopenia of 1 K/uL (reference range 1.2 - 3.5), creatinine of 1.4 mg/dL, with a baseline of 1 mg/dL (reference range 0.7 - 1.3), and troponin I within normal limits. C-reactive protein of 47 mg/L (reference range 0 - 0.3), ferritin of 1230 ng/mL (reference range 26 - 388), lactate dehydrogenase of 1121 U/L (reference range 84 - 246), procalcitonin of 0.08 ng/ml (reference range <0.5), and a D-dimer of 1689 ng/mLFEU (reference range <500). Chest x-ray showed diffuse interstitial infiltrates bilaterally. Duplex ultrasound of lower extremities was negative for deep vein thrombosis. He was admitted to the Respiratory Care Unit and managed with supplemental oxygen, dexamethasone, and intravenous (IV) ceftriaxone. Nevertheless, due to high suspicion of pulmonary embolism, a continuous heparin infusion was started empirically as computed tomography angiography (CTA) of the chest could not be done due to the ongoing acute kidney injury. On day 2 of admission, his oxygen requirements continued to increase, for which he was started on a high-flow nasal cannula (HFNC) of 25 L with 60% FiO2 and remdesivir. On day 3 of admission, he had increasing oxygen demands requiring HFNC 50 L with 60% FiO2. Tocilizumab was given by the infectious disease team. His kidney function returned to baseline level at day 4. A CTA scan of the chest revealed pneumomediastinum (Fig. 1 and 2) and multiple bilateral acute pulmonary embolisms with diffuse ground-glass opacities at the bases (Fig. 3). The following day, a repeat chest x-ray showed a stable pneumomediastinum, which tracked to the lower neck, and supraclavicular regions with no associated pneumothorax (Fig. 4). The patient finished a 10-day course of dexamethasone and remdesivir with the improvement of his clinical status. His oxygen requirements continued to decrease; therefore, he was switched to a 2 L nasal cannula. His follow-up chest x-ray images showed a stable pneumomediastinum with no progression of the disease. He was transferred to a long-term acute care facility, where he achieved a complete recovery, and was discharged home.

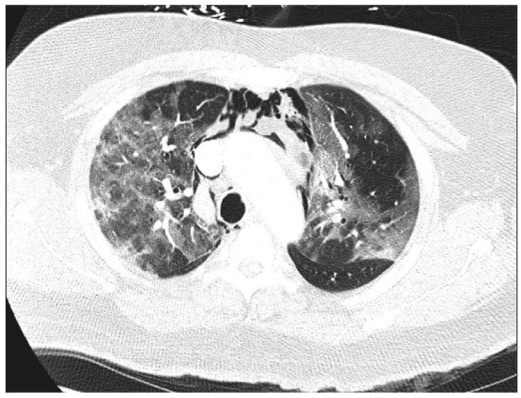

Fig. 1 – Computed tomography angiography (CTA) scan of the chest in axial view revealing pneumomediastinum and ground glass opacities at the bases.

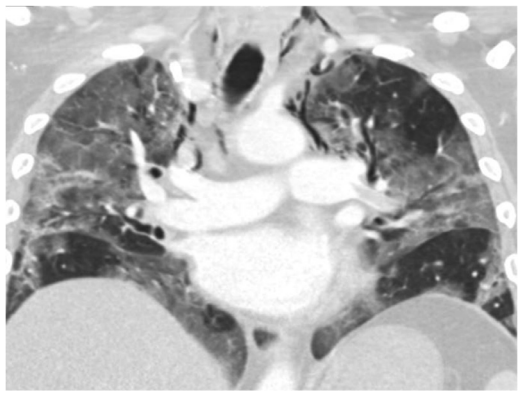

Fig. 2 – Computed tomography angiography (CTA) scan of the chest in coronal view revealing air that outlines multiple mediastinal structures including the aortic arch and extending to the lower neck.

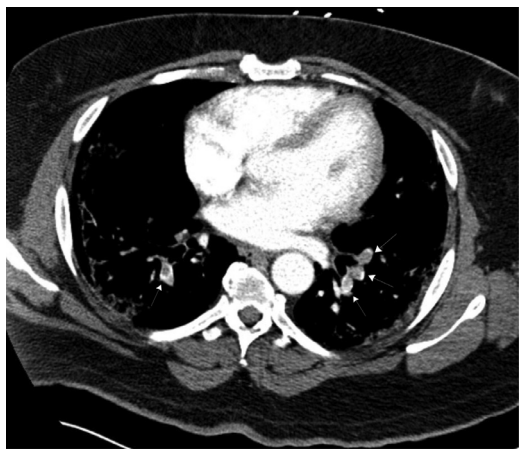

Fig. 3 – Computed tomography angiography (CTA) scan of the chest in axial view revealing multiple bilateral filling defects of the pulmonary artery in the lobar branches consistent with acute pulmonary embolisms (white arrows). Also revealing diffuse ground-glass opacities at the bases.

Table 1 – Literature review of spontaneous pneumomediastinum cases in patients with COVID-19.

Case	Age	Gender	Comorbidities	Invasive ventilation	Diagnosis	Treatment	Outcome
Elhakim TS et al. [7]	63	M	hypertension type II diabetes mellitus (DM)	No	Spontaneous pneumomediastinum	Conservative	Recovered
Mohan V et al. [11]	49	M	hypertension and type II DM	No	Spontaneous pneumomediastinum with subcutaneous emphysema	Conservative	Recovered
Oye M et al. [12]	32	M	None	No	Spontaneous pneumomediastinum Pneumothorax and subcutaneous emphysema	Chest tube for the pneumothorax	Recovered
Oye M et al. [12]	56	F	hypertension and type II DM	No	Spontaneous pneumomediastinum And bilateral Pneumothorax	thoracostomy tube	Recovered
Kolani S et al. [17]	23	F	None	No	Pneumomediastinum	Conservative	Recovered
Lacroix M et al. [18]	57	M	None	Yes	Pneumomediastinum with subcutaneous emphysema	Conservative	Unknow
Lei P et al. [19]	64	M	None	Unknown	Spontaneous pneumomediastinum	Conservative	Recovered
Wang J et al. [20]	36	F	None	Yes	Spontaneous pneumomediastinum	Conservative	Expired

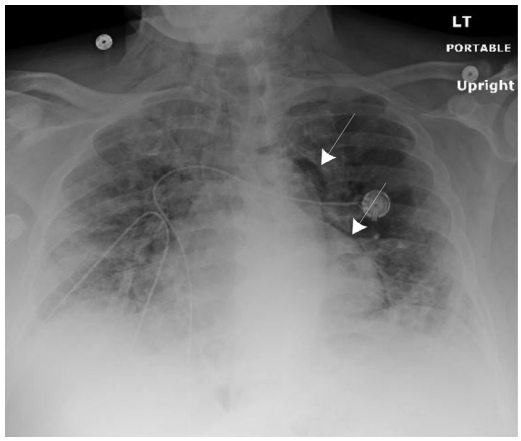

Fig. 4 – Chest x-ray revealing a crescent of air that outlines the ascending aorta and also the left border of the heart consistent with pneumomediastinum (white arrow), that is tracking to the lower neck, and supraclavicular regions.

Discussion

COVID-19 has a broad spectrum of clinical manifestations, affecting multiple organs in the human body. The lungs are frequently compromised, given the high expression of the angiotensin-converting enzyme 2 (ACE2) receptor complex in the alveolar cells, which the SARS-CoV-2 uses to enter the cell, making the lungs a target for dysregulated inflammation, and its acute consequences. Rarely, pneumothorax or spontaneous pneumomediastinum may occur with an incidence of 0.66% [1,2,5,6].

Pneumomediastinum (PM) is described as the presence of air or gas in the mediastinum. It is classified as spontaneous (SPM) or traumatic. SPM can be primary, where no underlying lung disease is identified, or secondary to lung or airway disease like asthma or cystic fibrosis [7]. On the other hand, traumatic pneumomediastinum can be caused by physical trauma or barotrauma produced by MV. Moreover, PM can also be categorized into benign or malignant. The malignant form can lead to fatal consequences as the accumulation of a significant amount of air in the mediastinum can lead to mechanical obstruction of the vessels and trachea [8].

SPM was first reported in 1819 by Laennec [9]. Its pathophysiology was described by Macklin et al. to be related to the pressure gradient between the alveoli and the lung interstitium. Additionally, it was documented how an acute increase in the intrathoracic pressure can produce alveolar rupture [6,10]. The exact correlation between COVID-19 and SPM is still not well understood. It is believed to be related to the increased alveolar pressure and diffuse alveolar injury, making the alveoli more prone to rupture [11].

Furthermore, the pathophysiology of P-SILI is also similar to COVID-19, where tachypnea, and progressive cough can result in acute lung injury. This pulmonary damage is produced when an intense inspiratory effort induces pulmonary damage through an increase in transpulmonary pressure in a reduced aerated compartment. Conditions like acute hypoxemic respiratory failure, COVID-19, and ARDS may present with this abnormality. The accompanying lung damage and pulmonary edema caused by these conditions prompt an augmentation

in the respiratory drive, ensuing a damaging, and repetitive series of events. The most acceptable strategy to break this vicious circle is invasive mechanical ventilation (IMV) [4,12,13].

Risk factors of SPM include smoking (tobacco and marijuana), asthma, chronic lung disease, infections, illicit drug use (heroin and cocaine), and MV [9,14,15]. Our patient had a history of childhood asthma, but he did not have a history of smoking, illicit drug use, or emphysematous changes due to chronic lung disease on his previous imaging studies. Furthermore, he did not require non–invasive or IMV during his stay. Uncomplicated SPM is usually managed conservatively since it is primarily self-limited [16].

Upon literature review, we recognized 8 cases of SPM developing in patients with COVID-19 (Table 1). The incidence was higher in males when compared to females. Our patient was similar to 5 patients with no MV use and 3 other patients where the CT scan showed SPM with subcutaneous emphysema. One patient expired with the mortality rate being up to 12.5% [7,11,12,17,18,19,20]. Our patient was fortunate to recover upon discharge completely.

Conclusion

This case highlights the emerging association of COVID-19, P-SILI, and pneumomediastinum. SPM should be suspected even in patients who did not receive IMV, non–invasive positive pressure ventilation or in the absence of chronic lung diseases and smoking. Early detection and continuous monitoring for progression can prevent life-threatening consequences.

Disclaimer

The authors received no financial support for the research or publication of this article. The authors whose names are listed above certify that formal consents were not required as we used entirely anonymized images from which the individual cannot be identified.

Patient consent

The authors whose names are listed above certify that formal consents was not required as we used entirely anonymized images from which the individual cannot be identified. Additionally, the patient's names, initials, hospital or social security numbers, dates of birth or other personal or identifying information was not used or mentioned anywhere in the manuscript.

REFERENCES

[1] Batah SS, Fabro AT. Pulmonary pathology of ARDS in COVID-19: a pathological review for clinicians. Respir Med 2021;176:106239. doi:10.1016/j.rmed.2020.106239.

[2] Martinelli AW, Ingle T, Newman J, Nadeem I, Jackson K, Lane ND, et al. COVID-19 and pneumothorax: a multicentre retrospective case series. Eur Respir J 2020;56(5):2002697. doi:10.1183/13993003.02697-2020.

[3] Zantah M, Castillo ED, Townsend R, Dikengil F, Criner GJ. Pneumothorax in COVID-19 disease- incidence and clinical characteristics. Respir Res 2020;21(1). doi:10.1186/s12931-020-01504-y.

[4] Oujidi Y, Bkiyar H, Housni B. Self-inflicted injury by the patient himself: P-Sili in acute covid deseas, case and literature review. Ijirr.com. Accessed July 7, 2021. https://www.ijirr.com/sites/default/files/issues-pdf/3724.pdf.

[5] Ni W, Yang X, Yang D, Bao J, Li R, Xiao Y, et al. Role of angiotensin-converting enzyme 2 (ACE2) in COVID-19. Crit Care 2020;24(1):422.

[6] Mason R. Pneumomediastinum and mediastinitis. Murray and Nadel's Textbook of Respiratory Medicine. 4th ed. Elsevier Health Sciences; 2005. Chapter 72.

[7] Elhakim TS, Abdul HS, Pelaez Romero C, Rodriguez-Fuentes Y. Spontaneous pneumomediastinum, pneumothorax and subcutaneous emphysema in COVID-19 pneumonia: a rare case and literature review. BMJ Case Rep 2020;13(12):e239489.

[8] Kouritas VK, Papagiannopoulos K, Lazaridis G, Baka S, Mpoukovinas I, Karavasilis V, et al. Pneumomediastinum. J Thorac Dis 2015;7(Suppl 1):S44–9.

[9] Roguin ARene Theophile Hyacinthe Laënnec. The man behind the stethoscope. Clin Med Res 2006;4(3):230–5. doi:10.3121/cmr.4.3.230.

[10] Macklin MT, Macklin CC. Malignant interstitial emphysema of the lungs and mediastinum as an important occult complication in many respiratory diseases and other conditions: an interpretation of the clinical literature in the light of laboratory experiment. Medicine 1944;23:281–358.

[11] Mohan V, Tauseen RA. Spontaneous pneumomediastinum in COVID-19. BMJ Case Rep 2020;13(5):e236519.

[12] Oye M, Ali A, Kandah F, Chowdhury N. Two cases of spontaneous pneumomediastinum with pneumothorax in patients with COVID-19 associated pneumonia. Respir Med Case Rep 2020;31(101308):101308.

[13] Weaver L, Das A, Saffaran S, Yehya N, Scott TE, Chikhani M, et al. High risk of patient self-inflicted lung injury in COVID-19 with frequently encountered spontaneous breathing patterns: a computational modelling study. bioRxiv. doi:doi:10.1101/2021.03.17.21253788.

[14] Mattox KL. Pneumomediastinum in heroin and marijuana users. JACEP 1976;5(1):26–8.

[15] Macrae C, Brown C, Aiken C, Jamdar R. Pneumomediastinum as a complication of cocaine abuse. Clin Med 2019;19(4):321–4.

[16] Ebina M, Inoue A, Takaba A, Ariyoshi K. Management of spontaneous pneumomediastinum: are hospitalization and prophylactic antibiotics needed? Am J Emerg Med 2017;35(8):1150–3.

[17] Kolani S, Houari N, Haloua M, Lamrani YA, Meryem Boubbou M, Serraj M, et al. Spontaneous pneumomediastinum occurring in the SARS-COV-2 infection. IDCases 2020;21(e00806):e00806.

[18] Lacroix M, Graiess F, Monnier-Cholley L, Arrivé L. SARS-CoV-2 pulmonary infection revealed by subcutaneous emphysema and pneumomediastinum. Intensive Care Med 2020;46(8):1620–1. doi:10.1007/s00134-020-06078-3.

[19] Lei P, Mao J, Wang P. Spontaneous pneumomediastinum in a patient with coronavirus disease 2019 pneumonia and the possible underlying mechanism. Korean J Radiol 2020;21(7):929–30. doi:10.3348/kjr.2020.0426.

[20] Wang J, Su X, Zhang T, Zheng C. Spontaneous pneumomediastinum: a probable unusual complication of coronavirus disease 2019 (COVID-19) pneumonia. Korean J Radiol 2020;21(5):627–8. doi:10.3348/kjr.2020.0281.