Delayed Spontaneous Pneumothorax in a Previously Healthy Nonventilated COVID-19 Patient

Ondrej Zahornacký, Štefan Porubčin, Alena Rovňáková, Pavol Jarčuška
Department of Infectious Diseases and Travel Medicine, Louis Pasteur University Hospital, Košice, Slovakia, and Faculty of Medicine, Pavol Jozef Šafárik University in Košice, Košice, Slovakia

Received March 2, 2022; Accepted October 18, 2022.

Key words: Spontaneous – Pneumothorax – SARS-COV-2 – COVID-19 – Pneumonia

Abstract: Spontaneous pneumothorax is a serious and life-threatening complication of SARS-CoV-2 pneumonia. It most commonly occurs during the acute phase of the disease in patients with pre-existing lung disease (e.g. emphysema, bronchiectasis, cystic fibrosis, etc.) and in patients who require oxygen supplementation in any form (low-flow oxygen therapy, high-flow non-invasive or mechanical invasive or mechanical invasion). A rare case of a 52-year-old patient with a spontaneous pneumothorax who developed four weeks after PCR SARS-CoV-2 positivity was described. Interestingly, the patient did not have any factors that the literature considered risky for the development of this complication. During the acute phase of the disease, his condition did not require hospitalization. Imaging examinations could not clarify the cause of pneumothorax. With this case report, we want to point out the fact that spontaneous pneumothorax, as a rare and life-threatening complication of COVID-19 infection, may develop during recovery, and it is necessary to think about this complication in the differential diagnosis of dyspnoea.

Mailing Address: Prof. Pavol Jarčuška, MD., PhD., Department of Infectious Diseases and Travel Medicine, Louis Pasteur University Hospital, Rastislavova 43, Košice 04011, Slovakia, and Faculty of Medicine, Pavol Jozef Šafárik University in Košice, Tr. SNP No. 1, Košice 04001, Slovakia; e-mail: pavol.jarcuska@gmail.com

https://doi.org/10.14712/23362936.2022.26

Introduction

More than a year has passed since the end of December 2019. In the Chinese city of Wu-Chan (Hubei Province), cases of pneumonia of unknown aetiology began to appear. It has rapid progression to acute respiratory insufficiency syndrome. On January 9, 2020, China's CDC (Disease Control and Prevention) identified a new coronavirus, SARS-CoV-2 (2019-nCoV), causing the disease called COVID-19 (ECDC, 2020).

Spontaneous pneumothorax is a relatively rare event that may complicate the course of SARS-CoV-2 pneumonia. The essence of the disease is the accumulation of air in the space between the parietal and visceral pleura. It is a life-threatening condition requiring rapid diagnosis and treatment (Zhang and Liu, 2020).

Pneumothorax and COVID-19

Approximately 80% of patients infected with SARS-CoV-2 virus have mild clinical manifestations of the disease and do not require hospitalization or oxygen therapy. Some patients develop viral pneumonia, which may be accompanied by various pulmonary and extrapulmonary complications. From the group of pulmonary complications, bacterial superinfection, the development of respiratory insufficiency syndrome, pulmonary embolization, or the development of a respiratory disease based on pulmonary parenchymal fibrosis in the later period are the most common in clinical practice (Zhou et al., 2020).

In the field of viral pneumonia, we speak of secondary pneumothorax, which probably arises due to diffuse, structural damage to lung tissue by coronavirus with increased intrathoracic pressure (most often with persistent cough), rupture of interalveolar septa and bulges, followed by air leakage. Spontaneous pneumothorax is more commonly observed in patients with pre-existing lung disease (e.g. emphysema, bronchiectasis, cystic fibrosis, etc.). Mechanical ventilation, as well as high-frequency non-invasive oxygen therapy, are other risk factors. A small percentage of patients may develop pneumothorax only based on ongoing viral pneumonia (Xu et al., 2020).

Case report

A 52-year-old patient, a non-smoker, treated for arterial hypertension (valsartan), bipolar affective disorder (i.e. without drug treatment), sleep disorder, and generalized anxiety disorder with claustrophobia, otherwise without other diagnoses (height 185 cm, weight 78 kg, BMI – body mass index 22.8). In the past, he underwent subtotal extirpation of schwannoma from C3-4 hemilaminectomy.

COVID-19 disease was confirmed by RT-PCR test 3. 2. 2021. He arrived for an examination at the infectious clinic on March 2, 2021, i.e. four weeks after confirming the disease. As part of his current illness, he reported persistent cough and dyspnoea, which lasted only from the morning since he came out of the

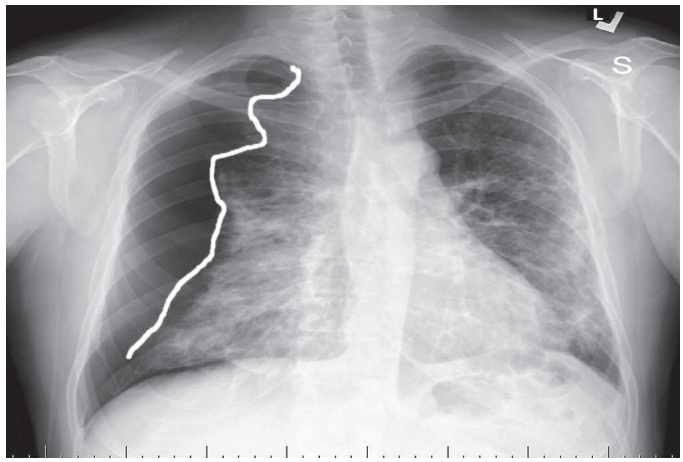

Figure 1 – X-ray of the chest with a finding of massive pneumothorax on the right, on the left are finding of spotted opacities – COVID-19 pneumonia (white line – pneumothorax line).

shower and is independent of body position. Azithromycin, rovamycin, and the immunomodulator inosine pranobex were used during quarantine.

Physical examination: afebrile, blood pressure 140/78 mm Hg, auscultation: basal crepitations on the left, weakened basal respiration on the right, regular heartbeat, tachycardia, 109 pulses/min, saturation 95–97%, otherwise somatic age finding appropriate.

The performed ultrasound examination of the lungs aimed to detect interstitial changes in the lung parenchyma documents on the left diffuse numerous B-lines and a small consolidation with minimal fluidothorax. On the other hand, the finding on the right was adverse in terms of the B line.

Due to the clinical condition, dyspnoea with tachycardia, an internal examination, and an X-ray examination of the chest (Figure 1) was subsequently performed with

Table 1 – Results of realized laboratory parameters

Investigated laboratory parameter	Resulting value/standard
Hemoglobin (g/dl)	15.46 (13–18)
White blood cells (10^9/l)	12.94 (10–18)
Plates (10^9/l)	363.00 (150–400)
D-dimer (mg/l)	2.10 (0.03–0.5)
CRP (mg/l)	6.26 (0–5.0)
Procalcitonin (μg/l)	0.02 (0–0.50)
IL-6 (ng/l)	6.02 (1.5–7.0)
pO_2 (kPa)	9.15 (10.67–14.36)
pCO_2 (kPa)	4.50 (4.26–6.38)
CD4+ T lymphocytes (10^9/l)	0.89 (0.3–1.4)
CD8+ T lymphocytes (10^9/l)	0.46 (0.2–0.9)

CRP – C-reactive protein; IL – interleukin

the finding of extensive pneumothorax on the right partial collapse of all three pulmonary lobes apically reaching 44 mm. In addition, in the left hemithoraxis, mottled, confluent opacities of the nature of infiltrative changes evaluated as COVID-19 pneumonia have been described.

The results of the performed laboratory examinations are described in Table 1.

After an internal examination, the patient was urgently admitted to the ICU (Intensive Care Unit) surgical clinic. He was drained of his right pleural cavity (in the fifth intercostal space, in the anterior axillary line using a 28 CH drain) and subsequently drained evacuated air.

After acute drainage, a control chest X-ray was performed (Figure 2), which documents the correct position of the chest drain. Pneumothorax is no longer

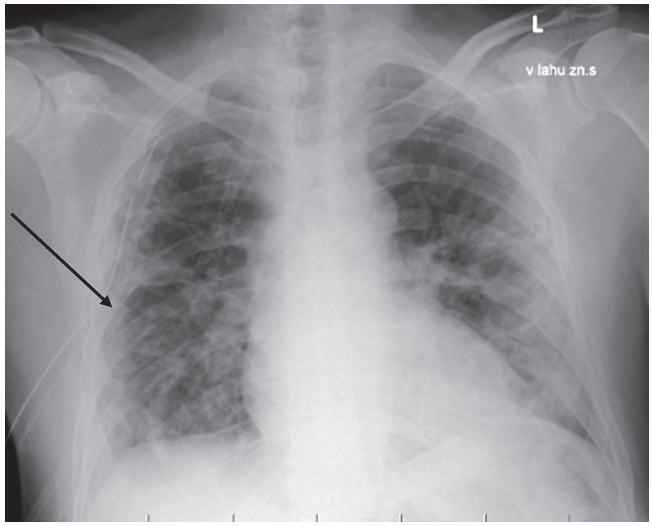

Figure 2 – X-rays of the chest after drainage of the right hemithorax (arrow – thoracic drain).

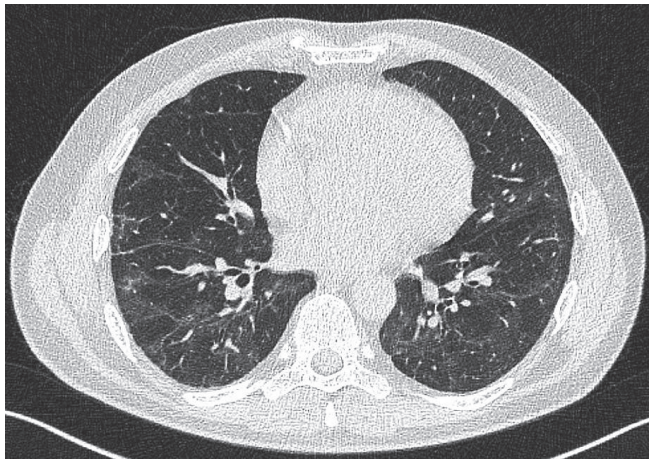

Figure 3 – High-resolution computed tomography examination of the chest with the finding of residual changes after COVID-19 pneumonia otherwise without other pathological changes.

described. Infiltrative changes persist bilaterally. The patient received comprehensive symptomatic treatment during hospitalization, and no antibiotics were given. HRCT (high-resolution computed tomography) of the lungs was not performed due to claustrophobia. After six days of hospitalization, the patient was discharged to outpatient care.

One month after discharge and subsequent patient education, HRCT lung examination was performed, which, despite claustrophobia, was well performed. This examination describes the residual changes after overcoming COVID-19 pneumonia (Figure 3), but without the explanatory cause of pneumothorax in the CT (computed tomography) image and the finding of subpleural bullae resp. another pathological finding.

The cause of spontaneous pneumothorax could not be clarified even after a follow-up pneumological examination.

Discussion

Spontaneous pneumothorax is a rare complication of COVID-19 infection occurring mainly in ventilated patients, resp. in patients requiring oxygen supplementation with high flow nasal cannula. The present case report describes a patient who developed spontaneous pneumothorax 4 weeks after a diagnosis of COVID-19 infection. Interestingly, the patient did not have any risk factors for his development (pre-existing lung disease, invasive ventilation, injury, smoking, etc.) and did not require oxygen therapy in any form during the acute phase of the infection.

The cause of pneumothorax in the described patient one month after RT-PCR positivity remains unknown. The performed HRCT examination of the chest did not reveal the cause of pneumothorax in terms of hitherto unknown and untreated respiratory diseases such as, e.g. chronic obstructive pulmonary disease, emphysema, bronchiectasis, bullae, etc. Persistent suffocating cough may also be one of the causes of the disease. Wang et al. (2020) state that barotrauma caused by persistent coughs can lead to this complication.

However, the pathology that led to spontaneous pneumothorax development may be at the microscopic level. Huis In 't Veld et al. (2021) report that lung tissue samples taken from patients during necropsy revealed changes in the hyaline membrane and microvessel thrombosis. Based on these findings, a possible explanation for the development of pneumothorax in our patient could be the development of subpleural organized microinfarcts due to peripheral thrombosis (the patient did not receive anticoagulant therapy). These areas of microinfarction could lead to disruption of pleural continuity and eventually to pneumothorax. However, it was most likely a combination of the mentioned mechanisms – barotrauma + microscopic damage to lung tissue (peripheral thrombosis and viral pneumonia).

Sun et al. (2020) described 2 cases of spontaneous pneumothorax development, which occurred four weeks after COVID-19 infection, but was caused by a rupture of the pulmonary bullae.

A similar case of spontaneous pneumothorax in a PCR SARS-CoV-2 positive patient who had no risk factors for its development was published by Huis In 't Veld et al. (2021). The course of the disease is in many ways similar to the case report we describe. There was a 38-year-old patient who was five weeks after overcoming COVID-19 infection. The acute phase of the disease was mild and not hospitalized. After five weeks, she was examined for sudden dyspnoea and right-sided pleurisy pain. A bilateral pneumothorax was described on a chest X-ray, the cause of which could not be elucidated (Huis In 't Veld et al., 2021).

Another case report in which the patient developed spontaneous unilateral tension pneumothorax after a clinical course suggesting COVID-19 infection is also mentioned in the literature. However, this patient did not have a confirmed coronavirus infection (PCR SARS-CoV-2 repeatedly negative). However, the clinical course of the disease and radiological findings indicated COVID-19. However, the patient had risk factors for developing pneumothorax – a history of asthma and active smoking (Flower et al., 2020).

Noppen (2010) report that the risk factors for spontaneous pneumothorax include the male sex, tall and slender, and active smoking.

The patient from our case report had the described risk factors (male, 185 cm, 78 kg, BMI 22.8) but no smoker.

Martinelli et al. (2020) found that pneumothorax, as a complication of COVID-19 infection, is three times more common in men, is most often right-sided, and is more common in patients over 50. However, only mechanically ventilated and spontaneously breathing patients requiring low-flow oxygen therapy have been studied (Martinelli et al., 2020).

Kanık-Yüksek et al. (2021) in their publication describe a case of spontaneous pneumothorax in a 17-year-old patient without risk factors. The patient was treated on an outpatient basis at the onset of the disease. The development of clinical signs occurred on day 9 of the RT-PCR positive test when he developed dyspnoea and chest pain. Spontaneous pneumothorax was demonstrated by imaging (CT, X-ray). No other risk factors for spontaneous pneumothorax (chronic or previous lung disease, smoking, height, low body weight, etc.) have been identified in the patient (Kanık-Yüksek et al., 2021).

Ekanem et al. (2021) in their publication describe a group of 1,619 patients, of whom 22 (1.4%) developed spontaneous pneumothorax. 52% of patients had a history of arterial hypertension, 32% had diabetes mellitus, and 14% smoked. However, it is important to note that all patients in this group were hospitalized during the acute phase of COVID-19 and required oxygen therapy in various forms (from the nasal cannula to the ECMO – extracorporeal membrane oxygenation). They developed spontaneous pneumothorax between 1 and 15. day of hospitalization (median day 9). 8 patients (36%) left (Ekanem et al., 2021).

It is crucial to note that HRCT lung examination should also be performed in all patients diagnosed with pneumothorax. We also want to note that ultrasound

examination of the lungs is an imaging method capable of capturing pneumothorax through basic B mode (abolished lung sliding, lung point sign) and also special imaging – M mode (bar code sign). Unfortunately, at the time of the COVID-19 pandemic, which many patients characterize, ultrasound examination of the lungs is mainly focused on diagnosing interstitial pneumonia. Monitoring of lung sliding in B mode and examination in M mode is often not performed due to time constraints (similar to our case).

Sartans (valsartan) have not been mentioned in the literature as a possible cause of spontaneous pneumothorax.

Conclusion

Spontaneous pneumothorax is a rare (incidence about 1%) and potentially lethal complication of SARS-CoV-2 pneumonia (Chen et al., 2020).

This article presents a case report of a 52-year-old patient who developed spontaneous pneumothorax four weeks after RT-PCR of SARS-CoV-2 positivity. An interesting case is the finding of spontaneous pneumothorax in a patient without risk factors, without oxygen support, and thus the possible influence of artificial barotrauma. During the acute phase of the disease, his condition did not require hospitalization. The pathophysiology of spontaneous pneumothorax remains unclear. We assume that this is a combination of risk factors: long-term cough-induced barotrauma and the development of subpleural microinfarcts due to peripheral vascular thrombosis in the field of undiagnosed viral pneumonia.

References

Chen, N., Zhou, M., Dong, X., Qu, J., Gong, F., Han, Y., Qiu, Y., Wang, J., Liu, Y., Wei, Y., Xia, J., Yu, T., Zhang, X., Zhang, L. (2020) Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *Lancet* **395(10223)**, 507–513.

ECDC (2020) *Coronavirus disease 2019 (COVID-19) in the EU/EEA and the UK – tenth update*, 11 June 2020.

Ekanem, E., Podder, S., Donthi, N., Bakhshi, H., Stodghill, J., Khandhar, S., Mahajan, A., Desai, M. (2021) Spontaneous pneumothorax: An emerging complication of COVID-19 pneumonia. *Heart Lung* **50**, 437–440.

Flower, L., Carter, J. P. L., Rosales Lopez, J., Henry, A. M. (2020) Tension pneumothorax in a patient with COVID-19. *BMJ Case Rep*. **13**, e235861.

Huis In 't Veld, M. A., Ten Kortenaar, S. W., Bodifee, T. M., Stavast, J., Kessels, B. (2021) Delayed spontaneous bilateral pneumothorax in a previously healthy nonventilated COVID-19 patient. *J. Emerg. Med*. **60**, 793–795.

Kanık-Yüksek, S., Özkaya-Parlakay, A., Güney, D., Gülhan, B., Bayhan, G. İ., Şenel, E. (2021) A case of spontaneous pneumothorax with persistent air leakage during the course of COVID-19. *Izmir Dr. Behcet Uz Cocuk Hast. Dergisi* **11(2)**, 202–205.

Martinelli, A. W., Ingle, T., Newman, J., Nadeem, I., Jackson, K., Lane, N. D., Melhorn, J., Davies, H. E., Rostron, A. J., Adeni, A., Conroy, K., Woznitza, N., Matson, M., Brill, S. E., Murray, J., Shah, A., Naran, R., Hare, S. S., Collas, O., Bigham, S., Spiro, M., Huang, M. M., Iqbal, B., Trenfield, S., Ledot, S., Desai, S., Standing, L., Babar, J., Mahroof, R., Smith, I., Lee, K., Tchrakian, N., Uys, S., Ricketts, W., Patel, A. R. C.,

Aujayeb, A., Kokosi, M., Wilkinson, A. J. K., Marciniak, S. J. (2020) COVID-19 and pneumothorax: A multicentre retrospective case series. *Eur. Respir. J*. **56**, 2002697.

Noppen, M. (2010) Spontaneous pneumothorax: Epidemiology, pathophysiology and cause. *Eur. Respir. Rev*. **19**, 217–219.

Sun, R., Liu, H., Wang, X. (2020) Mediastinal emphysema, giant bulla, and pneumothorax developed during the course of COVID-19 pneumonia. *Korean J. Radiol*. **21**, 541–544.

Wang, W., Gao, R., Zheng, Y., Jiang, L. (2020) COVID-19 with spontaneous pneumothorax, pneumomediastinum and subcutaneous emphysema. *J. Travel Med*. **27**, taaa062.

Xu, Z., Shi, L., Wang, Y., Zhang, J., Huang, L., Zhang, C., Liu, S., Zhao, P., Liu, H., Zhu, L., Tai, Y., Bai, C., Gao, T., Song, J., Xia, P., Dong, J., Zhao, J., Wang, F. S. (2020) Pathological findings of COVID-19 associated with acute respiratory distress syndrome. *Lancet Respir. Med*. **8(4)**, 420–422.

Zhang, L., Liu, Y. (2020) Potential interventions for novel coronavirus in China: a systematic review. *J. Med. Virol*. **92**, 479–490.

Zhou, C., Gao, C., Xie, Y., Xu, M. (2020) COVID-19 with spontaneous pneumomediastinum. *Lancet Infect. Dis*. **20**, 510.