CASE REPORT

Point-of-care ultrasound for diagnosis of pneumothorax in a pregnant COVID-19 patient in the emergency department

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Introduction

Spontaneous pneumothorax is a rare but very serious complication in patients with COVID-19 pneumonia. Although the mechanism of pneumothorax occurrence is not fully understood, it is thought that it may develop due to the diffuse alveolar damage caused by pneumonia, interstitial emphysema, bullae or alveolar rupture caused by persistent cough (Vega et al. 2020). Its timing is uncertain, and it may be the first admission complaint of patients (Abotaleb et al. 2021); it may also develop during outpatient follow-up (González-Pacheco et al. 2021) or hospitalisation (Martinelli et al. 2020). According to the conducted studies, the incidence of pneumothorax in COVID-19 patients was 1% in those who need to be hospitalised, 2% in those who need to be hospitalised in the intensive care unit (ICU), and 15% in those who had mechanical ventilation requirement. Pneumothorax was found in 1% of patients who died due to COVID-19 pneumonia (Martinelli et al. 2020). However, no pneumothorax case associated with COVID-19 positivity in a pregnant patient has been reported in the literature.

In this case, we wanted to present a 16-week pregnant patient admitted to the emergency department (ED) with complaints of dyspnoea, chest pain and cough and was diagnosed with pneumothorax and COVID-19 pneumonia due to the examinations performed in the ED. This case report is the first published report in the literature of a pregnant COVID-19 patient who was presented to the ED with pneumothorax.

Case report

A 25-year-old woman, at 16 weeks of gestation (gravity 6/parity 0) was admitted to the ED with complaints of dyspnoea, cough for four days and chest pain located on the left side that started on the day of admission. She had a history of five spontaneous miscarriages and deep vein thrombosis two months ago. She had no history of smoking, recent thorax trauma or previous pneumothorax. Clinical examination revealed that her body temperature was 37.3 °C, heart rate was 146/min, blood pressure was 140/90 mmHg, respiratory rate was 30/min and oxygen saturation (SpO₂) was 90% in room air. The patient was dyspneic, tachypnoeic and accessory respiratory muscles were participating in respiration. On auscultation, breath sounds were absent throughout the left hemithorax. The heart was rhythmical but tachycardic. A 12-lead ECG showed a sinus tachycardia at 145 beats/min. The patient’s laboratory parameters of on the admission and follow-up are shown in Table 1. No abnormal findings were detected in the tests for the aetiology of thrombophilia and possible antiphospholipid syndrome. The by real-time reverse transcription-polymerase chain reaction (RT-PCR) COVID-19 test was positive in the nasal swab. Emergency medicine specialists performed bedside transthoracic echocardiography and lung ultrasonography. Echocardiography showed no wall motion defects, no pericardial fluid and a normal ejection fraction of 60% to 65% with normal right ventricular size and function. POC-LUS (point-of-care lung ultrasound) was performed in the supine position. The absence of lung sliding in B mode and barcode sign in M mode was seen in the left hemithorax. (Figure 1(B)). The diagnosis of pneumothorax was confirmed by a portable anteroposterior (AP) chest X-ray. A large, left-sided pneumothorax with mediastinal shift and radiological signs of tension was seen. (Figure 1(C)). The obstetrician also evaluated the patient via transabdominal USG, her findings were consistent with the week of gestation, and no abnormal findings were found. Then, she was admitted on oxygen support at 15 lt/min with a non-rebreather reservoir mask. Tube thoracostomy was performed to the left hemithorax in the critical care unit of the ED. On the portable AP chest radiograph taken after tube thoracostomy, the left lung was re-expanded and pneumonic infiltrations were detected in the perihilar region on the right lung (Figure 1(D)). The patient was transferred to the COVID area of ICU. Oxygen treatment was continued with a non-rebreather reservoir mask. She did not require intubation or mechanical ventilation. Conservative supportive treatment was given. Low molecular weight heparin treatments were continued which was already she used. The thoracic drainage tube was removed on the fifth day of follow-up. The patient, who had
no problems in her follow-ups, was discharged on the 14th day of her hospitalisation.

**Discussion**

Spontaneous pneumothorax is rare during pregnancy, during delivery, or after delivery. In a review of 74 articles (case reports and small case series), only 87 pregnant pneumothorax cases have been reported so far. The most common predisposing factors were blebs, bullae or lung cysts, previous pneumothorax history, lymphangioleiomyomatosis, asthma, recurrent chest infections, ectopic deciduosis, catamenial pneumothorax and hyperemesis gravidarum (Agrafiotis et al. 2021). However, chest infections, ectopic deciduosis, catamenial pneumothorax thorax history, lymphangioleiomyomatosis, asthma, recurrent factors were blebs, bullae or lung cysts, previous pneumo-cases have been reported so far. The most common predispos-ration, or after delivery. In a review of 74 articles (case ers, anti-nuclear antibodies (ANA) and anti-double stranded reports and small case series), only 87 pregnant pneumothorax sodium (mmol.L⁻¹)

| Blood parameter                              | Hospital Day 0 | Day 1 | Day 7 | Day 14 |
|----------------------------------------------|---------------|-------|-------|-------|
| White blood cell (WBC) (10^³ µL)             | 15.7          | 10.4  | 6.5   | 7.3   |
| Hemoglobin (g.dL⁻¹)                          | 14.5          | 14.9  | 11.9  | 10.9  |
| Platelet (10⁹ µL)                            | 230           | 155   | 223   | 279   |
| Lymphocyte (10⁹ µL)                          | 1.6           | 0.7   | 1.0   | 2.3   |
| Glucose (mg.dL⁻¹)                            | 155           | 106   | 77    | 77    |
| Urea (mg.dL⁻¹)                               | 28            | 13    | 14    | 11    |
| Creatinine (mg.dL⁻¹)                         | 0.43          | 0.25  | 0.2   | 0.26  |
| Alanine transferase (IUL⁻¹)                  | 34            | 31    | 51    | 43    |
| Aspartate transferase (IUL⁻¹)                | 22            | 34    | 39    | 34    |
| Sodium (mmol.L⁻¹)                            | 139           | 136   | 136   | 137   |
| Potassium (mmol.L⁻¹)                         | 3.9           | 3.85  | 4.09  | 4.1   |
| C-reactive protein (CRP) (mg.dL⁻¹)           | 3.8           | 123   | 79.3  | 12.7  |
| Procalcitonin (µg.L⁻¹)                       | 0.05          | 0.22  | 0.20  | 0.13  |
| Fibrinogen (mg.dL⁻¹)                         | 573.7         | 900   | 900   | 900   |
| Ferritin (µg.L⁻¹)                            | 44.5          | 116.7 | 195.2 | 111.6 |
| Lactate dehydrogenase (IUL⁻¹)                | 526           | 490   | 340   | 270   |
| Creatine kinase myocardial band (CK-MB) (µg.L⁻¹) | 2.0          | 1.0   | 2.3   | 0.6   |
| Troponin (ng.L⁻¹)                            | 12            | 5     | 16    | 3     |
| D-Dimer (µg.L⁻¹)                             | 590           | 950   | 1710  | 1810  |
| Prothrombin time (sn)                        | 10.3          | 11.5  | 10.7  | 10.5  |
| Activated partial thromboplastin time (sn)    | 15.7          | 21    | 19.1  | 20.5  |
| INR                                          | 0.84          | 0.94  | 0.87  | 0.85  |

Value other than reference values in bold.

functional residual capacity and total lung capacity, decreases, and oxygen consumption of the placenta, foetus and maternal organs increases (Wong et al. 2006). Physiological dyspnoea of pregnancy is not associated with exercise, coughing, wheezing or other pulmonary symptoms. Symptoms suggestive of pathological dyspnoea are sudden onset of shortness of breath, dyspnoea at rest, orthopnea, cough, chest pain, fever or haemoptysis. Pathological dyspnoea may develop due to cardiac diseases (arrhythmias, valve diseases, congenital heart diseases, myocardial diseases, etc.) or pulmonary diseases (asthma attack, pneumonia, pneumothorax, pulmonary embolism, etc.) (Bobrowski 2010; Grewal et al. 2014). Some of the symptoms of pregnancy, such as shortness of breath, nasal congestion, nausea-vomiting or fatigue, overlap with the symptoms of COVID-19. Therefore, if these findings are observed in afebrile pregnant patients, they should be evaluated regarding COVID-19 (Breslin et al. 2020). Our case had a coughing complaint ongoing for four days, dyspnoea and chest pain started on the day of emergency admission suggesting pathological dyspnoea. These symptoms were findings that required the exclusion of COVID-19 infection, especially during the pandemic period. Besides, on auscultation, breath sounds were absent in the left lung. In a study conducted on the incidence of pneumothorax in COVID-19, pneumothorax was found in 60 (incidence 0.91%) out of 6574 COVID-19 admissions, according to the data collected from 16 centres (Martinelli et al. 2020). High intrathoracic pressure caused by the persistent cough in COVID-19, rupture of alveoli into the pleural space due to alveolar septal inflammation and alveolar swelling secondary to an infection (Sun et al. 2020), rupture of pre-existing pulmonary cysts or pneumatoceles as a result of positive pressure ventilation (Martinelli et al. 2020), barotrauma caused by mechanical ventilation are possible pathophysiological scenarios of pneumothorax. The late onset of pneumothorax suggests a sustained period of lung inflammation with diffuse alveolar damage followed by fibrosis and cyst lesions in the late phase of COVID-19 pneumonia.
However, our patient presented with pneumothorax on the fourth day of symptoms in the early phase of COVID-19 pneumonia, without the development of alveolar damage and lung fibrosis. Since our case did not have any previous imaging, it was not known whether there were possible pulmonary cysts or pneumatoceles. However, she had no smoking, or trauma history or previous history of pneumothorax. The patient’s presentation to the ED with pneumothorax in the initial stage of the disease, while there was no severe lung injury, suggests that the possible responsible mechanism was high intrathoracic pressure caused by a persistent cough.

Although computed tomography (CT) remains the gold standard imaging test for the diagnosis of pneumothorax (Musolino et al. 2021), we chose POC-LUS as the first imaging method in our patient to prevent the teratogenic effects of radiation. The advantages of POC-LUS are that it is simple, fast, inexpensive, can be applied repetitively, and by the bedside (Volpicelli et al. 2012) also eliminates the requirement to transport critically ill patients and prevents patients from being taken out of the isolation zone. It can be easily performed at the bedside by trained emergency medicine physicians who wear the necessary personal protective equipment to limit the risk of COVID-19 transmission (Musolino et al. 2021). During our focussed examination for pneumothorax, a linear transducer was used. Starting from the second intercostal space, the pleura between the ribs was visualised. Once the pleura has been identified, lung sliding was evaluated. While lung sliding was observed in the right lung, it was not observed in the left lung. The absence of lung sliding is highly sensitive but not specific for pneumothorax. With movement mode (M mode), normal lung (right lung) sliding produced a beach or seashore sign (Figure 1(A)). In the lung with pneumothorax (left lung), this lack of lung sliding was demonstrated on M mode by loss of the beach, resulting in the presence of linear lines above and below the level of the parietal pleura. This sign is often referred to as the barcode sign (Figure 1(B)) (Irwin and Cook 2016). Since pneumothorax level, parenchymal pathologies and secondary aetiologies cannot be determined clearly with POC-LUS, patients who are considered for tube thoracotomy or surgery should also be evaluated with AP chest X-ray (Kavurmaci et al. 2019). We also performed an AP chest X-ray to determine the level of pneumothorax, which we diagnosed by POC-LUS. We have both confirmed the diagnosis of the patient and determined the requirement for tube thoracostomy via X-ray.

If the pneumothorax that occurs during pregnancy is small (<2 cm), the mother is not dyspneic, and there is no foetal distress, it can be managed with a simple observation. Otherwise, aspiration can be performed, or a chest drain can be applied to patients with persistent air leaks. In our case, tube thoracostomy was performed in the critical care unit of the ED because the pneumothorax was large enough to cause a mediastinal shift, and the patient had tachycardia, tachypnoea and hypoxia (MacDuff et al. 2010). Because of the risk of recurrence in subsequent pregnancies, a minimally invasive video-assisted thoracoscopic surgery (VATS) procedure should be considered after remission. Successful pregnancies and spontaneous deliveries without pneumothorax recurrence have been reported after the VATS procedure (Lal et al. 2007). Our patient is now at the 27th week of pregnancy, and her pregnancy continues without any problems. She is still under routine follow-up.

**Conclusion**

Differentiation of physiological and pathological dyspnoea in pregnant patients is possible with the correct questioning of accompanying symptoms and careful evaluation of physical examination findings. Especially during the pandemic period, it should be considered that the dyspnoea present in
pregnant patients may be related to COVID-19 pneumonia and other accompanying pathologies. In order to prevent catastrophic results and conclude a diagnosis without wasting time, it is necessary to use appropriate imaging methods (POC-LUS, transthoracic echocardiography, PA chest radiography) with the least teratogenic effects. Otherwise, in a patient with a pneumothorax, it can have potentially life-threatening consequences if the wrong management is chosen, such as continuous positive airway pressure due to hypoxia.

**Ethical approval**

The ethics registration approval was unnecessary due to the nature of the study.

**Disclosure statement**

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