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Case Report

Pulmonary Pneumatoceles in a COVID-19 Pneumonia: Coincidence or Evolutionary Aspect?

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Abstract

A Coronavirus disease 2019 (COVID-19) outbreak, has rapidly swept around the world just within a month, causing global public health emergency. Ground glass opacities, consolidation, and crazy paving pattern are typical chest computed tomography (CT) manifestations; otherwise, pulmonary pneumatoceles are a rare evolutionary aspect. Herein, we report a case of a 53-year-old male who was diagnosed with COVID-19 pneumonia on the basis of RT-PCR analysis with a pneumatocele formation in bilateral lobes of the lung on follow-up chest CT scan. The aim of this report is to highlight this atypical radiological evolution of COVID-19 pneumonia with representative pictures.

Keywords: *Coronavirus Disease 2019 (COVID-19); Computed Tomography (CT); Pulmonary Pneumatoceles*

Introduction

Coronavirus disease 2019 (COVID-19), a highly contagious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was firstly reported in Wuhan, Hubei Province of China [1] that led to a pandemic emergence according to the World Health Organization (WHO) on March 11, 2020 [2]. Different radiological patterns are observed at different times in the course of the disease in most of the first cases. Bilateral distribution of ground glass opacities (GGO) with or without consolidation in posterior and peripheral lungs was the cardinal hallmark of COVID-19 [3,4].

Pulmonary pneumatoceles are thin-walled, gas-filled spaces within the lung that usually occur in association with acute pneumonia [5] and are common in infants and young children, but unusual in adults [6]. They are most commonly associated with *S. aureus* and *S. pneumoniae* infections [7,8]. The mechanism is believed to be a combination of parenchymal necrosis and check-valve airway obstruction [6].

So far, few reports have provided information on the imaging progress and follow up of 2019 novel coronavirus pneumonia (COVID-19). In this article, we investigate the imaging findings with a first example of pneumatoceles across the course of the disease in a patient with COVID-19 pneumonia (confirmed by RT-PCR) in our university hospital of Casablanca, Morocco.

Patient and Observation

A 53-year-old man was admitted during the early phase of the COVID-19 pandemic in Morocco (March 5th 2020), with a 4-days history of fever, productive cough, chest pain, shortness of breath and general weakness. He had no medical past history, taking no medications. He was otherwise non-smoker and had no travel history or contact with known COVID-19 cases.

Clinically, he was alert. His temperature was 37.8°C; blood pressure was 120/80 mmHg, pulse rate was regular 88 beats per minute and was in respiratory distress with 36 breaths per minute. Oxygen saturation was 85% on room air (which rose to 90% with high-concentration oxygen mask). Whereas his chest examination revealed bilaterally decreased air movement and diffuse crackles and wheezing. Arterial blood gas analysis showed respiratory acidosis with hypoxemia. Laboratory investigations had revealed a lymphocytopenia (0.6 × 10^3/L); as well as increased Creatinine and C-reactive Protein (CRP) levels 498 mg/l; fibrinogen and D-dimer. The renal and hepatic function were without particularity.

Chest radiograph showed a dense patchy interstitial infiltration (Figure 1). Initial chest Ct scan showed bilateral diffuse ground-glass opacities and crazy paving aspect (Figure 2).

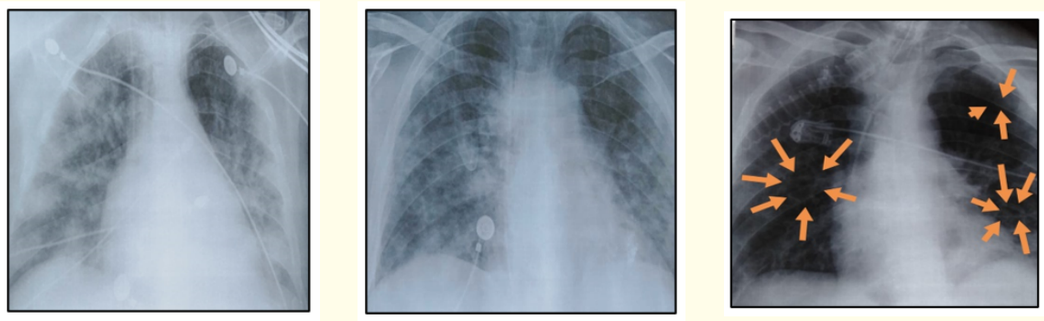

Figure 1: *A. Initial Chest X-ray (day 7 after the onset of illness) showing dense patchy opacities scattered across the two pulmonary fields associated with bilateral interstitial infiltrates. B. On day 17, repeat chest radiograph showed rapid development of diffuse bilateral opacities. C. Chest x-ray on days 30 following symptom onset, showing radiological improvement and multiple thin-walled cystic lesions (arrows).*

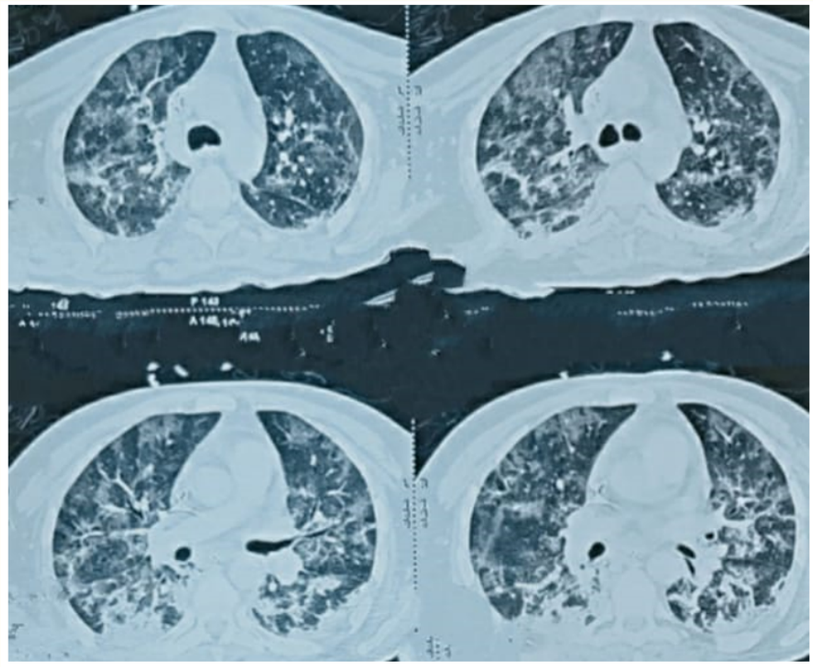

Figure 2: *Findings on chest CT scan on admission showing multiple central and peripheral patchy ground glass opacities in bilateral lobular and central with septal thickening that gave the appearance of "crazy paving" and peripheral consolidation diffusely distributed over the two lungs.*

Within 24 hours of presentation, he deteriorated rapidly with severe hypoxemic respiratory failure and he was intubated and protective mechanical ventilation was initiated.

The patient was diagnosed with coronavirus disease 2019 (COVID-19) on the basis of RT-PCR analysis of nasal pharyngeal swab. He was started on hydroxychloroquine 200 mg, (three times daily) for 14 days with Azithromycin (250 mg, daily, for 07 days).

He also was given thrombosis prophylaxis with enoxaparin 100 IU/kg twice-daily and vitamins.

Additionally, corticosteroid treatment (Methylprednisolone 2 mg/kg/day) was administrated to attenuate lung inflammation. On the sixth day of ICU stay, the patient had sudden cardio-pulmonary arrest (CPA). Cardiopulmonary resuscitation has been started followed by a continuous infusion of norepinephrine.

After eight days of mechanical ventilation, patient's respiratory symptoms improved, oxygen saturation remained above 95% and maintained normal body temperature, he was extubated. However, On the thirteenth hospital day, due to deterioration in the clinical and imaging findings, the patient was reintubated and put under mechanical ventilation. A surgical tracheotomy was required 06 days after. Antibiotherapy was switched to imipenem-amikacin on day 14 for acute respiratory distress syndrome and septic shock. On day 22, he was diagnosed with a ventilator associated pneumonia. *Acinetobacter baumannii* and *Pseudomonas aeruginosa* were identified as causative organisms. Treatment was switched to intravenous ceftazidime-colimycin and tigecycline.

Nasopharyngeal swab tests of SARS-CoV-2 were performed repeatedly for surveillance and were negative on day 24.

On radiographs and chest CT performed after one month revealed bilateral lobe pneumatoceles formation which gradually increased in size with no air-fluid level. These pneumatoceles increased gradually in size, however no barotraumatic complication was ever identified.

The multiple ground-glass opacities with bilateral parenchymal consolidation and interlobular septal thickening still remained at this point (Figure 3A and 3B and figure 4).

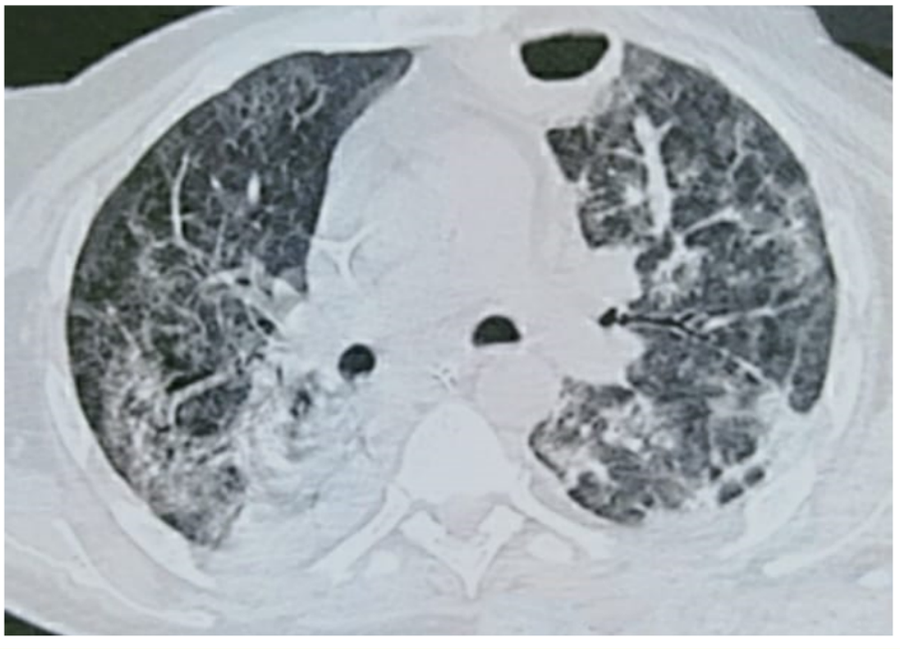

Figure 3A

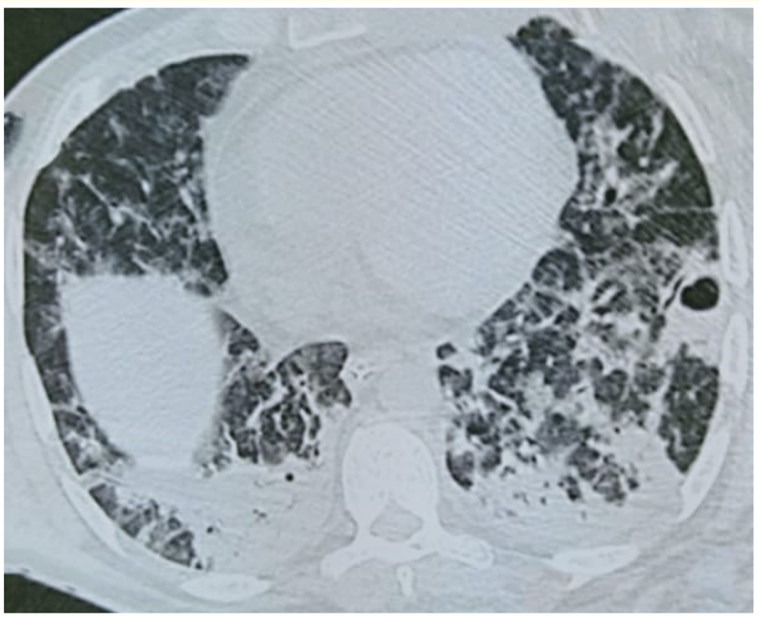

Figure 3B

Figure 3: *Follow up chest CT scan performed on day 35 showing incidental small, thin-walled cyst in right ventral upper lobe (A) and the fowler (B) that likely represents a pneumatocele*

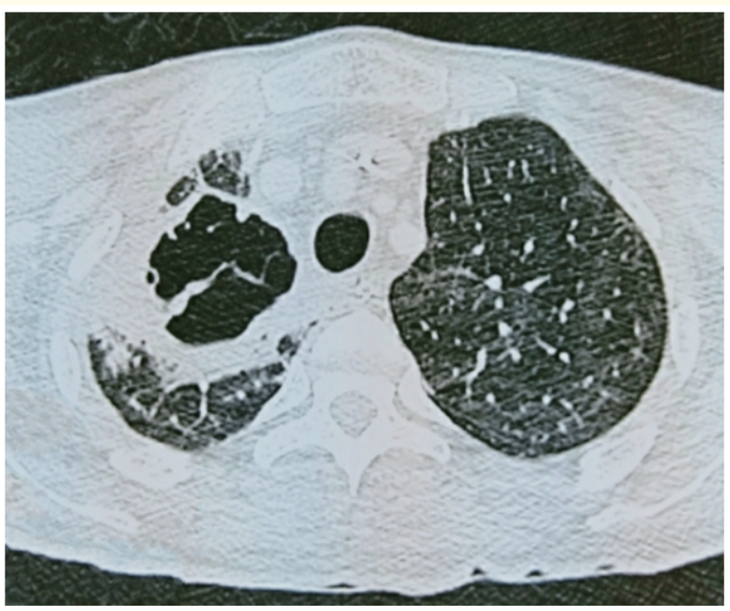

Figure 4: *Follow up chest CT scan performed on day 45 showing pneumatocele increasing in size with false membranes within it.*

Discussion

The current outbreak of COVID-19 has become a global health emergency. Although, atypical CT image findings of COVID-19 are less reported in current studies, we believe that they are diverse and evolve rapidly. Otherwise, pulmonary pneumatoceles have been rarely reported.

Pneumatocele is a thin-walled lung cavity filled with air usually seen as a complication of acute pneumonia [9] and are common in infants and young children but unusual in adults [3]. They can be single but are more often multiple [6]. The causes of pneumatocele include severe pneumonia, thoracic trauma, hydrocarbon ingestion, and positive pressure ventilation [6-10]. Mostly they occur as a sequel to acute bacterial pneumonia, due to *Staphylococcus aureus* [11], *Streptococcus pneumonia* [12], or *Acinetobacter calcoaceticus* [15]. Pneumatocele formation in adult pulmonary tuberculosis had been seldom reported [16,17]. Complication may occur including tension pneumatocele [18], pneumothorax and superinfection. Three theories have been proposed to explain the formation of pneumatocele: Pulmonary overinflation caused by check valve airway obstruction, drainage of necrotic lung parenchyma with subsequent enlargement caused by check valve airway obstruction and focal air collection in pulmonary interstitial tissue caused by a direct communication between the pulmonary interstitium and parenchyma [6].

On follow-up CT scans, Goh., *et al*. [19] identified an incidental small, thin-walled subpleural cyst in right upper lobe that likely represents a pneumatocele in a COVID 19 patient. This was similar to Zhou., *et al*'s findings, describing a pneumomediastin as a complication of pneumatoceles in a COVID 19 case [20].

Acinetobacter has the ability to be a necrotizing infection and, thus, provide a nidus of structural damage [21]. In the report by Hunt., *et al*. [15], Pneumatoceles were present in 8.8% of ICU patients (3 of 34) with *Acinetobacter pneumonia*.

A potential role of bacterial and fungal superinfection may not be ruled out. However, we think that SARS-CoV-2 may have caused pneumatocele formation in our patient.

In summary, pneumatoceles may be a rare pulmonary complication of COVID-19 pneumonia. Although, the precise mechanism is unknown. The occurrence of pneumatocele in COVID-19 patients should be monitored closely. It can potentially cause severe barotraumatic complication. To our knowledge this is the first case of Pneumatoceles occurring in COVID19 pneumonia with evolving imaging proofs.

Conclusion

In summary, the chest CT scan manifestations of COVID-19 often presented as patchy or mixed ground-glass opacities and consolidation, involving the periphery of bilateral lungs, that can quickly change over a short period of time. To our knowledge, the occurrence of pneumatoceles is rare among COVID 19 patients. Thus, our findings indicate that the radiological evolution of COVID-19 pneumonia is variable over time. This case highlighted the need to analyze the evolution of chest imaging in patients with COVID-19 pneumonia and compare imaging results across the course of the disease. It also prompts a discussion of our current understanding of the prognosis of infection.

Competing Interests

The authors have no conflicts of interest to declare

Authors' Contributions

Malika Oulahiane and Sahar Yahya: Drafting of manuscript.

Ouissal Aissaoui: Critical revision.

Afak Nsiri, Khalid Khaleq, Aziz Bouhouri, Rachid Al Harrar: Final approval.

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