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Case report

Pneumomediastinum: a rare complication in COVID-19 patients

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Abstract. A 62-year-old man with COVID-19 had PS for fever, coughing, and breathlessness. Two days after therapy, the patient's clinical condition worsened. X-ray and CT showed pneumomediastinum, emphysema and pneumothorax. The patient was intubated and subjected to conservative therapy. The patient was dis-charged after about 20 days. Radiological imaging plays a key role in the proper diagnosis and treatment of COVID-19 patients with related complications.

Key words: pneumomediastinum, pneumothorax, COVID-19, computed tomography, X-ray, SARS-COV-2

Introduction

The first cases of acute respiratory syndrome due to SARS-CoV-2 were described in 2019 in China. On February 12, 2020, WHO named this disease COVID-19 (1), and on March 11 the pandemic was declared. Symptoms may present in mild form with fever, dry cough and myalgia or evolve in dyspnea, hypoxemia, ARDS, respiratory failure and death (2).

The most common complications of COVID-19 are ARDS, pulmonary embolism, pneumothorax, and less frequently pneumomediastinum (3,4) isolated or combined with pneumothorax, pneumopericardium or subcutaneous emphysema (5).

CT and chest X-ray are important to diagnose and to differentiate the clinical stage.

We reported a case of male patient with SARS-CoV-2 infection complicated by pneumomediastinum, pneumothorax and subcutaneous emphysema.

Case presentation

A 62-year-old man went to emergency room with a fever of 39 °C, dry cough and breathlessness.

The patient was diagnosed with Sars-CoV-2 infection based on RT-PCR analysis of sputum.

He had chronic lymphatic leukemia. He denied the use of tobacco. Pressure was 120/70 mmHg and oxygen saturation was 75 % in ambient air, improving to 94 % with 15L/min of O2. The first chest X-ray showed areas of parenchymal thickening bilaterally, interstitial thickening and lower lobes consolidation (Fig.1).

The treatment was azithromycin, corticosteroids, LMWH and paracetamol. After two days patient developed hypothermia and hypotension. The second chest X-ray showed pneumomediastinum (PM) and bilaterally subcutaneous emphysema from laterocervical region to upper thoracic wall with right apical pneumothorax (PNX). The patient was intubated and a control CT confirmed the X-ray finds: areas of parenchymal consolidation with bronchogram aerial, pulmonary hepatitis and bilaterally "ground-glass" areas and interstitial thickening. Conservative therapy was used by thoracic surgeon. (Fig.2A-B).

After 4 days, rate of subcutaneous emphysema and pneumomediastinum decreased (Fig.3). The patient's condition resolved almost completely after about 20 days and was discharged with home therapy.

Figure 1. Diffuse areas of bilaterally interstitial thickening and consolidation at lower lobes.

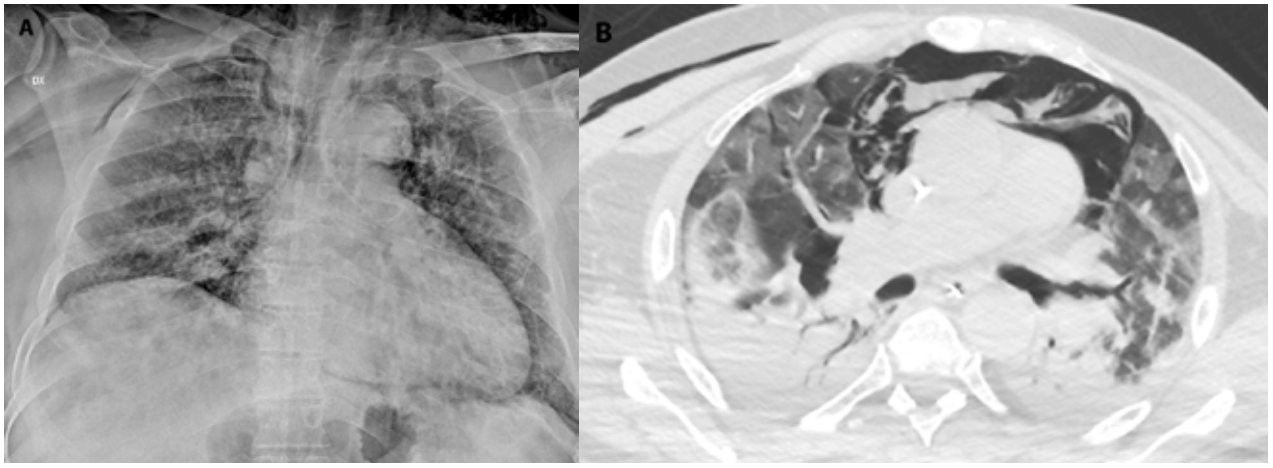

Figure 2. Chest X-ray (A) and CT (B) show pneumomediastinum, pneumothorax and emphysema of soft tissue.

Discussion

Pneumomediastinum means free air in mediastinal cavity. (6)

It can be classified as spontaneous (SPM) or traumatic. The causes of traumatic PM are mechanical ventilation, chesty trauma or iatrogenic injury. Spontaneous PM may be classified as primary, if no underlying lung disease is present, or secondary, in which there is a pathology as asthma or cystic fibrosis.

PM can also be classified as benign or malignant. Benign PM can quickly evolve into malignant

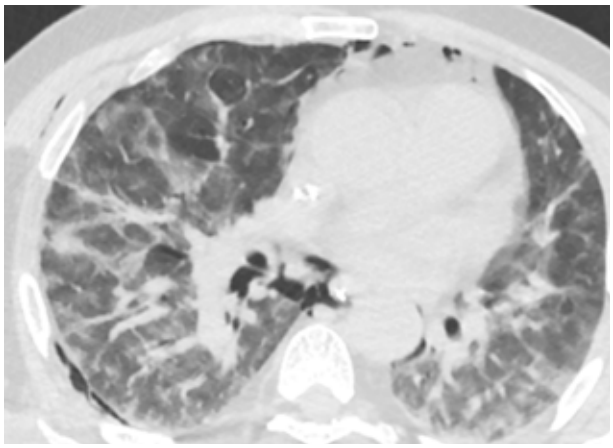

Figure 3. CT of patient after 4 days of conservative therapy

condition. (7) An example is when the intramediastinal pressure increases without escape: the air can only find an escape route in the neck, in retroperitoneum or bilateral pleural cavities causing bilateral PNX. Malignant PM can lead to mechanical obstruction of heart and blood vessels. PM is considered a rare occurrence (8). The majority are men (76%) (9) and is more frequent in children (1/800 to 1/15 500) because they have more lax mediastinal tissue to makes air migration simple.

The pathophysiology of SPM is based on the Macklin phenomenon (10): it is described in three stages.

The first phase consists of the alveolar rupture. The alveoli have pores between the adjacent walls to the air passage. Marginal alveoli in pulmonary bases don't have pores, so they can release air into the connective tissue sheath. When a sudden increase intrathoracic pressure occurs, there is alveoli overdistension: pressure gradient can break the marginal alveoli, causing interstitial pulmonary emphysema. The final stage is pneumomedistinum, when air reaches mediastinal structures. Causes of increase intrathoracic pressure are cough, vomiting, or asthmatic attacks.

Vessels also contribute to the process. During forced exhalation, the venous return is reduced, so reduce pulmonary vessels size, but fine-expiratory alveolar pressure is higher than normal. The consequence is huge increase of pressure gradient, rupture of the sheath and PM.

Studies suggest that immune dysregulation SARS-CoV-2 correlated could be a cause of lung lesions of ARDS. (11,12). Fox et al (13) published a series case of autopsies COVID-19: the most important finding was widespread alveolar damage with a mononuclear response around small thrombosis vessels. Cytokine-mediated inflammatory unregulated causes significant alveolar damage, so the alveolar wall is prone to rupture, exacerbated by coughing. Our patient had a remarkable cough during last weeks before, an important trigger point to breaking wall, in alveoli subjected to inflammatory stress, probably related to his hematological pathology.

Radiological imaging plays an important role in evaluating the course COVID-19 infection, especially in patients with unexplained clinical deterioration, to choose patient's management. (15,16).

Chest X-rays are the first imaging and often suggest diagnosis by showing linear or curvilinear light outlining mediastinal contours.

The most frequently side of PNX is right in 38.1%. It is related to tracheal bifurcation anatomy: right bronchus is more vertical and shorter than the left. Our patient had a thin layer of PNX in the anticlive LSD, at the top of the LID.

CT is useful for establishing or confirming the diagnosis. It may also provide additional diagnostic information such as pnemomediastinum.

The imaging characteristics of COVID-19 pneumonia is related to stage of disease. In first phases reticulum-nodular alterations are frequent. After, there are bilateral opacity of multi-lobe ground glass (GGO) with peripheral distribution. Thickening of septum, overlapping solidification on GGO, bronchiectasis and fibrotic lesions are other type of imaging that occur above time. The next evolution is consolidation of GGO with usually distribution bilateral, peripheral with medium/lower predominance.

The Macklin effect, in first stages of SPM, on CT appears as air linear collections contiguous to bronchopulmonary sheaths. If really there is a correlation between the degree of alveolar damage and PNM, then it would be more present in patients with large lung lesions with a worst outcome. In literature (14,15,16) most patients with PNM have extended lung injuries, as our patient.

About 70% of patients with SPM get complicated in SCE because mediastinal pressure is reduced thanks to air passage to subcutaneous tissue (14). The most frequent localization is the neck, with crackles noises, because the visceral layer of deep cervical fascia continues into mediastinum. The free air can also spread to face, abdomen, perineum, pericardial tissue causing pneumopericardium, (17,18) to spinal canal causing pneumorrhea, (19,20) to pleural cavities causing PNX (21,7).

Our male patient developed SPM, PNX and SCE after 2 day of hospitalization without invasive or non-invasive positive ventilation, history of hypertension, diabetes, smoking history, lung disease

That suggest there is an inherent component in COVID-19 infection that predisposes to air leakage, which can precipitate without alveolar pressure increase factors (22).

The radiologist should communicate the imaging finding to the clinical doctor as soon as possible to some changes in respiratory management.

Conflict of Interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article

Consent form for case reports: Written informed consent was obtained from the patient concerned.

References

1. World Health Organization. WHO Director-General's remarks at the media briefing on 2019-nCoV on11 February 2020.
2. Wu C, Chen X, Cai Y, et al. Risk Factors Associated With Acute Respiratory Distress Syndrome and Death in Patients With Coronavirus Disease 2019 Pneumonia in Wuhan, China. JAMA Intern Med. 2020 Jul 1;180(7):934-943. Erratum in: JAMA Intern Med 2020 Jul 1;180(7):1031.
3. Gibson PG, Qin L, Puah SH. COVID-19 acute respiratory distress syndrome (ARDS): clinical features and differences from typical pre-COVID-19 ARDS. Med J Aust 2020;213:54–6.
4. Urigo C, Soin S, Sahu A. Spontaneous pneumomediastinum as a complication of a COVID-19 related pneumonia: case report and review of literature. Radiol Case Rep 2020;15(12):2577–81.
5. Kalpaxi A, Kalokairinou M, Katseli P, et al. Spontaneous pneumomediastinum and COVID-19 pneumonia: Report of three cases with emphasis on CT imaging. Radiol Case Rep 2021 Sep;16(9):2586-2592. Epub 2021 Jun 23.
6. Macklin MT, Macklin CC. Malignant interstitial emphysema of the lungs and mediastinum as an important occult complication in many respiratory diseases and other conditions: interpretation of the clinical literature in the light of laboratory experiment. Medicine 1944;23:281–358.
7. Iqbal N, Malik A, Chaudhry M. The Macklin Effect in COVID-19. Cureus. 2021 Aug 6;13(8):e16949.
8. Jougon JB, Ballester M, Delcambre F, et al. Assessment of spontaneous pneumomediastinum: experience with 12 patients. Ann Thorac Surg 2003;75:1711–4.
9. Agut A, Talavera J, Buendia A, et al. Imaging diagnosis-spontaneous pneumomediastinum secondary to primary pulmonary pathology in a dalmatian dog. Vet Radiol Ultrasound 2015;56:E54–7.
10. Park DR, Vallières E. Pneumomediastinum and mediastinitis. In: Mason JR, Murray JF, Broaddus VC, Nadel JA, editors. Murray and Nadel's Textbook of Respiratory Medicine Online, 4th edition. Elsevier Saunders 2005; 2039–48.
11. Prompetchara E, Ketloy C, Palaga T. Immune responses in COVID-19 and potential vaccines: lessons learned from SARS and MERS epidemic. Asian Pac J Allergy Immunol 2020;38:1–9.
12. Brogna B, Brogna C, Martino A, et al. SARS-CoV-2 infection with different radiological insights. Diagnostics 2020;10:283.
13. Fox SE, Akmatbekov A, Harbert JL, et al. Pulmonary and cardiac pathology in African American patients with COVID-19: an autopsy series from new Orleans. Lancet Respir Med 2020;8:681–6.
14. Cut TG, Tudoran C, Lazureanu VE, Marinescu AR, Dumache R, Tudoran M. Spontaneous pneumomediastinum, pneumothorax, pneumopericardium and subcutaneous emphysema-not so uncommon complications in patients with COVID-19 pulmonary infection-a series of cases. J Clin Med 2021;10(7):1346.
15. Ozsoy IE, Tezcan MA, Guzeldag S, Ozdemir AT. Is spontaneous pneumomediastinum a poor prognostic factor in Covid-19? J Coll Physicians Surg Pak 2021;31(2):132–7.
16. Eperjesiova B, Hart E, Shokr M, Sinha P, Ferguson GT. Spontaneous pneumomediastinum/pneumothorax in patients with COVID-19. Cureus 2020;12(7):e8996.
17. Vázquez JL, Vázquez I, González ML, et al. Pneumomediastinum and pneumothorax as presenting signs in severe Mycoplasma pneumoniae pneumonia. Pediatr Radiol 2007;37:1286–8.
18. Vanzo V, Bugin S, Snijders D, et al. Pneumomediastinum and pneumopericardium in an 11-year-old rugby player: a case report. J Athl Train 2013;48:277–81.
19. Allen CJ, Teisch LF, Stahl KD. Spontaneous pneumomediastinum, pneumopericardium and epidural pneumatosis: insights on clinical management. Acute Card Care 2015;17:20–3.

20. Belotti EA, Rizzi M, Rodoni-Cassis P, et al. Air within the spinal canal in spontaneous pneumomediastinum. Chest 2010;137:1197–200.
21. Iyer VN, Joshi AY, Ryu JH. Spontaneous pneumomediastinum: analysis of 62 consecutive adult patients. Mayo Clin Proc 2009;84:417–21
22. 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.

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