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Original Research Article

SERIES OF COVID-19 PATIENTS WITH A SIGNIFICANT SPONTANEOUS PNEUMOMEDIASTINUM AND SPONTANEOUS SURGICAL EMPHYSEMA

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ABSTRACT

The coronavirus disease 2019 (COVID-19) pandemic presents mainly with respiratory symptoms and signs. It is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) first detected in Wuhan, China, in December 2019. In a recent series of patients with severe acute respiratory syndrome secondary to corona virus pneumonia, pneumomediastinum (SP) and spontaneous surgical emphysema (SSE) have been reported. A clear mechanism by which SP and SSE occur in SARS-CoV-2 pneumonia is unknown. However, SP and SSE are in principle considered self-limiting conditions that respond to conservative therapeutic measures. The progress of these conditions should be monitored for the possibility of pneumomediastinum-related cardiovascular and respiratory complications.

Keywords: COVID-19; pneumothorax; pneumomediastinum

INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic presents mainly with respiratory symptoms and signs **(1).** It is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) first detected in Wuhan, China, in December 2019. **(2).**

In a recent series of patients, spontaneous pneumomediastinum (SP) and spontaneous surgical emphysema (SSE) had been reported in the case with severe acute respiratory syndrome associated with coronavirus pneumonia. A clear mechanism by which SP and SSE occur in SARS-CoV-2 pneumonia is unknown **(3).** However, SP and SSE are in principle considered self-limiting conditions that respond to conservative therapeutic measures. The progress of these conditions should be monitored for the possibility of pneumomediastinum-related cardiovascular and respiratory complications **(4).**

At the tissue level of the COVID-19 cases, the destruction of lung tissue is thought to result from an excessive immune response to the virus rather than

from the direct effects of the virus replication. Most COVID-19 patients present with intense repetitive episodes of dry cough **(5).**

These episodes of cough are known to produce a sudden increase in distal airway pressure which can cause an alveolar rupture and a secondary gas leakage to the peri-bronchovascular pulmonary interstitium, from where the air can dissect proximally and finally reaching the mediastinum. This phenomenon, called the "Macklin effect", has been implicated as the cause of pneumomediastinum that appears in some closed thoracic lesions such as asthma attacks and Valsalva manoeuvres **(6).**

During the COVID-19 pandemic, there have been limited reports on SP and SSE in COVID-19 patients. Seven cases of COVID-19 patients managed in Khoula Hospital intensive care unit (ICU) had SP and SSE **(7).** In this study, we present a case series of 7 adult patients of ages ranging from 25 to 56. The COVID-19 was diagnosed via SARS-Cov-2 RNA-PCR **(8).** They had comorbid factors e.g. bronchial asthma, diabetes mellitus, and obesity. All 7 patients required mechanical ventilation, among them 6 needed invasive and 1 needed non-invasive ventilator and none of 7 had a previous history of pneumothorax. A chest X-ray (CXR) was performed in all of the 7 patients which showed extensive bilateral infiltrations. During the ICU admission, they developed SP and SSE on different days of admission. One of the patients had SP and SSE on day one of admission to the ICU. The chest X-ray identified the presence of ectopic gas dissecting the tissues of the mediastinum and the neck. All the cases were managed conservatively with SP and SSE had resolved in radiological control except one case who needed bilateral intercostal chest drain (ICD).

First case

A 48-year-old man was admitted with a history of poorly controlled type 2 diabetes mellitus. On the 5th day of the COVID-19, he developed fever, repetitive cough, and shortness of breath associated with malaise and anorexia. He was admitted to a private hospital on the 11th day of COVID-19. The diagnosis of COVID-19 was confirmed by reverse transcription-polymerase chain reaction (RT-PCR). On the 17th day of the illness, the patient became agitated, dyspneic, and had tachycardia. Finally, he was intubated and maintained on 100% a fraction of inspired oxygen (FiO2) and was transferred to Khoula Hospital for expert management of COVID-19 critical cases. On arrival, the arterial blood gas (ABG) showed respiratory acidosis (PH 7.28 PCO2 86 PO2 78 HCO3 33.6). The blood investigations on admission revealed significant raises in C-reactivate protein (CRP) 110mg/L, WBC 26 10*3/uL, Ferritin 1398ug/L, and LDH 686(iU)/L. Chest X-ray showed an extensive patchy area of consolidation with ground-glass opacities, diffuse infiltrations, and a mild pneumomediastinum. The patient was covered on empirical antibiotics. On the second day 2 of admission (day 18th of the illness), the repeated chest x-ray showed a significant increase in pneumomediastinum, right-sided pneumothorax, and bilateral extensive surgical emphysema. He was on positive end-expiratory pressure (PEEP) 14 cmH2O, FiO2 75. He was supported on Noradrenaline infusion and bilateral ICDs were inserted. On day 7 of admission, the repeated CXR showed significant resolving of emphysema, pneumothorax, and pneumomediastinum. His blood investigation results had improved CRP 35mg/L, LDH 448(iU)/L, and WBC 15 10*3/uL. On day 9 of admission, he ultimately died due to ARDS.


Fig 1a


Fig.1b


Fig.1c


Fig 1d


Fig.1e


Fig.1f

Fig 1 . Showing changes of pneumomediastinum, right-sided pneumothorax, and bilateral extensive surgical emphysema in Patient one

Second case

A 25-year-old man, who has no comorbidity. He was admitted to the ICU of a peripheral hospital for COVID-19. He had a history of cough and fever 10

days before admission. The diagnosis of COVID-19 was confirmed by **(**RT-PCR**)**. He developed respiratory distress and he was intubated with FiO2 80%, PEEP of 12 cmH2O. He was hemodynamically stable and he was shifted to Khoula hospital **(**ICU**)** for further management. The blood investigation on admission revealed a significant rise in LDH 1481(iU)/L, D-dimer 1,6mg/L, and CRP 187mg/L. The chest X-ray showed the extensive patchy areas of consolidation with ground-glass opacities and diffuse infiltration.

The patient deteriorated further and developed septic shock, noradrenaline infusion was started. After 3 days of admission, he developed neck swelling and upper chest surgical emphysema. The repeated chest x-ray showed new changes of pneumomediastinum and bilateral extensive surgical emphysema. His ventilatory requirements went up to 100% FiO2 and PEEP reduced to 10 cmH2O. There was a significant increase of the D-dimer 65mg/L, WBC 28 10*3/uL, and CRP 197mg/L. On the 5th day of admission, He deteriorated further and finally had a cardiac arrest from that he could not be resuscitated.

Fig 2a

Fig 2b

Fig 2c

Fig 2d

Fig 2e

Fig 2 Showing changes in pneumomediastinum and bilateral extensive surgical emphysema in the second Patient.

Third Case

This was a 56-year-old man had a history of bronchial asthma on regular steroids inhaler. He was admitted to the ICU of a peripheral hospital with shortness of breath, fever, and cough for 7 days. The diagnosis of COVID-19 was confirmed by **(**RT-PCR**)**. He was readmitted after 5 days with intense coughing. He was managed with non-invasive ventilation (NIV) and maintained a saturation of 96%. His laboratory tests on admission were significant for CRP 144mg/L LDH 339(iU)/L and WBC 10 10*3/uL. His CXR on admission showed an extensive patchy areas of consolidation with ground-glass opacities and diffuse infiltration. On day 3, a repeated CXR showed pneumomediastinum and bilateral extensive surgical emphysema. The NIV was changed to high flow O2. The patient became hemodynamically unstable and he was intubated. On Day 8, his inflammatory markers were improved. His CXR showed significant improvement of subcutaneous emphysema and pneumomediastinum without surgical intervention. His ventilatory requirements had improved until he was extubated. Later on, he was doing well and shifted to the ward.

Fig 3a

Fig 3b

Fig 3c

Fig 3d

Fig 3e

Fig.3. Showing changes of pneumomediastinum and bilateral surgical emphysema in the third Patient

Fourth case

A 32-year-old female had a history of iron deficiency anemia, G6PD, and being overweight. She had a history of cough, fever, shortness of breath, and diarrhea. The diagnosis of COVID-19 was confirmed by **(**RT-PCR**)**. She was desaturated below 88 and was dyspneic on the oxygen mask.

Later on, she was intubated and transferred to Khoula hospital for expert management of COVID-19 critical cases. Her laboratory tests on admission were significant for CRP 113 mg/L and LDH 391(iU)/L. CXR was showing an extensive patchy areas of consolidation with ground-glass opacities and diffuse infiltration. She was on APV/SIMV mode of ventilation, FiO2 55%, PEEP 10 cmH2O maintaining saturation of 92-90. She desaturated again and FiO2 increased to 70%, PEEP is 8 cmH2O, and saturation 88-90%. Day 9, repeated CXR showed bilateral extensive pneumonitis with no significant improvement, pneumomediastinum, and bilateral extensive surgical emphysema. After several days, repeated CXR showed no pneumomediastinum.

She was extubated and reintubated after 2 days due to respiratory distress and she developed pulmonary edema and septic shocks. Her condition remained critical and static with a poor prognosis. She arrested on day 33 of admission.

Fig 4a

Fig 4b

Fig 4c

Fig 4d

Fig 4e

Fig.4. Showing changes of bilateral extensive pneumonitis, pneumomediastinum, and bilateral extensive surgical emphysema in the fourth patient

Fifth case

This was a 44-year-old obese man. He presented first to peripheral hospital with a history of shortness of breath, fever, dry cough, and throat pain. The diagnosis of COVID-19 was confirmed by **(**RT-PCR**)**. He refused hospital admission. After 48 hrs, he was admitted with SOB and tachypnea after a while he was intubated. On day 5 he was escorted to Khoula hospital on admission CXR showed bilateral extensive surgical emphysema and pneumomediastinum with bilateral ground-glass opacities. He became unstable and required inotropic support. After 2 days of admission to ICU, he deteriorated further and finally died.

Fig 5 Showing changes of bilateral extensive surgical emphysema and pneumomediastinum with bilateral ground-glass opacities in the fifth Patient

Sixth case

Fig 6a

Fig 6b

Fig 6c

Fig 6d

Fig 6e

Fig 6f

Fig 6g

Fig.6. Showing changes of pneumomediastinum, and bilateral extensive surgical emphysema in the sixth Patient

A 50-year-old man, who had no comorbidity, presented to a peripheral hospital with fever, cough, and chest discomfort for 10 days. He was in respiratory distress. The diagnosis of COVID-19 was confirmed by **(**RT-PCR**)**. His CXR on admission showed an extensive patchy areas of consolidation with ground-glass opacities and diffuse infiltration. While he was admitted there for a total of 3 days, his respiratory status deteriorated, he was intubated and transferred to the ICU in Khoula hospital for expert management. On arrival, he was hemodynamically unstable and on high requirements ventilatory support. The next day, his ventilatory support had reduced. On the 5th day of admission, he developed surgical emphysema confirmed by CXR which showed pneumomediastinum and bilateral extensive surgical emphysema. Bilateral ICDs were inserted and removed after a while.

After 3 days, CXR showed resolving of subcutaneous pneumomediastinum and surgical emphysema. The patient was in ICU for 40 days and a tracheotomy tube was inserted for weaning, later on, the patient again developed surgical emphysema and pneumomediastinum. Therefore ICD was inserted again. However, he deteriorated and Noradrenaline infusion was started. Later on patient started to improve and needed a tracheostomy for weaning. The patient developed pneumothorax.

Seventh case

A 42-year-old man, known patient of DM 2 on metformin, presented to a private hospital with a complaint of fever, cough, and shortness of breath. In the state of respiratory distress, he was admitted for 12 days there with ventilatory support. The diagnosis of COVID-19 was confirmed by **(**RT-PCR**)**. CCR was showing the extensive patchy areas of consolidation with ground-glass opacities and diffuse infiltration. He was tachypnoeic and desaturation 60% with 15 L Oxygen via non rebreathing mask (NRM) then intubated and shifted to ICU in Khoula hospital. His laboratory tests on admission were significant for severely respiratory acidosis (ABG PH 6,97 / pco2 118 / po2 53. /HCO3 27,6. /sat 78%).

He was on critical condition (septic shock & AKI), FiO2 100% PEEP 14 cmH2O. He was vitally unstable on maximum noradrenaline. Repeated CXR showed pneumomediastinum and bilateral extensive surgical emphysema. ICD was placed. The next day, he developed bradycardia proceeded fast to asystole.

Fig 7a

Fig 7b

Fig 7c

Fig 7. Showing changes of pneumomediastinum and bilateral extensive surgical emphysema in the seventh Patient

Table 1: Distribution of study participants case studies.

Patients	Age	Sex	Comorbidities	Admission reasons	Day intubated (since admission)	Ventilation parameters PEEP (initial/ maximum)	Time of spontaneous surgical emphysema	Management	Outcome (since admission)
1	48	M	DM2	11 days SOB , pyrexia , cough	D12	6/12	D2	Intrapleural chest drains	Died D18
2	25	M	Nill	10 days, pyrexia , cough , respiratory distress	D1	12/15	D3	Conservative	Died D5
3	56	M	Bronchial asthma	14 days, SOB , pyrexia , cough	D3	14/14	D3	Conservative	Extubated D18
4	32	F	Iron deficiency anemia, G6PD	7 days, SOB , cough, respiratory distress	D1	10/12	D9	Conservative	Died D33
5	44	M	Nill	2 days , SOB , pyrexia, cough	D2	10/10	D5	Conservative	Died D7
6	50	M	Nill	10 days , respiratory distress , pyrexia, cough	D3	9/10	D5	Conservative	Still admitted
7	42	M	DM2	12 days , SOB , cough, pyrexia	D12	12/14	D12	Intrapleural chest drains	Died D14

DISCUSSION

These were 7 patients **(**25–56 years of age, 6 men and 1 woman**)** who initially attended different peripheral hospitals in Oman initially with fever and/or chest symptoms **(**cough, dyspnea, and/or chest pain**)** from March to October 2020, coinciding with the peak of the SARS-CoV-2 pandemic **(**COVID-19**)** that was ravaging Oman. Similar results were obtained in a study conducted by Mansoor H et al in a case series for Pneumothorax In Covid-19 Pneumonia patients. **(9).** Tests for the detection of SARS-CoV-2 nucleic acid by polymerase chain reaction **(**RT-PCR**)** and a chest X-ray were performed for all 7 patients. RT-PCR was positive in all patients, and chest X-ray showed **(**in all 7 cases**)** bilateral opacities suggesting infection.

Once admitted, treatment of SARS-CoV-2 infection started and other drugs **(**antipyretics, bronchodilators, corticosteroids, etc.**)** were used depending on the particular needs of each patient. All 7 patients required oxygen administration and mechanical ventilation during admission **(**before the onset of SP**)**. Similar study results were obtained in a study conducted by Leyla T et al in a case series for Pneumothorax In Covid-19 Pneumonia patients. They reported similar results to the present study **(10).**

None of the 7 patients had a history of smoking and none had a previous history of pneumothorax or SP. After admission, the clinical course of all the 7 patients was complicated by SP **(**unrelated to invasive procedures such as tracheal intubation or tracheotomy**)**, which was not clinically suspected in any case, and first detected on chest X-ray in all patients. Chest X-rays identified the presence of ectopic gas dissecting the tissues of the mediastinum and the neck. The clinical course was favorable in 2 of the 7 cases; 5 patients died from infectious complications unrelated to SP. No SP required surgical treatment and all 7 cases were managed conservatively, with SP disappearing in radiological controls. Similar results were also obtained in a study conducted by Anthony W et al in a case series for Pneumothorax In Covid-19 Pneumonia patients. **(11).**

CONCLUSION

We concluded from the present study that, the course of the 7 patients was complicated by SP **(**unrelated to invasive procedures such as tracheal intubation or tracheotomy**)**, which was not clinically suspected in any case, and first detected on chest X-ray in all patients. Chest X-rays identified the presence of ectopic gas dissecting the tissues of the mediastinum and the neck. The clinical course was favorable in 2 of the 7 cases; 5 patients died from infectious complications unrelated to SP. No SP required surgical treatment and all 7 cases were managed conservatively, with SP disappearing in radiological controls.

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