Post COVID-19 large pneumatocele: clinical and pathological perspectives

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Abstract

A middle aged COVID-19 male patient presented 2 weeks after discharge with new onset of dyspnoea and desaturation. Radiological studies revealed right side pneumothorax and lower lobe cystic air space. Chest drain was inserted and on a later date the patient underwent thoracoscopic surgery where a large pneumatocele was identified. Deroofing and closure of sources of air leak were done. Histopathological examination demonstrated extensive fibrosis, intra-alveolar Haemorrhage and pneumocytes hyperplasia. 

Keywords: COVID-19 • Pulmonary complication • Pneumatocele

INTRODUCTION

The full picture of acute lung pathology and the long-term respiratory sequelae of COVID-19 infection are still evolving. Available data indicate that many patients experience persistent radiological changes months after their initial illness.

Corona virus targets alveolar epithelial cells, which together with the associated cytokine storm make the alveoli liable to rupture with subsequent air leakage and formation of cystic air space lesions [1].

CASE REPORT

A 42-year-old COVID-19 male patient presented 2 weeks after discharge with shortness of breath, chest tightness and cough with blood tinged mucoid sputum. He was afebrile with heart rate around 105 beat per minute; \textit{SO}₂ was 83\% on room air. Blood picture showed normal total and differential leucocytic count. Chest X-ray revealed right side pneumothorax and lower lobe cystic air space. Chest computed tomogram showed right side lung inflation; lower lobe large cystic air space with small fluid level and compression atelectasis of the adjacent parenchyma. Mediastinal lymphadenopathy and minimal pleural effusion were also observed (Fig. 1A, B).

In first admission, the patient received supportive treatment for 3 weeks in isolation ward. Pre-discharge chest X-ray showed bilateral ground glass opacities and fibrotic bands (Supplementary Material, Fig. S1).

After insertion of chest drain, \textit{SO}₂ improved to 88\% on room air. Chest computed tomogram showed right side lung inflation; lower lobe large cystic air space with small fluid level and compression atelectasis of the adjacent parenchyma. Mediastinal lymphadenopathy and minimal pleural effusion were also observed (Fig. 1B-D).

Swab for COVID-19 returned negative for 2 times. Patient underwent thoracoscopic surgery. Intra-operatively, there was a pneumatocele occupying the lateral and posterior aspects of the right lower lobe. After opening the cyst, there were few blood clots and scanty amount of bloody fluid. Deroofing was done and some foci of air leak in the floor of the cyst were dealt with. Histopathological examination showed thin pieces of parenchymal tissue with fibroblast proliferation, inflammatory cell infiltration mainly lymphocyte, marked intra-alveolar haemorrhage and prominent hyperplasia of pneumocytes (Fig. 2A and B). Sampled mediastinal lymph node showed reactive hyperplasia.

After surgery patient experienced relieve of chest tightness, and he was discharged home with \textit{SO}₂ 93\% on room air (Supplementary Material, Fig. S2).

DISCUSSION

A pulmonary pneumatocele is a thin-walled, air space within the lung that usually develops in an area of consolidation. It is commonly reported in paediatric patients in association with staphylococcus pneumonia; however, several case records of pneumatocele were reported in adults after infection with various pathogens including viruses [2].

The precise pathogenesis of pneumatocele is uncertain; most authors attribute it to endobronchial check valve mechanism allowing air trapping and development of distal air space cyst. Another theory suggested that, inflammation and necrosis of a portion of the airway results in focal collections of air in interstitial tissue; air then dissects its way up to the pleura where it forms a grossly identifiable pneumatocele [3]. We postulate that the air...
leaked in the interstitium causes striping and separation of a
thin layer of lung parenchyma with more injury to small blood
vessels and bronchioles. This can explain the presence of some
blood clots and bloody fluid inside the cyst and the foci of air
leak in the floor. Pre-existing inflammation may predispose to
this process.

It seems logical that positive pressure ventilation perpetuates
the development of pneumatoceles; on the contrary, it is difficult

Figure 1: (A) Chest X-ray showing right side pneumothorax and lower lobe pneumatocele (blue arrow). (B) Chest X-ray showing chest drain in place, resolution of pneumothorax and lower zone pneumatocele with small fluid level. (C and D) Chest CT scan, axial and coronal views delineating the origin and extent of the pneumatocele; there are compression atelectasis of the medial aspect (white arrow), small fluid level and entrance of chest drain (black arrow).

Figure 2: Histopathological studies of the resected roof of the pneumatocele showing. (A) Marked fibrosis and intra-alveolar haemorrhage (Hematoxylin and Eosin (H&E), ×200). (B) Hyperplasia of pneumocytes (H&E, ×400).
to propose a relationship between corticosteroids use in COVID-19 and the development of pneumatocele. In previous reports, pneumatoceles complicated pneumonia in adult patients on long-term corticosteroid therapy [4]. Some authors reported similar findings in a COVID-19 patient and they described the air space as a bulla rather than a pneumatocele [5]. Radiologically, it may be difficult to differentiate between both conditions, but pathologically each entity has distinct features. Bullae result from destruction of alveoli resulting in air space with fibrous wall and possible intracystic trabeculae. On the other hand, whatever the pathogenesis of pneumatocele, the ultimate result is the accumulation of air within the lung parenchyma; accordingly, the wall of the pneumatocele is formed of lung tissue. In our patient, we had the opportunity to surgically remove the air space cyst and histopathology proved its pneumatocele nature.

The majority of pneumatoceles usually resolve spontaneously within few weeks of onset, and the treatment is mainly directed towards the underlying infection. However, it may undergo dramatic changes in size especially in patients on mechanical ventilation or undergoing general anaesthesia. In special situation with compression of the surrounding lung and cardiorespiratory compromise or accumulation of pus inside, image-guided catheter drainage is advocated as a first-line strategy. In the case of failure of percutaneous techniques, surgical resection is required. In our patient, we resorted to surgical resection because of significant patient symptoms and low oxygen saturation due to post COVID-19 complications and pneumatocele surrounding lung compression, in addition to the possibility of infection due to the presence of air-fluid level inside the cyst.

In summary, pneumatoceles may complicate the course of COVID-19 infection. Conservative management is the mainstay of treatment. However, follow-up and timely intervention should be planned.

**SUPPLEMENTARY MATERIAL**

Supplementary material is available at ICVTS online.

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