Intraoperative ventilation strategy in a patient with empyema thoracis complicated by bronchopleural fistula

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Bronchopleural fistulae (BPF) are communications between the bronchioles of the respiratory tract and pleural space. No consensus has been established for the management of BPF due to varied presentation. We report the successful use of one lung ventilation with left sided double lumen tube in a patient with BPF following recurrent thoracic empyema, posted for decortications & repair under general anaesthesia. This case was unique as the patient had restrictive lung disease on the left side due to fibrosis of pleural space and mediastinum following tuberculosis. There were features of obstructive lung disease on the right side due to compensatory emphysema. We had to work up an individualised ventilatory strategy focussed on the better lung to cater to the unique need of our patient that turned out to be safe & effective. Lung protective ventilatory strategy along with proper postoperative management helped in early recovery of the patient.

Keywords:
bronchopleural fistula, decortication, one-lung ventilation, thoracic empyema

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Introduction

Tuberculous empyema is a chronic, active infection of the pleural space, which may lead to bronchopleural fistulae (BPF) and has worse outcome than a nontuberculous empyema [1].

BPF have varied presentation and are particularly challenging when positive-pressure ventilation is required and may result in inadequate tidal-volume delivery to alveoli [2]. We report the successful use of one-lung ventilation with left-sided double-lumen tube (DLT) in such a patient.

Case report

A 25-year-old man weighing 53 kg had presented with complaints of fever off and on since the past 20 days along with productive cough and dyspnoea and was posted for decortication and repair of BPF under general anaesthesia.

The patient was diagnosed with left-sided pulmonary tuberculosis with empyema 4 years back, for which a chest drain was put and he received a full course of antituberculous treatment for 9 months. The patient had recurrence of symptoms after 2 years, following which a chest drain was inserted again on the left side and he was prescribed an injection of streptomycin.

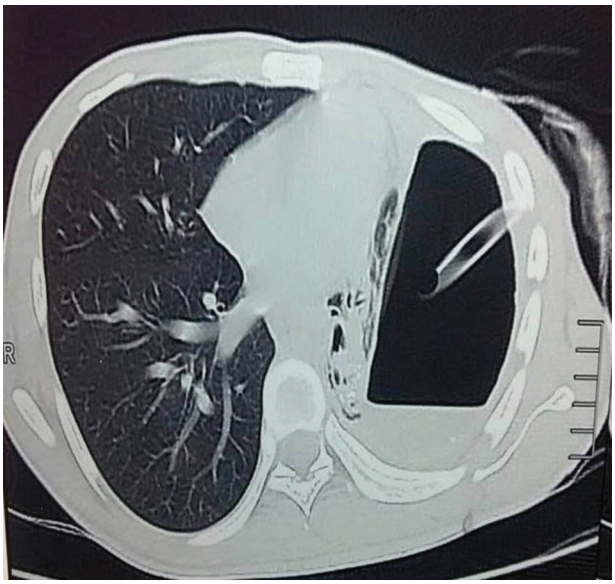
On examination, his breath sounds were diminished on the left side with coarse crepitations. Haematological investigations were within normal limits. Chest radiography showed air fluid level on the left side with emphysematous change of the lung field on the right side (Fig. 1). Computed tomographic scan confirmed these findings (Fig. 2). The air bubbles flowed intermittently through the water seal chamber of the chest drain only during inspiration, suggestive of a small fistulae [3].

In the operating room, the table was given a 30° left lateral tilt with head-up position to prevent spillage into the right lung. Baseline arterial blood gases on room air were obtained (pH 7.46, PCO_2 38 mmHg, PO_2 78 mmHg), followed by rapid sequence induction of general anaesthesia. Trachea was intubated with a left-sided DLT of 37 Fr size, and the bronchial lumen was clamped after inflating the cuff.

One-lung ventilation was established on the right side with a tidal volume of 5 ml/kg, frequency of 16/min and positive end-expiratory pressure (PEEP) of 5 cmH_2O. Intraoperative saturation was maintained between 92 and 95%, with manual recruitment manoeuvre whenever required.

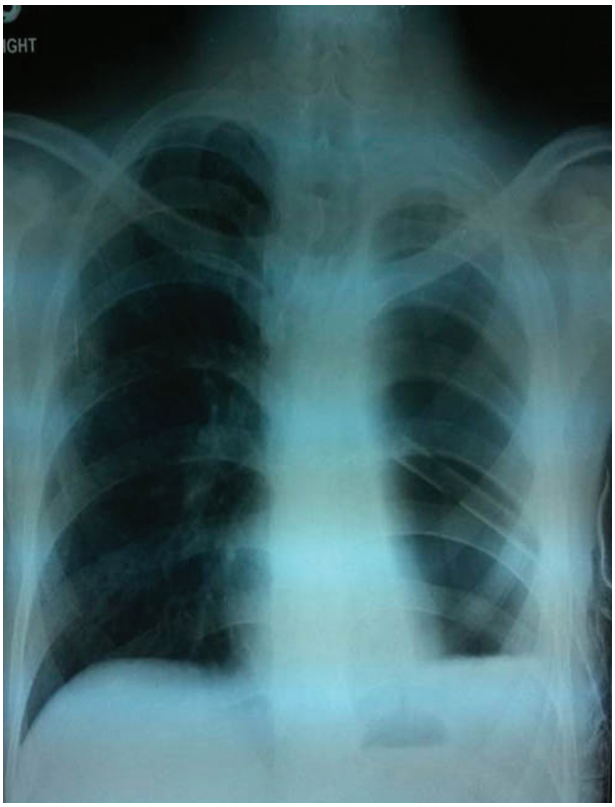
Debridement was done at the sixth intercostal space on the left side, pus was aspirated and the BPF was sealed. Now the bronchial lumen was unclamped and two-lung

Figure 1



Chest radiography showing the changes.

Figure 2



Computed tomographic scan showing large air fluid level in the left hemithorax and emphysematous changes in the right lung parenchyma.

ventilation was started to confirm BPF repair without residual leak, and a chest drain was placed. Trachea was extubated after suctioning and return of spontaneous respiration with satisfactory tidal volume and blood gases (pH 7.45, PCO_2 40 mmHg, PO_2 92 mmHg). The patient was transferred to an ICU on spontaneous ventilation with supplemental oxygen through a face mask.

Postoperative management included propped-up position, incentive spirometry, chest physiotherapy, and maintenance of analgesia with morphine through the epidural catheter. On the fourth postoperative day, the patient was transferred to the ward.

Discussion

This case was unique in the sense that (a) the patient had restrictive lung disease on the left side because of fibrosis of pleural space and mediastinum following tuberculosis, and (b) there were features of obstructive lung disease on the right side because of compensatory emphysema.

As the patient was put on chest drain with underwater seal preoperatively as a part of conservative management to relieve dyspnoea and to promote lung expansion, this posed possible problems of loss of tidal volume and abnormal gas exchange intraoperatively. Volume of flow through BPF is a function of the size of air-leak (resistance) and the transpulmonary pressure gradient (airway pressure–pleural pressure) [3]. We were also concerned that the presence of restrictive disease on the affected side may mandate high airway pressure in the attempt to ventilate that side. Prevention of contamination of the other lung was another concern.

Mechanical ventilation was aimed at lung protection, improved oxygenation to the obstructive side and providing a good surgical field on the restrictive side. More physiological tidal volumes and appropriate levels of PEEP can decrease the extent of ventilator-induced lung injury [4].The advantage of using DLT in this case was to achieve lung isolation to prevent spillage of infective material to the right side and significant loss of tidal volume through the BPF.

Various strategies have been described for long-term ventilation in cases of BPF, such as (a) conventional-volume or pressure-limited ventilation with increased respiratory rate at a low tidal volume, increased total inspiratory time to decrease peak airway pressures and minimized PEEP; (b) timed occlusion of chest tubes to decrease BPF leak; (c) independent lung ventilation for selective ventilation of the high- and low-compliance lung either with two ventilators or differential lung ventilation using a single ventilator with a variable-resistance valve; (d) high-frequency jet ventilation or high-frequency oscillation; and (e) extracorporeal oxygenation [2,5–8]. However, these strategies have been mostly tried in a critical care setup for prolonged ventilation and not for intraoperative purposes. Logistics issues, limitations of

using inhalational agents and the complicated course of this patient did not allow us to consider them or the bronchoscopic repair, which is also very effective [9].

Although conventional ventilation has been labelled a failure in the intensive care setup [2], we opted for this strategy focusing on the better lung, which turned out to be safe and effective. Probably our strategy was successful because the duration of intraoperative ventilation was much less than the duration of ventilation required for intensive care patients. We suggest that intraoperative ventilation strategy should be individualized depending on the clinical conditions and using the various ventilation techniques described for intensive care patients.

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Conflicts of interest
There are no conflicts of interest.

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