

# Intercostal muscle flap for repair of bronchopleural fistula

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## ABSTRACT

A 50-year-old male patient, a known case of chronic obstructive pulmonary disease (COPD), presented with the features of bronchopleural fistula (BPF) on the right side for 1 month. The patient was a chronic smoker and did not give any history suggestive of pulmonary Koch's. The patient had sudden-onset breathlessness and chest pain 1 month before, which was diagnosed to be due to spontaneous pneumothorax. An intercostal drain was inserted but even after 1 month of all conservative measures, the lung remained collapsed and there was large air leak in the intercostal drain. Computed tomogram (CT) of the chest revealed collapsed and entrapped lung with surgical emphysema of the subcutaneous tissues due to rupture of the emphysematous bulla on the right side along with the presence of emphysematous bullae on the left upper lobe also. Surgical intervention in the form of decortication of entrapped lung and repair of the BPF with intercostal muscle flap was performed. The patient recovered well and was discharged after 10 days.

**KEY WORDS:** Bronchopleural fistula, empyema, entrapped lung, intercostal muscle flap

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## INTRODUCTION

Common causes of bronchopleural fistula (BPF) are lung resection, thoracic surgery,<sup>[1]</sup> thoracic trauma, pulmonary Koch's, rupture of lung abscess and rupture of emphysematous bullae, as was seen in this case. BPF is an important cause of morbidity and mortality and its management depends on various factors like size of fistula, respiratory reserve of the patient, associated diseases and general condition of the patient. BPFs, which are small in size or are due to minor parenchymal leaks, usually close spontaneously whereas large BPF, those arising from the major bronchi or causing respiratory compromise usually require intervention in the form of bronchoscopic closure, video-assisted thoracic surgery (VATS), muscle flap closure, decortication, lobectomy, pneumonectomy and thoracoplasty. Many times, a combination of techniques and/or multiple interventions are required.

Various flaps used for the closure of BPF and reported in the literature are intercostal muscle flap,<sup>[2]</sup> pericardial flap,<sup>[3]</sup> latissimusdorsi muscle flap,<sup>[3]</sup> serratus anterior muscle flap, rectus abdominis muscle flap and omentum.<sup>[4]</sup> The intercostal muscle flap, as was used in this case, is easy to harvest, causes no functional disability, has adequate vascularity, has adequate length to reach most of the sites and is harvested through the same incision used for thoracotomy.

Bronchoscopic techniques used for the closure of BPF include application of glue, gelfoam<sup>[5]</sup> and/or stents<sup>[6]</sup>; these techniques are usually successful when the size of the fistula is small. Large BPF and those associated with entrapped lung or empyema thoracis are managed with surgery.

## CASE REPORT

A 50-year-old male patient, a known case of COPD, presented with the features of BPF on the right side for 1 month. The patient was a chronic smoker and did not give any history suggestive of pulmonary Koch's or any other associated disease apart from COPD. The patient had sudden-onset breathlessness and chest pain 1 month before, which was diagnosed as spontaneous pneumothorax, and an intercostal drain was inserted but even after 1 month of all conservative measures, the lung

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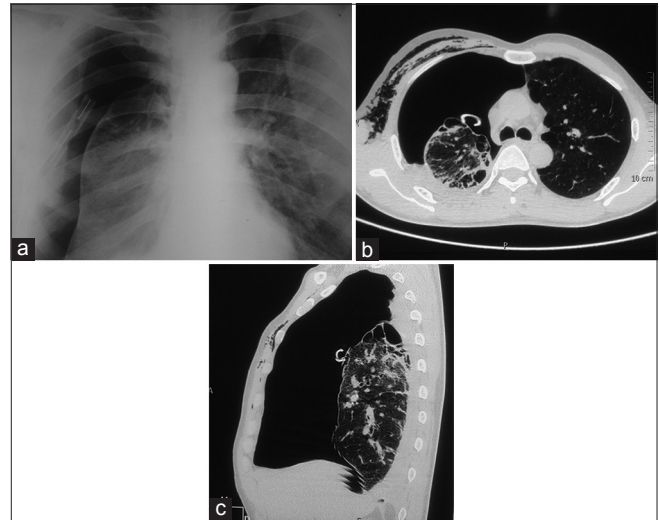
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remained collapsed [Figure 1a] and there was a large air leak in the intercostal drain; negative suction on the intercostal drain was also not effective. Bronchoscopic closure of the BPF was also attempted but was not successful. CT chest revealed collapsed and entrapped lung [Figure 1b and c], with surgical emphysema of the subcutaneous tissues due to rupture of the emphysematous bullae on the right side along with presence of emphysematous bullae on the left upper lobe. Surgical repair was planned as with all the conservative measures, the lung remained collapsed and the air leak persisted. The patient was emaciated and weak and was pre-operatively optimized with a high-protein diet, multivitamins, bronchodilators, incentive spirometry and antibiotics for another week before surgery. General anesthesia was given using double-lumen endotracheal tube and supplemented with thoracic epidural analgesia and invasive arterial pressure and central venous pressure monitoring were also performed. The right posterolateral approach was chosen, intercostal muscle flap was harvested and part of the fifth rib was resected. The lung was found completely entrapped in a fibrous peel [Figure 2a] and decortication of the thickened visceral peel was performed from the entire right lung [Figure 2b] and inferior pulmonary ligament was also ligated and divided. The site of the BPF was localized in the segmental bronchus to apical segment of the right upper lobe and closure of the fistula with polypropylene 4'0' sutures was performed and reinforced with intercostal pedicled muscle flap [Figure 2c]. There were multiple small unruptured bullae present near the site of the BPF, and they were also closed with polypropylene 4'0' sutures. The repair site was tested for air leak after pouring saline in the thoracic cavity and after ensuring no major air leak, two intercostal drains were inserted and standard thoracotomy closure was carried out. The patient was extubated in the operating room and deep breathing exercises were started from the first post-operative day to keep the lungs expanded. Chest roentgenogram on the second post-operative day [Figure 3a] revealed partial re-expansion of the lung along with presence of residual space in the upper zone. With continued chest physiotherapy and respiratory exercises, there was complete re-expansion of the lung with obliteration of the remaining space in the upper zone [Figure 3b]. The patient recovered well and was discharged after 10 days. Histopathological examination of the resected visceral peel revealed non-specific inflammation without any evidence of granuloma formation or dysplasia and cultures were sterile.

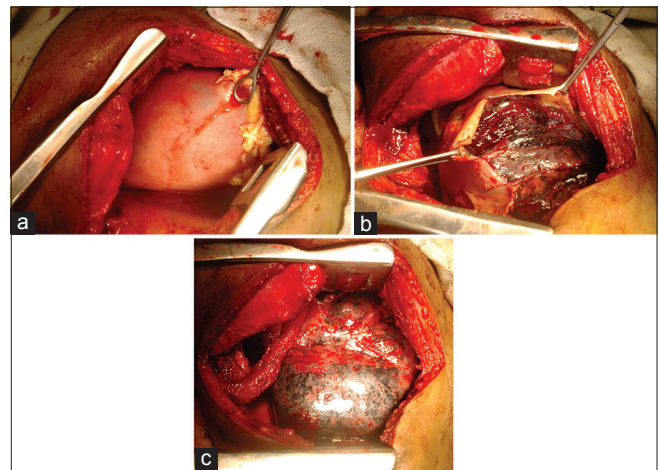
## DISCUSSION

BPF is commonly associated with empyema or empyema develops subsequently if management of BPF is delayed. In this case, pleural fluid and sputum culture were sterile and total and differential leukocyte counts were within the normal range, probably because the patient was on antibiotics. This case is reported to highlight the advantages of intercostal muscle flap for repair of

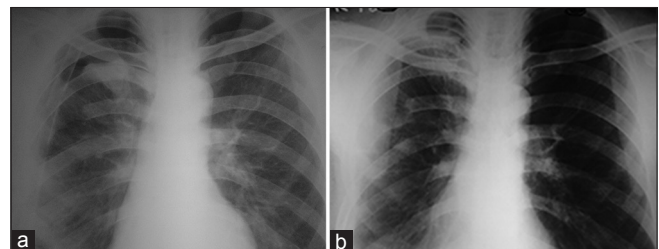
BPF and typical presentation of entrapped lung and its management.



**Figure 1:** (a) Pre-operative chest roentgenogram showing collapsed right lung with intercostal tube *in situ*. (b) Pre-operative computed tomography of the chest in the axial section showing collapsed and entrapped right lung. (c) Pre-operative CT chest in the sagittal section showing collapsed and entrapped right lung



**Figure 2:** (a) Intraoperative photograph showing collapsed and entrapped right lung. (b) Intra-operative photograph showing decortication of the entrapped right lung. (c) Intra-operative photograph showing use of intercostal muscle flap for closure of bronchopleural fistula



**Figure 3:** (a) Post-operative chest roentgenogram showing lung expansion on the second post-operative day. (b) Post-operative chest roentgenogram showing expanded right lung on the 10th post-operative day after removal of the intercostal drain

VATS is now-a-days commonly used for the management of early-stage empyema before the development of thickened peel. Closure of BPF through VATS may be performed using pleural or pericardial flaps and/or application of glue. Open surgery is usually required for late stages of empyema and for muscle flap closure of BPF. Lobectomy or even pneumonectomy may be required in cases of BPF with complete destruction of the underlying lobe or lung, respectively, with or without the use of muscle flaps.

Acute BPF due to dehiscence of bronchial stump after lung resection like pneumonectomy or lobectomy is a serious<sup>[7]</sup> condition and requires urgent drainage of the pleural space along with intervention for closure of bronchial opening. The intervention can be either through bronchoscopic techniques using gel foam or glue or in unsuccessful cases through surgical approach by revision of the bronchial stump along with the use of muscle flaps. Thoracoplasty can be used in some cases where there is recurrence of BPF after muscle flap repair, but the procedure leads to reduction of pulmonary function and chest wall deformity.<sup>[8]</sup>

Sometimes the BPF is associated with empyema or infected pleural space; even in those cases, use of intercostal muscle flaps is associated with favorable outcome because of the good vascularity and autologous nature of the flap thereby increasing the chances of healing. Free flaps<sup>[9]</sup> have also been described in cases like redo surgery where pedicled flaps have already been used or are of insufficient length. Free flaps are more technically demanding procedures than pedicled flaps.

## CONCLUSION

Use of intercostal muscle flap is an easy and effective technique for the repair of BPF.

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