Bronchoscopic Closure of Bronchopleural Fistula Using Gelfoam

AM Shah, Pratibha Singhal, PN Chhajed, Amita Athavale, Rajam Krishnan, AC Shah

Abstract
Management of a persistent bronchopleural fistula (BPF) can be a therapeutic challenge. The etiological factors responsible for BPF include pulmonary tuberculosis, post-thoracic resection surgeries, trauma, malignancy, necrotising infections and rupture of lung abscess. The immediate management of BPF is drainage of the pleural cavity with insertion of an intercostal drainage tube. Patients with BPF may also require surgical intervention in the form of a wedge resection or lobectomy or muscle flap surgery. We report a case of a peripheral BPF secondary to a bacterial infection, which was successfully managed by the instillation of gelfoam via flexible bronchoscopy.

INTRODUCTION
A bronchopleural fistula (BPF) is an abnormal communication between the pleura and the tracheobronchial tree. The immediate management of bronchopleural fistulas is drainage of the pleural cavity with insertion of an intercostal drainage tube. Patients with persistent BPF that fail conservative management may require surgical intervention (wedge resection, lobectomy, muscle flap surgery) with failure rates as high as 35-40% and an overall mortality of up to 20%. If a major bronchial stump dehiscence occurs during the first week after pulmonary resection, immediate resuture and reinforcement is the procedure of choice. The modalities in the bronchoscopic management of BPF include endobronchial occlusion with tissue glue, fibrin glue, gelfoam and lead plugs. The use of gelfoam in the management of BPF secondary to wedge resection for adenocarcinoma of the lung and concomitant mycobacterial infection has been reported in 1986. We report a case of peripheral BPF secondary to bacterial infection, which was successfully managed by the instillation of gelfoam via flexible fibre-optic bronchoscopy.

CASE REPORT
A 55-year old diabetic male presented with a left hydropneumothorax and subcutaneous emphysema (Fig. 1). A 32 French Portex intercostal tube with underwater seal was inserted from the left 5th intercostal space in the mid-axillary line which drained purulent exudative fluid. The patient was treated with cefuroxime axetil 750 mg intravenously in b.i.d. doses and human rapid acting insulin. Pleural fluid cultures showed growth of streptococcal species sensitive to cefuroxime axetil and were negative for tuberculous organisms.

Despite control of infection and complete expansion of the lung, the air leak from the intercostal drainage tube persisted for more than 35 days. A computerized tomography of the chest was suggestive of a BPF in the posterior segment of the left upper lobe. The estimated size of the BPF based on the CT scan was 3 mm. A diagnostic flexible bronchoscopy revealed purulent secretions with air bubbles from the posterior segment of the left upper lobe. Wedging of the segmental bronchus with the bronchoscope lead to stoppage of air leak in the intercostal drainage tube bottle. A therapeutic intervention - bronchoscopic instillation of gelfoam into the posterior segment of the left upper lobe was undertaken. Gelfoam was scraped onto a petridish and mixed with 0.9% saline to make into a thin liquid gel. The flexible bronchoscope...
(Pentax FB 19H) was passed nasally under local anaesthesia after premedication with atropine. A 5 French catheter was passed via the operating channel of the bronroscope and guided into the posterior segment of the left upper lobe. Five milliliters of the gelfoam was instilled into the posterior segment of the left upper lobe via this catheter. The intercostal tube was clamped for 3 hours following the procedure. There was no air leak following the release of the clamp. A chest roentgenogram after 24 hours did not show pneumothorax and hence the intercostal drainage tube was removed. There were no complications associated with the procedure. Subsequent follow-up chest roentgenograms at the end of 1 and 6 months were normal.

**DISCUSSION**

The various approaches in the management of peripheral BPFs have included use of prolonged tube suction, multiple tubes and jet ventilation. The management of prolonged air leak from lung parenchyma can often be difficult, leading to morbidities. Prolonged pleural suction can be maintained in the hope that the fistula will seal spontaneously. However, failure to seal spontaneously or compromise in the gas exchange warrants techniques to diminish or stop the air leak while full lung expansion is maintained. In the past, patients with BPF were either left with a tube thoracostomy or a surgical attempt was made to close the fistulous opening. If a major bronchial stump dehiscence occurs during the first week after pulmonary resection, immediate resuture and reinforcement is the procedure of choice. Surgical approaches (wedge resection or lobectomy) also have a significant morbidity and failure rates.

Bronchoscopic interventions have not been commonly used in the management of BPF. The various materials that have been used bronchoscopically in the management of BPF include tissue glue, fibrin glue, gelfoam, lead shot, autologous blood patch, silicone rubber plugs (gelatin-capule shaped). More recently absolute ethanol injection via bronchoscope has been used for BPF < 3mm in diameter. Most of these agents occlude the fistula and induce a local reactive proliferation of the bronchial mucosa. This proliferative process is responsible for the long-term closure of the fistula. The long-term fate of these agents in the lung is unknown. In one animal study, fibrin glue was applied to the pleural side of a BPF and a histologic examination performed at the end of 3 months revealed that the glue was completely reabsorbed and no foreign body reaction was discernable. Silicone rubber plugs are slippery and have been reported to migrate proximally. Other agents that have also been reported in the management of BPF include silver nitrate and electrocautery, which promote closure of the BPF by producing inflammation and mucosal sloughing. The disadvantage of these agents may be that they act over a period of time.

The properties desired of an ideal endobronchial plug for the management of BPF would include that it be minimally tissue reactive, easy to sterilise, radio-opaque, precisely implantable by minimally invasive techniques, potentially removable and easy to monitor follow up. An ideal endobronchial plug would eliminate the need for major thoracic surgery and significantly reduce the morbidity and the mortality associated with BPF.

The advantages of using gelfoam as an endobronchial blocker include that it is easily available, inserted via flexible bronchoscopy under local anesthesia, nontoxic and completely phagocytosed within one month. In our patient, the bacterial infection was well controlled and gelfoam instillation caused temporary blockage of the peripheral BPF, thus allowing it time to heal. The use of gelfoam in the management of bronchopleural fistula in a patient with coexisting lung cancer and *Mycobacterium tuberculosis* infection has been reported in 1986. Gelfoam was cut into strips and injected via the suction channel of the flexible bronroscope under general anesthesia. We have described a method in which the procedure was carried out under local anesthesia and the gelfoam paste was injected into the desired segment via a catheter. Although atelectasis or pneumonia may occur in the obstructed segment, neither occurred in our patient. A newer technique for endobronchial sealing and bridging is being developed of placing a spongiosa block and fixing it by placing customized stents. When the spongiosa gets organized, the stent can be removed.

Conservative management and surgical intervention are the conventional approaches in the management of BPF. Some patients who fail to heal with conservative management may be poor surgical candidates due to compromised respiratory status, co-morbid medical conditions, or generalized debilitation. Successful bronchoscopic intervention would help reduce cost and duration of hospital stay. We have described a safe method of treating peripheral bronchopleural fistula with the injection of gelfoam via flexible bronchoscopy. To conclude, in selected patients with BPF, bronchoscopic instillation of gelfoam can hasten recovery, reduce morbidity and avoid major thoracic surgery.

**REFERENCES**