Invited commentary on intraoperative ventilation strategy in a patient with empyema thoracis complicated by bronchopleural fistula

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Bronchopleural fistula (BPF) is a clinical condition of varied aetiology that is potentially life threatening and it refers to leakage of air from the respiratory tree into the pleura that lasts for more than 24 h [1]. The incidence varies from 4.5 to 20% after pneumonectomy and is only 0.5% after lobectomy. Certain patient characteristics increase its incidence and include preoperative radiation to the chest, destroyed or infected lung from inflammatory disease, immunocompromised host, and insulin-dependent diabetes [2]. The incidence of BPF in historical patients not subjected to bronchial stump coverage was between 6 and 12% after pneumonectomy for lung cancer surgery or benign disease.

BPF can be classified as peripheral or central depending on the site of the leak. Apart from the obvious anatomical difference, the two differ significantly with reference to aetiology, diagnostic techniques and management options [1]. The anaesthetic management of a patient with a BPF is often complex; besides the aetiology and the size of the defect, the experience of the operator and the institutional setting in which the procedure is performed also play an important role.

Mortality rates of 18–50% have been reported following BPF. A particularly poor prognosis exists for BPF developing late in the course of a nontraumatic illness requiring mechanical ventilation, in which there are leaks in excess of 500 ml/breath [1]. As is evident in the article published along with this commentary, anaesthetic management for a patient with a BPF often needs to be tailor-made to compliment the treatment modality.

The treatment of BPF includes various surgical and medical procedures to reduce or seal the leak: manipulation of chest tube suction, independent lung ventilation (ILV), high-frequency jet ventilation (HFJV), high-frequency oscillatory ventilation and bronchoscopic application of different glues, coils and sealants. Treatment options should be individualized depending on the site and size of BPF and the severity of patient's comorbid conditions. There have been cases reported on general anaesthesia under spontaneous respiration for the airway stent placement to treat tracheal and bronchial fistula [3].

ILV is the basic principle, often utilized in the anaesthetic techniques for managing a patient with BPF with a significant air leak. It is a method of mechanical ventilation in which the right lung and the left lung are managed independently, through either anatomical or physiological separation. ILV can either be one-lung ILV or two-lung ILV [4]. When conventional ventilation fails, ILV can administer mechanical ventilation selectively in the fistulous side by giving the lowest possible (tidal volume), respiratory rate, positive end-expiratory pressure and inspiratory time [4]. ILV is commonly achieved by using a double-lumen endotracheal tube or a single-lumen endotracheal tube combined with a bronchial blocker.

ILV may, however, prove to be technically difficult. There may be leak of gas and pressure from one lung to another if the seal is imperfect. Often the two lungs have different compliance and it may require

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ventilating each lung independently, which is technically more challenging. A case series has shown that differential lung ventilation is an appropriate treatment for acute severe native lung hyperinflation [5]. Even though this single study was conducted for patients who have had a single-lung transplant for end-stage emphysema, the results could be easily applied to patients with a Bronchopleural fistula (BPF).

Early reports of techniques of lung isolation such as using a Fogarty catheter have been described quite early in the literature [6]. The case presented in this report could not be ventilated adequately with ILV or HFJV. Bronchoscopic insertion of endobronchial valves to treat BPF has been described in a variety of settings [7].

Jet ventilation may prove to be useful in managing selected cases of BPF. It has been proposed to produce lower proximal airway pressures and a more even distribution of ventilation, resulting in decreased ventilation through the disrupted segment [6]. HFJV was approved quite early by US Food and Drug Administration for ventilating patients with BPF [8]. However, research is still ongoing to assess its effect on the fistula air leak. A recent study has shown that gas leak will be minimized and ventilator volumes maintained during jet ventilation using frequencies around 200/min and lower driving pressures, but confirmatory clinical studies are required [9].

In patients with bilateral BPF, bronchoscopy can be used to close small defects (1–3 mm); ILV, often, cannot be used in patients with bilateral lung involvements; high-frequency ventilation is of limited value in patients with distal and parenchymal disease [10,11]. In complex cases in which oxygenation is not improved by any measure, extracorporeal membrane oxygenation can be used to tide over the oxygenation until the BPF is repaired; the limited availability of the modality restricts its use to highly specialized centres only.

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Conflicts of interest
There are no conflicts of interest.

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