Lobar bronchial blockade in broncho-pleural fistula

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A 59-yr-old man with bullous lung disease developed a refractory bronchopleural fistula involving the right upper lobe. Despite independent lung and high-frequency jet ventilation, a large air leak persisted. Following the introduction of a bronchial blocker into the right upper lobe bronchus via the tracheal lumen of a left-sided endobronchial tube, oxygenation and ventilation improved, and the airleak was reduced by 90%. The presence of pneumonia led to an inexorably downhill course with death from overwhelming sepsis.

Un homme de 59 ans, avec une maladie pulmonaire bulleuse, a développé une fistule bronchopleurale réfractaire en regard du lobe supérieur droit. Une large fuite d'air persistait malgré une ventilation à haute fréquence type « jet » et une ventilation indépendante aux deux poumons. Suite à l'introduction d'un bloqueur bronchial dans la bronche de lobe supérieur droit, en passant par la lumière trachéale d'un tube endotrachéal gauche, l'oxygénation et la ventilation se sont améliorées et la fuite d'air a été réduite de 90%. La présence d'une pneumonie a causé une détérioration inexorable, causant le décès suite à une septicémie fulgurante.

One of the most serious complications of mechanical ventilation is bronchopleural fistula formation. The high airway pressures that are often the cause also make healing a long and difficult process. We present a case in which selective lobar bronchial blockade substantially reduced the amount of air leak through the fistula, and led to improvement in gas exchange.

Case report

A 59-yr-old man with a long standing history of chronic obstructive lung disease, was admitted to hospital with a diagnosis of a right middle lobe pneumonia. In the 24 hr following admission, increasing dyspnoea, and worsening arterial blood gases (FIO_2 of 0.5, pH 7.09, $PaCO_2$ 93 mmHg, PaO_2 62 mmHg, HCO_3^- 28 mmol · L^{-1}) necessitated tracheal intubation and mechanical ventilation. One hour later, the patient became haemodynamically unstable; a chest *x*-ray revealed a right-sided tension pneumothorax. A 32 Fr thoracostomy tube was introduced at the fifth intercostal space in the midaxillary line, and connected to −20 cm H_2O suction, with prompt cardiovascular resolution. Immediately afterwards, the low exhaled volume alarm was activated, and it was noted that of each 700 ml tidal volume, only 200 ml was returned with expiration. Arterial blood gases (FIO_2 0.5, pH 7.09, $PaCO_2$ 93 mmHg, PaO_2 62 mmHg, HCO_3^- 28 mmol · L^{-1}) were indicative of considerable alveolar hypoventilation.

The patient was paralyzed with a continuous infusion of vecuronium, and various ventilatory modes were tried over the next two days:

1 Independent lung ventilation: A 39 Fr left-sided endobronchial tube (Sheridan Catheter Corp., Argyle, New York) was inserted. The left lung was ventilated with an FIO_2 of 1.0, RR of 20 bpm, VT of 400 ml, and PEEP of 2.5 cm H_2O. P_{aw} ranged between 35 and 40 mmHg. The right lung received an FIO_2 of 1.0 with 5 cm H_2O CPAP. The PaO_2 was approximately 65–70 mmHg, $PaCO_2$ 45–50 mmHg, and pH 7.28–7.31. Increasing the PEEP delivered to the left lung to 5 and 7.5 cm H_2O did not alter oxygenation.
2 Single lumen endotracheal tube with HFJV. The FIO_2 was set at 1.0, RR varied from 100 to 120 bpm, driving

Key words
COMPLICATIONS: bronchopleural fistula;
EQUIPMENT: tubes, endobronchial.

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Accepted for publication 3rd September, 1991.

ABBREVIATIONS
RR = respiratory rate
bpm = breaths per minute
VT = tidal volume
P_{aw} = airway pressure
PEEP = positive end expiratory pressure
CPAP = continuous positive airway pressure
HFJV = high frequency jet ventilation
PSI = pounds per square inch
I:E = inspiratory:expiratory

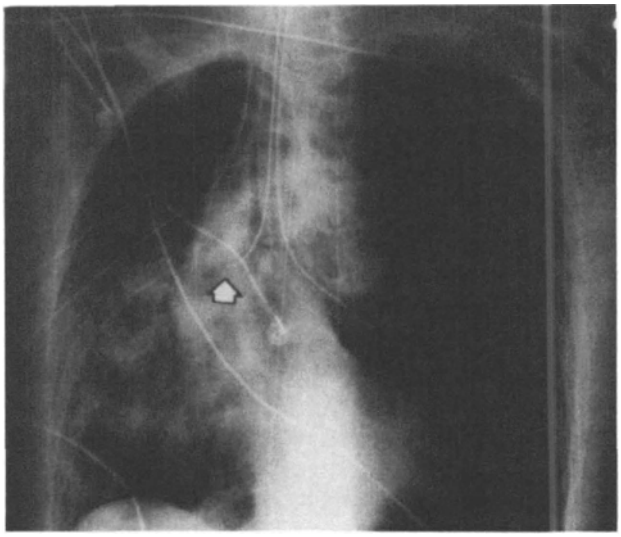

FIGURE Chest *x*-ray. A double lumen tube is in place, with the bronchial orifice in the left mainstem bronchus. The arrow indicates the position of the bronchial blocker as it passes through the tracheal lumen of the tube into the right upper lobe bronchus.

pressure from 30–40 PSI, PEEP of 5 cm H_2O, and I:E ratio of 0.25. The range of PaO_2 was 45–49 mmHg, $PaCO_2$ 45–50 mmHg, and pH 7.28–7.31.

3 Independent lung ventilation via the 39 Fr left-sided endobronchial tube. The left lung was ventilated in the assist/control mode, FiO_2 of 1.0, RR of 30 bpm, VT of 400 ml, PEEP of 0. P_{aw} varied between 30 and 40 mmHg. On the right lung, HFJV was used with an FiO_2 of 1.0, RR of 100–120 bpm, driving pressure of 30 PSI, PEEP of 0, I:E ratio of 0.25. The range of PaO_2 was 48–68 mmHg, $PaCO_2$ 40–45 mmHg, and pH 7.32–7.38.

4 With the 39 Fr left-sided endobronchial tube in place, ventilation of the left lung continued while a 6 Fr Fogarty catheter (American Edwards Laboratories, Añasco, PR) was inserted via the the tracheal lumen into the right upper lobe bronchus (Figure). Guidance was provided by a 4 mm bronchoscope, also inserted through the tracheal lumen. With the Fogarty balloon inflated, the leak through the right-sided chest tube decreased from 500 ml to 50 ml per breath. The lungs were ventilated in the assist control mode, FiO_2 of 1.0, RR of 20 bpm, VT of 700 ml, PEEP of 0. The P_{aw} varied between 30–35 mmHg. The range of PaO_2 was 100–120 mmHg, $PaCO_2$ 35–40 mmHg, and pH 7.40–7.46.

Despite these measures, the patient died three days later as a result of overwhelming sepsis.

Discussion

Numerous techniques have been used in the ventilatory management of patients with bronchopleural fistulas. These have included independent lung ventilation,[1] high frequency ventilation,[2] and joining the exhalation valve of the ventilator circuit with the chest tube system at a common PEEP device.[3] We attempted the first two modalities, as well as combining conventional ventilation to the non-affected lung, and HFJV to the fistulous lung. However, none of these manoeuvres led to a reduction of the substantial air leak. This was not unexpected, as pneumonia was present. We concluded that if the fistula was exposed to any positive pressure, healing would not occur. Elimination of CO_2 was not a major problem, and this is consistent with previous reports.[4] Ratliff[5] described the insertion of a lead blocker into the right upper lobe bronchus in a patient with a massive bronchopleural fistula. However, this was done through a single lumen endotracheal tube, while the patient was on cardiopulmonary bypass. By using a double lumen tube, we could maintain oxygenation and ventilation, while positioning the bronchial blocker.

Oxygenation was improved, and the volume of leak diminished by the use of an endobronchial blocker. However, placement was difficult and suctioning of the blocked segment was not possible. This may predispose to infection in lung segments distal to the blocker. While a double lumen tube allows the lungs to be ventilated independently with the lobar blocker *in situ*, there are numerous problems with its use. The individual lumens are small and more easily obstructed by secretions. Suctioning is also more difficult. The large diameter of the tube predisposes to laryngeal damage, while the presence of an endobronchial cuff may cause injury to the mainstem bronchus. Ideally, therefore, this technique should be considered a temporary measure. Definitive surgical repair should be given consideration. We were hesitant to pursue this course because the pneumonia showed no signs of abating; however, if confronted by a similar situation in the future, a more aggressive surgical approach may be chosen. Operative repair may be more applicable in other clinical situations, for example traumatic, non-infected fistualae, refractory to ventilatory management.

The superiority of conventional ventilation versus high frequency jet ventilation in the healing of established air leaks remains to be established. Jet ventilation has been proposed to produce lower proximal airway pressures and more even distribution of ventilation, resulting in decreased ventilation through the disrupted segment,[6] and this is borne out by numerous anecdotal reports.[7,8] However, in the presence of severe concomitant parenchymal disease and poorly compliant lungs, jet ventilation may add little to the management of a bronchopleural fistula[9] and this was so in our patient.

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