THE ANAESTHETIC MANAGEMENT OF PATIENTS WITH BRONCHOPLEURAL FISTULA WITH THE ROBERTSHAW DOUBLE-LUMEN TUBE

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SUMMARY

A method of anaesthesia for the repair of bronchopleural fistulae is described which involves the use of the Robertshaw double-lumen tube. Our experience with its use on twenty occasions is described, and in eleven of them the method was completely successful. In none of the other nine cases were the difficulties encountered such as to render the technique unsafe. Both from the point of view of safety and for the patient's comfort, general anaesthesia for intubation was found to be preferable.

Thoracic surgeons have in recent years recognized that operative closure of bronchopleural fistula following pulmonary resection is the most successful method of management (Belcher and Sturridge, 1962). This attitude together with early diagnosis might be expected to bring an increasing number of patients with fistula to operation.

Parkhouse (1957) has described the aetiology and diagnosis of bronchopleural fistula and the problems it raises for the anaesthetist. These are:

1. Spillover of fluid from the pleural cavity into the bronchi of the sound lung, and of the remaining lobe, if present.

2. Loss of gases through the fistula to the pleural cavity and sometimes to the exterior.

3. The possibility of a tension pneumothorax occurring if the fistula is valvular.

A simple but reliable anaesthetic technique is required to overcome these problems. This paper describes our experience in the management of twenty of these cases with the tube described by Robertshaw (1962). The use of this tube for other purposes has been described in detail in another paper (Zeitlin, Short and Ryder, 1965). A summary of the operations will be found in table I. Seventeen of the operations were performed in the lateral position, two in the prone position, and the repair of the duodenal perforation was performed with the patient supine.

ANAESTHETIC TECHNIQUE

In eight cases we attempted to intubate under local anaesthesia. In six cases this was successful, but in the other two intubation was impossible without induction of general anaesthesia. Twelve cases were managed in the manner described below.

<table>
<thead>
<tr>
<th>Table I</th>
<th>Operations for bronchopleural fistula.</th>
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</thead>
<tbody>
<tr>
<td>Lesion</td>
<td>Operation</td>
</tr>
<tr>
<td>Post-pneumonectomy fistula</td>
<td>Repair of fistula</td>
</tr>
<tr>
<td>Post-pneumonectomy fistula; perforated duodenal ulcer fistula</td>
<td>Repair of perforation</td>
</tr>
<tr>
<td>Post-lower lobectomy fistula</td>
<td>Upper lobe decortication; middle lobectomy</td>
</tr>
<tr>
<td>Post-lower and middle lobectomy fistula</td>
<td>Repair of fistula; upper lobe decortication</td>
</tr>
<tr>
<td>Spontaneous rupture of tuberculous cavity</td>
<td>Upper lobectomy; middle and lower lobe decortication</td>
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*Now at the Middlesex Hospital, London.
TABLE II
Types of tube used.

<table>
<thead>
<tr>
<th>Type of tube</th>
<th>Large size</th>
<th>Medium size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right endobronchial Robertshaw</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Left endobronchial Robertshaw</td>
<td>9</td>
<td>2</td>
</tr>
</tbody>
</table>

except that in one case anaesthesia was induced with cyclopropane. A summary of the Robertshaw tubes which were used will be found in table II.

The pleural space is aspirated and emptied as completely as possible pre-operatively unless there is an intercostal tube already in position. Pre-medication is left to the personal preference of the anaesthetist in the light of the general condition of the patient and the fact that the patient will be induced in the sitting position.

The patient is brought to the anaesthetic room sitting up at 45 degrees and leaning towards the affected side. Prior information about conditions in the bronchial tree may be obtained by asking the patient to cough, when moist sounds will reveal the presence of secretions in the trachea or main bronchi. A large and a medium-sized Robertshaw tube are selected, the endobronchial tube being on the side opposite the lesion. The bronchoscope, laryngoscope, sucker and the cuffs are tested. Pre-oxygenation is carried out for a minimum of 3 minutes before induction, the patient breathing from a plastic facepiece into which oxygen is flowing at 8 l./min.

General anaesthesia is induced by a sleep dose of 2½ per cent thiopentone followed by tubocurarine 30 mg, and a cricothyroid injection of 2 ml of 4 per cent lignocaine. A bronchoscope is then passed, the bronchial tree aspirated, and the anatomical conformation inspected to preclude any gross abnormality that might prevent the insertion of the tube. Laryngoscopy is next performed and the Robertshaw tube passed and advanced as far as it will go with moderate pressure. The yoke is connected and the lumen on the affected side isolated from the anaesthetic gases and left open to the atmosphere. The endobronchial cuff is inflated and positive pressure ventilation may now be safely started. Satisfactory ventilation is confirmed by inspecting the chest movements and by auscultation. Gas will escape up the open lumen if the tube has been misplaced or the bronchial cuff has not been sufficiently inflated. The tracheal cuff is then inflated and the tube is secured at the mouth. At this stage the airway is safe and the patient may be placed flat. Great care is taken to make sure that the tube is not dislodged when the patient is placed in position on the table.

It must be stressed that this method of induction allows spontaneous respiration, albeit increasingly depressed respiration, to continue while bronchoscopy, aspiration, intubation and isolation of the affected side are performed. The time until inflation with oxygen becomes necessary is considerably prolonged and it has, in fact, rarely been needed before completion of intubation.

A considerable amount of fluid from the space may flow out of the open lumen of the tube. This is aspirated to prevent accumulation in the trachea in the area above the bronchus between the two cuffs. Once the chest has been opened and the fluid from the space removed, the fistula may be demonstrated by plugging the open lumen and inflating down that side with gas. The adequacy of the repair may subsequently be demonstrated in the same way. At the end of the operation the bronchial tree on the sound side is aspirated by way of the endobronchial lumen, and the tube is removed. Postoperative bronchoscopy may be indicated if the bronchial tree contains some secretions.

ILLUSTRATIVE CASE REPORTS

Failure to intubate under local anaesthesia.

PATIENT J.M., male, aged 50. A right pneumonectomy for carcinoma of the bronchus was followed 10 days later by the development of a bronchopleural fistula. The patient was given pethidine 100 mg, promethazine 25 mg, and atropine 0·6 mg as premedication and on arrival in theatre seemed to be well sedated. Two ml of 4 per cent lignocaine was injected into the trachea via the cricothyroid membrane, and the mouth, pharynx and larynx were sprayed with the same solution under direct vision. An attempt was made to pass a large left Robertshaw tube. However, the patient panicked, despite explanation and reassurance, and it became clear that this attempt would fail. General anaesthesia was induced with nitrous oxide, oxygen and halothane, and the tube was then passed with ease without even causing a
change in the respiratory rhythm. Further management of the case was uneventful.

The ease of intubation under a light general anaesthetic suggests that the topical anaesthesia was in fact complete. The patient unfortunately panicked despite apparently adequate premedication, explanation and reassurance. Because the likelihood of spillover is greatly increased if the patient becomes restless, as was the case here, we used general anaesthesia for intubation of the later cases.

**Postoperative death.**

**PATIENT G.M., male, aged 60.** Four days after a right pneumonectomy for carcinoma of the bronchus this patient developed signs of a bronchopleural fistula with evidence of spillover of space fluid into the sound lung. Repeated aspiration bronchoscopy and posturing failed to control this, and surgical closure of the fistula was considered to be his only hope of survival. This was done in spite of his now very poor respiratory reserve. Under topical anaesthesia a large left Robertshaw tube was passed, after which anaesthesia was induced with nitrous oxide and oxygen. During the operation the bronchial cuff was found to have herniated across the carina and to be distending the fistula. Since the right hemithorax had already been emptied, the tube was withdrawn into the trachea for the insertion of the last few bronchial sutures. The patient did not recover consciousness at the end of the operation after reversal of the tubocurarine and bronchial aspiration. There was a tracheal tug and the tidal volume was 150 ml. He was therefore reintubated with a cuffed endotracheal tube and artificial ventilation was continued. He did not regain consciousness and died 6 hours postoperatively.

**PATIENT C.W., male, aged 64.** This patient was under medical treatment for a left-sided lung abscess when perforation of a duodenal ulcer occurred. There was also a chronic empyema on the right side due to a bronchopleural fistula. This was treated by a right upper lobectomy and decortication of the upper lobe. The bronchopleural fistula was closed by lobectomy. This was treated by right upper lobectomy and decortication of the upper lobe. The anaesthetic management was as already described except that a large right Robertshaw tube was used.

Patient G.M. was intubated under topical anaesthesia as it was considered that he would not withstand the slightest degree of respiratory depression, such as might have followed an inhalational or intravenous induction. Patient C.W. was induced with cyclopropane, on the other hand, in view of his obviously reduced cardiovascular reserve, in order to minimize any reduction of peripheral resistance (McArdle and Black, 1963).

Partial herniation of the endobronchial cuff across the carina appears to be a hazard of the left Robertshaw tube. This occurred in patient G.M. but did not prejudice the airway and the tube was safely withdrawn once the pleural space was empty and any leak of gases could be controlled by the surgeon.

Air passing through the open lumen simulated a failure of the bronchial cuff in patient C.W. This phenomenon was probably caused by mediastinal and paradoxical diaphragmatic movement forcing air to and fro through a large fistula.

A successful outcome in patient G.M. was precluded by the bronchopneumonia due to spillover of space fluid before the operation. The combination of severe respiratory and intra-abdominal disease overwhelmed patient C.W.

**Fistulae closed by lobectomy.**

**PATIENT C.A., male, aged 23.** This patient developed an empyema following a spontaneous pneumothorax due to rupture of a tuberculous cavity in the right upper lobe. This was treated by right upper lobectomy and decortication of the middle and lower lobes. The anaesthetic management was as already described except that a large right Robertshaw tube was used.

**PATIENT G.A., male, aged 55.** A right lower lobectomy for carcinoma was complicated by an empyema due to a bronchopleural fistula. This was treated by a right middle lobectomy and decortication of the upper lobe. The anaesthetic technique was performed as has already been described except that the right Robertshaw tube was successfully placed only at a second attempt despite the fact that bronchoscopy had revealed a normal left bronchial tree. There were no signs of hypoxia and the further course was uneventful.

As it was known that resection was to be limited to the right upper lobe in patient C.A., a right endobronchial tube was used. This had the advantage of taking empyema pus from the right upper lobe bronchus directly to the exterior. This avoided soiling of the trachea in the area between the two cuffs which would have occurred had a left tube been used.
This approach was not possible in patient G.A. as a right residual pneumonectomy may well have been necessary. There was adequate time for reinsertion of the tube in this patient without risk of hypoxia or spillover after the routine precautions already described had been taken.

Unsuspected bronchopleural fistulae.

Patient C.M., male, aged 58. This patient had a left pneumonectomy for a carcinoma of the bronchus complicated by the development of a bronchopleural fistula. This was repaired but 15 days later his wound disrupted and the patient was presented for repair of his chest wall. After induction with thiopentone followed by tubocurarine a cuffed endotracheal tube was passed. When inflation was started large bubbles of gas were seen to leak through the chest wall. The tube was therefore withdrawn and a large right Robertshaw tube inserted, the endobronchial cuff inflated and uneventful anaesthesia continued while the fistula and the chest wall were repaired.

Patient R.B., male, aged 64. A right pneumonectomy for carcinoma of the bronchus was complicated by a postoperative pyrexia. On the tenth day the wound burst and 2 pints of fluid drained. This patient was also presented for suture of chest wall but on this occasion, as a result of the experience with the previous case, a left Robertshaw tube was passed. The wisdom of this was proved, as it was again possible to demonstrate the presence of a fistula when inflation was begun. Anaesthesia for closure of this fistula was uneventful except that the medium-sized tube which was used (the large size was not available at the time) became dislodged. When the patient was on the table it was advanced to its proper position and fortunately no spillover had occurred.

Bronchopleural fistulae may be encountered unexpectedly and the Robertshaw tube readily meets this situation. The possibility of a hitherto unsuspected bronchopleural fistula should be borne in mind when faced with a case of wound breakdown following pneumonectomy. Case R.B. shows the advisability of using as large a tube as possible so that the close fit in the trachea helps to stabilize it.

Table III

<table>
<thead>
<tr>
<th>Complications</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previously unsuspected fistula</td>
<td>1</td>
</tr>
<tr>
<td>Failure to intubate under local anaesthesia; successful under general anaesthesia</td>
<td>2</td>
</tr>
<tr>
<td>Leakage of gas past right endobronchial cuff</td>
<td>1</td>
</tr>
<tr>
<td>Displacement when too small a tube used</td>
<td>1</td>
</tr>
<tr>
<td>Successful placement of tube only at second attempt</td>
<td>1</td>
</tr>
<tr>
<td>Herniation of left endobronchial cuff over the carina and distension of right-sided fistula</td>
<td>3</td>
</tr>
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</table>
directly via the fistula to the exterior; the part of the trachea above the endobronchial cuff may be aspirated with ease through these tubes, thus reducing the danger of spill-over should this cuff fail; and finally the presence and whereabouts of the fistula may be demonstrated to the surgeon and the airtightness of the subsequent repair tested. Dennison and Lester (1961) and Francis and Glennie Smith (1962) used a Carlens double-lumen tube for right-sided fistulae, but found that the carinal hook interfered with the surgical repair. These authors used Green-Gordon or Pallister tubes for left-sided fistulae, but found that they became dislodged easily and they could not depend on them to give reliable protection to the sound lung.

Our experience with Robertshaw tubes in other spheres of thoracic anaesthesia suggested that they might be well suited to these particular circumstances (Zeitlin, Short and Ryder, 1965). Intubation with these tubes should present no difficulty to the anaesthetist who is used to passing ordinary endotracheal tubes. They provide reliable endobronchial anaesthesia and possess all the advantages of double-lumen tubes.

ACKNOWLEDGMENTS
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REFERENCES


