

# Airway apparatus for thoracic surgery

K George Lee

## Abstract

One-lung anaesthesia is becoming mandatory for thoracic operations; knowledge of the required apparatus is essential for anaesthetists. Developed in the 1950s from non-anaesthetic apparatus, the double-lumen endobronchial tube (DLT) remains the most widely used piece of equipment in this field. The early rubber tubes are giving way to modern plastic, but the principle and function of the DLT remains unchanged. The introduction of robust fine fibreoptic bronchoscopes (FOB) has improved the positioning of tubes, and also stimulated the reintroduction of bronchus blockers. Miniature video cameras have recently been incorporated into tracheal tubes, giving a constant view of the lower airway during anaesthesia. This article outlines the development and use of the currently available double-lumen tubes and bronchus blockers. It concludes with comparison of the two methods of lung isolation.

**Keywords** Bronchus blocker; double-lumen tube; endobronchial intubation; lung isolation; one-lung anaesthesia; Robertshaw

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Indications for one-lung anaesthesia (OLA) are classified as absolute or relative, but OLA is now considered to be essential in most cases. Minimally-invasive approaches such as video-assisted thoracoscopic surgery (VATS) are now commonly used for routine thoracic operations. These procedures are impossible without some form of lung collapse. Knowledge of the required apparatus is essential for anaesthetists.

## Background

Soon after tracheal intubation was pioneered in the 1920s, anaesthetists attempted both endobronchial intubation and bronchial blockade to facilitate thoracic surgery. Unreliability, lack of suction channel and slow lung collapse limited the usefulness of their early apparatus.

Double-lumen endobronchial tubes (DLTs) were invented by physicians for spirometry of individual lungs in conscious patients ('bronchspirometry') in the 1930s. Anaesthetists developed the idea in the 1950s, improving the lumens and perfecting versions for both left and right lung cannulation. In 1962 Frank Robertshaw incorporated the best of all the available technology into his rubber DLT. This still remains the gold standard DLT and 'Robertshaw' has become a generic name for DLTs, but strictly the name pertains to one particular make of rubber tube.

One-lung ventilation during thoracic surgery is still most commonly achieved using a DLT, but the use of bronchial blockers is enjoying new interest. Using fibreoptic bronchoscope

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## Learning objectives

After reading this article, you should be able to:

- outline the early development of endobronchial apparatus
- select and insert an appropriate double-lumen tube for one-lung anaesthesia
- insert and position a bronchus blocker for one-lung anaesthesia

(FOB) guidance, a blocker is passed down a tracheal tube, placed in the main bronchus of the lung to be collapsed and its cuff inflated. Gas escapes through the blocker's lumen collapsing the lung, while the other lung remains ventilated. Selective lobar bronchial blockade is also possible. However, in lung resection the blocker itself can occupy the bronchus to be cut, limiting its value. Cannulating the right main bronchus with DLT or blocker is always more problematic than the left, due to the more complex bronchial anatomy. The landmarks in the early development of thoracic apparatus are shown in [Box 1](#).

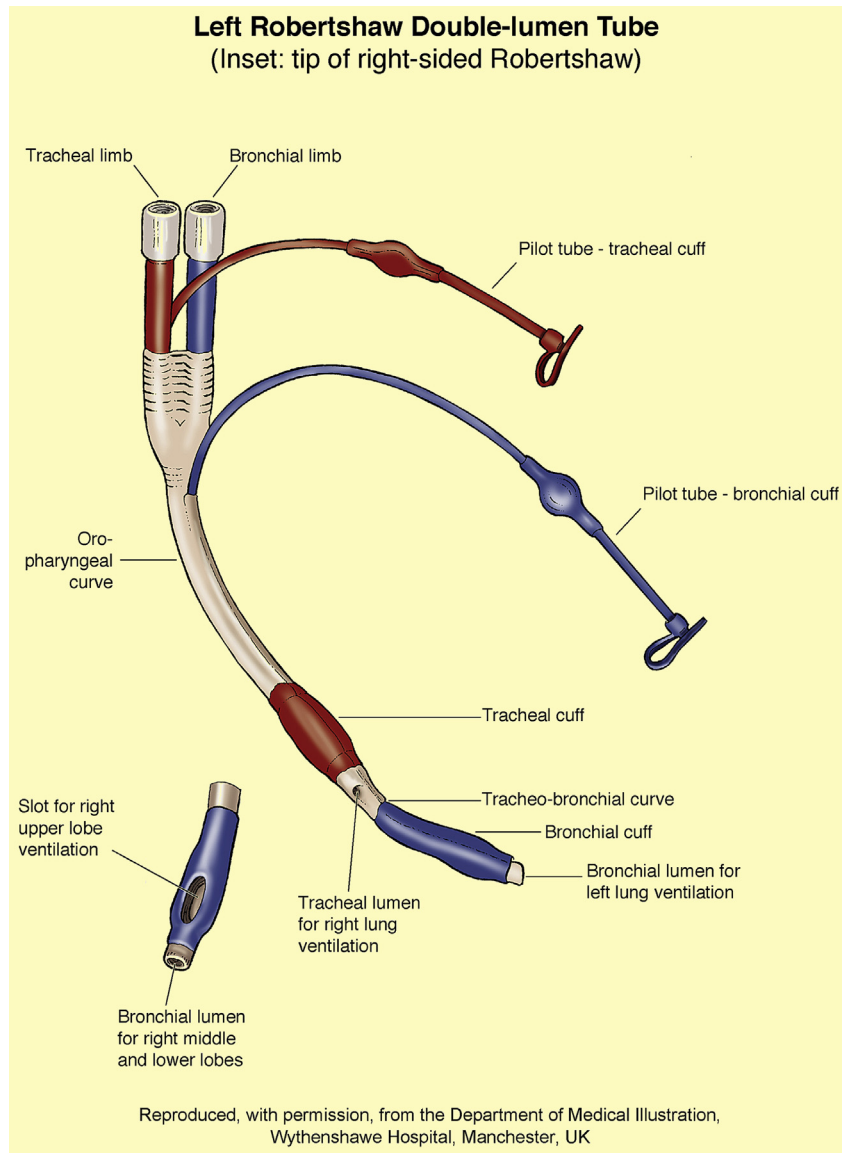
## Double-lumen endobronchial tubes

The principle of the DLT remains unchanged and designs are based on Robertshaw's. In the UK, the true Robertshaw (P3 Medical, UK) is still used, now in its white rubber (disposable) form ([Figure 1](#)). The Mallinckrodt Bronchocath (supplied by Covidien) is widely available, made from polyvinyl chloride (PVC) ([Figure 2](#)). Other DLTs are manufactured by Rusch (Teleflex), Portex (Smiths), Sheridan (Teleflex) and Fuji Systems (Teleflex), made from PVC or silicon rubber. Robertshaw tubes are available in three normal adult sizes – large, medium and small, plus an extra-small for adolescents. Other DLTs are available in four adult sizes – 41, 39, 37 and 35 French gauge (external circumference in mm), although 32 and 28 are also available. Left and right forms of DLTs are shaped to cannulate the trachea and the selected main bronchus, the tracheal lumen

## Landmarks in the early development of thoracic apparatus

- 1928 Magill – tracheal intubation
- 1931 Gale and Waters – bronchial intubation
- 1932 Double-lumen rigid bronchoscope for bronchspirometry published
- 1936 Magill – right and left endobronchial tubes and bronchus blocker
- 1938 Gebauer – first flexible rubber double-lumen tube (DLT) for bronchspirometry
- 1949 Carlens – DLT published for spirometry
- 1950 Carlens' DLT used for lung resection
- 1955 Gordon and Green – slotted right bronchial cuff for upper lobe
- 1959 Bryce-Smith DLT – larger D-shaped lumens, flat cross-section tube
- 1962 Robertshaw tube
- 1983 Bronchocath – first successful plastic DLT

## Box 1



**Figure 1**

opening just above the carina (Figures 1 and 2). Right-sided bronchial limbs have a side opening which ventilates the right upper lobe, with varying success. The rubber right-sided Robertshaw has been proved to be the most reliable of all right-sided DLTs for right upper lobe ventilation (Figure 1 inset).

**Tube selection**

While the use of a left-sided DLT for a right thoracotomy is not in dispute, the choice of tube for left thoracotomy remains controversial. To avoid problems with right upper lobe ventilation, many anaesthetists prefer to use left-sided DLTs for left thoracotomy – only using a right-sided tube if the surgery involves the left main bronchus, such as a left pneumonectomy. However, some believe a right-sided DLT should always be selected for a left thoracotomy, arguing that ventilation of the dependent right lung is more reliably achieved by intubating the dependent main

bronchus and the right upper lobe problem is less of an issue with FOB checking of tube position.

When selecting a DLT, size reflects patient height better than other characteristics. The narrowest part of the upper airway is the cricoid ring (not the vocal cords), and the left main bronchus is smaller than the right. As a rule, try to use the largest tube that will pass. Bearing these in mind, a small Robertshaw or 35/37 tube would suit most women, while a medium/large or 39/41 most men. Studies using various patient parameters to predict required DLT size have been done, but no approach is totally reliable for all tubes.

**Tube insertion**

DLTs are more bulky than standard tracheal tubes and have their own double catheter mounts. Using normal laryngoscopy, pass the bronchial portion of the tube through the cords with the tip

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