Review article
The design of pediatric tracheal tubes

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Summary
Differences in the anatomy and physiology of the young child necessitate specialist equipment and anesthetic equipment is constantly evolving. We will review the factors influencing the design of pediatric tubes and highlight those areas of special interest. There have been pleas for more standardization of tube markings, as this would help with positioning of tubes, especially in small babies, and there are recent advances in this area. Anesthetists need to be aware that there are important differences between tubes so that they take this into account when choosing an appropriate tube. In addition, developments in the design of cuffed tubes are increasingly being used both for routine care and specialist surgery.

Keywords: tubes tracheal; cuffs tracheal; intubation; equipment; pediatric

Introduction
Tracheal tubes (TT) have been used since the late 19th century (1). Gillespie wrote about tracheal intubation in children in 1939 (2), when the anesthetic equipment for children was adapted from adult equipment and infant equipment was either nonexistent or poor (3). Rapid advances were made after 1940 (3,4).

Many of the design features and manufacturing requirements for TTs are dictated by national guidelines, for example the British Standards Institute or the European Community CE mark. There are a variety of pediatric TTs available and recent innovations in tube design have focussed on improved materials and design.

Materials
Most TTs are made of poly vinyl chloride (PVC) which is cheap, transparent, nontoxic, latex free and thermoplastic so that the tube will soften at body temperature and mold to the airway (5). Some tubes are made of silicone which is softer and more suitable for long-term intubation. Reinforced tubes have wire embedded in the PVC or silicone. Stainless steel is used for laser tubes and is useful in CO₂ laser surgery as the least likely material to be associated with airway fires (6).

Design
Shape, size and markings
The tube lumen is usually round. Each tube is sized according to the internal diameter (ID) in millimeters (mm). The outer diameter (OD) will vary with the manufacturer and the material used (Table 1). Tracheal tubes are available from 2 mm ID. The distal end is beveled and with or without the Murphy eye. Sizes increase by 0.5 mm increments and cuffed tubes are available from many suppliers above 3 mm ID.

Tip design
The smooth bevel of pediatric tubes is designed to decrease local trauma during intubation. Tip design

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