

ENDOTRACHEAL TUBE

BACKGROUND OF THE INVENTION

I. Field of the Invention

The present invention relates to endotracheal tubes for ventilation of the lungs, and more particularly, to such tubes suitable for blind guided intubation.

II. Description of Prior Art

When a patient stops breathing, it is imperative that effective ventilation be instituted as soon as possible. Ventilation is best accomplished by forcing air through an endotracheal tube inserted through the mouth and laryngeal opening and into the trachea (in which case the tube may be referred to as an orotracheal tube). The endotracheal tube is usually a preformed, semi-flexible tubular member having a gas flow lumen extending therethrough. The tube has an arcuate shape imparted to it and the distal tip is usually cut completely across at an angle to define a beveled edge to facilitate its insertion between the vocal cords.

The usual method of orotracheal intubation relies on a blade laryngoscope by which to visualize the laryngeal opening so as to facilitate insertion of the tube. The endotracheal tube used to intubate with the blade laryngoscope is usually introduced into the laryngeal opening from the right side thereof (i.e., the patient's right side). To facilitate this procedure, the distal tip is beveled on its side relative to the curvature of the tube (i.e., the tube is cut with a left side-facing bevel that extends at an angle down from the left aspect of the tube through the right aspect) such that the terminal tip defines a right-sided chisel point, which obstructs the view of the vocal cords as little as possible as it approaches those cords and provides a suitably narrow contour for insertion therebetween, and a left-sided elliptical hole circumscribed by the left side-facing beveled edge. Intubation with the blade laryngoscope presents significant difficulties and risks, however. In addition to possible injury or trauma to the patient in the utilization of the blade laryngoscope, it is not uncommon for the orotracheal tube to be accidentally inserted into anatomical spaces surrounding the larynx, such as the closely adjacent esophagus. Such misintubation, if not quickly recognized and corrected, may have fatal consequences.

Another approach to intubation is so-called blind intubation in which a guide device is inserted into the throat to guide the orotracheal tube into the laryngeal opening without requiring visualization of the laryngeal opening. I have developed blind intubation guides which both minimize injury and trauma in use, and also substantially reduce the risk of misintubation. Such intubation guides are shown, for example, in my U.S. Pat. No. 5,339,805 and my U.S. Patent Application entitled "Orotacheal Intubation Guide", filed concurrently herewith. The disclosures of my aforesaid '805 patent and concurrently-filed patent application are both incorporated herein by reference in their entireties. With some blind intubation guides such as mine, the endotracheal tube is advanced through the guide into the laryngeal opening along the midline of that opening rather than obliquely from the side of that opening, as with a blade laryngoscope. Thus, the side-facing bevel of the tube tip may be of no useful benefit and, indeed, may be disadvantageous in that the right-sided chisel point may become impacted on the right side of the larynx, and the left-facing elliptical hole may snag on left-sided laryngeal features, such as the left arytenoid and corniculate cartilages, thus preventing the tube from advancing into the trachea.

Another blind intubation technique is to railroad the tube over another member such as a tubular orotracheal intro-

ducer. In such a technique, the introducer is inserted into an orotracheal tube and extends through the tube lumen beyond the distal tip. The forward end of the introducer is inserted through the laryngeal opening into the trachea, and the tube is railroaded downward over the introducer into the trachea. Here again, the side-beveled configuration of the tube tip predisposes it to become impacted or hung-up on anatomical features of the larynx for the same reasons described above.

An endotracheal tube proposed in U.S. Pat. No. 4,050,466 has a rear-facing bevel (i.e., the tube tip is cut at an angle that extends down from the outer surface of the tube's convex posterior wall through the outer surface of the tube's concave anterior wall), rather than a side-facing bevel. The rear-facing bevel moves the chisel point of the bevel tip from a lateral aspect of the tube to the anterior aspect. I have discovered, however, that the chisel point created by this complete posterior bevel is too broad, and too anteriorly disposed. As a result, the tube may have a tendency to become impacted on the posterior base of the epiglottis or hung up on the vocal cords at the anterior commissure of the glottis where the space between the vocal cords is the narrowest. Even if the tube successfully passes through the glottis, the chisel point would tend to become lodged on or between the cartilaginous rings within the trachea thus preventing further advancement in the trachea.

SUMMARY OF THE INVENTION

The present invention provides an improved endotracheal tube, especially for use with blind intubation guides and orotracheal tube introducers, which minimizes the tendency of the tube to snag on anatomical features of and within the larynx and trachea. To this end, and in accordance with principles of the present invention, the distal tip of the endotracheal tube is provided with only a partial or incomplete posterior or rear-facing bevel which allows the tube to slide down the midline of the rear wall of the larynx without snagging the arytenoid cartilages, which are lateral thereto. The partial posterior bevel leaves a depending projection or lip of the anterior tube wall rather than a chisel point. The partial posterior bevel does not cut completely through the anterior wall of the tube, but instead stops short thereof such as at the inner surface of the anterior wall. The depending lip thus created is advantageously tapered to facilitate its insertion into the narrow opening (glottis) between the vocal cords, and is also curved posteriorly back toward the axis of the tube lumen to define a convex bearing surface which will slide easily down the inner surface of the epiglottis and the inner surface of the anterior tracheal wall without becoming impacted on the epiglottis, anterior commissure, or tracheal rings. The downwardly extending convex bearing surface of the lip may be aligned with the outer anterior tube wall or offset therefrom, and may include a fin on its inferior aspect to facilitate insertion into the glottis.

The lip is semi-flexible and confined to a small size which stops short of the midline axis of the tube distal tip so that if the lip impacts in the body and flexes upward, it will not occlude the lumen of the tube or obstruct the flow of air to the patient's lungs. Similarly, the lip will not obstruct the passage of a bronchoscope fiberbundle or suction catheter passed through and beyond the tube. Instead, the lip is flexed backward by such tubular instruments as they pass, and returns to its original shape when they are withdrawn from contact with the lip. The lip is tapered to a narrowly rounded distal edge to facilitate passage of the tube tip into and through the glottic opening. Where the lip is simply curved inwardly toward the tube lumen, the angle of the curved lip may be about 45° to 55° measured from a line tangent to the