LASER COMPATIBLE JET VENTILATION TUBE

BACKGROUND OF THE INVENTION

This invention is directed to medical devices used during laser surgery and more particularly to an elongated endotracheal jet ventilation tube that, upon being impacted by a laser beam, will not support combustion and will remain substantially integral.

Jet ventilation is a method of enabling a patient to breathe during surgery by forcing anesthetic gases through a tube of relatively small diameter. Two known methods of jet ventilation include supraglottic jet ventilation and subglottic jet ventilation. Supraglottic jet ventilation is performed with a relatively small diameter tube attached to a laryngoscope. A distal end of the ventilation tube is sized to reach just above the vocal fold. Because the path to the vocal fold is relatively short and direct, the supraglottic jet ventilation tube need not be flexible and can be formed of a rigid biocompatible material such as stainless steel.

For subglottic jet ventilation, the tube must be of sufficient length to extend past the vocal fold, preferably into the trachea. Therefore, in subglottic jet ventilation it is advantageous for the tube to be easily flexed to conform to the curvature of a patient's airway. Since an airway conforming jet ventilation tube is needed for subglottic jet ventilation, the material of choice is usually flexible plastic such as polyvinylchloride (PVC) or silicone.

Unfortunately, PVC or silicone tubes can combust if struck by a laser beam. Thus there is general reluctance to use laser surgery with subglottic jet ventilation, especially if the surgical area is proximate to the ventilation tube. Consequently, the prospect of ventilation tube combustion in an operative field of anesthetic gases containing increased levels of oxygen or other combustion supportive gases has resulted in limited use of subglottic jet ventilation during laser surgery.

It is thus desirable to provide a subglottic jet ventilation tube that is sufficiently flexible to conform to a patient's airway and will not support combustion upon impact with a laser beam. Since a laser strike can also break apart a ventilation tube, it is also desirable to provide a subglottic jet ventilation tube that remains substantially integral upon impact by a laser beam.

OBJECTS AND SUMMARY OF THE INVENTION

Among the several objects of the invention may be noted the provision of a novel jet ventilation tube, a novel subglottic jet ventilation tube that is formed of a material which resists combustion upon impact by a laser beam, a novel subglottic jet ventilation tube that resists combustion and is flexible enough to conform to a patient's airway during installation of the tube, a novel subglottic jet ventilation tube that remains substantially integral upon impact by a laser beam, and a novel method of preventing laser induced combustion and breakup of a subglottic jet ventilation tube upon impact by a laser beam.

Other objects and features of the invention will be in part apparent and in part pointed out hereinafter.

In accordance with the invention, the laser compatible jet ventilation tube includes a flexible elongated conduit formed of a combustion resistant plastic material. A distal end of the conduit is provided with centering means for centering the delivery outlet in a trachea. The proximal end of the conduit is provided with a fitting that permits detachable connection of the conduit to anesthetic equipment. A noncombustible flexible reinforcement member is joined to a predetermined length of the conduit to enable the conduit to remain substantially integral as a result of impact to the jet tube by a laser beam.

In several embodiments of the invention the reinforcement member is in the form of an elongated wire encased in combustion resistant plastic material provided at an exterior surface of the conduit. The reinforcing wire can be located between the conduit and a gas monitoring line joined to the conduit to monitor gas levels during surgery.

In other embodiments of the invention the reinforcement member is in the form of a coil of noncombustible material such as metal. The reinforcing coil can be provided at the inside or outside of the conduit.

In instances where the coil is inside the conduit, the monitor line can also be inside the conduit. In instances where the coil is outside the conduit the monitor line can be inside or outside the coil.

The flexibility of the conduit and the reinforcing member, whether it is straight wire or coil, and the flexibility of the monitor line enable the jet tube to be flexed during installation to conform with the curvature of a patient's airway. When the distal end of the jet tube is directed into the trachea the centering means contact the side walls of the trachea to hold the jet tube in a stable position in the airway. Should a laser beam strike the jet tube, the components thereof will not support combustion and the reinforcing member will maintain the integrity of the jet tube. Thus the reinforcing member helps assure that the jet tube will not break into separate independent parts as a result of a laser strike because of the continuity of the reinforcing member along the vulnerable extent of the jet tube.

If desired, the distal end centering means can be similarly reinforced with noncombustible material such as metal similar to that used in the coil. In addition, the centering means can be formed as a segmented structure connected to the conduit at several places. Thus if a laser beam strikes the centering member and severs one or more but not all of the segmented portions, there is no separation of the conduit from the centering means. The centering member is thus maintained integral with the conduit despite a laser strike.

The method of preventing laser induced combustion and break up of a ventilation tube by a laser strike is to form the ventilation tube of a combustion resistant material that is sufficiently flexible to permit conformity of the tube to a patient's airway and to provide a combustion resistant monitoring line and centering means.

The invention accordingly comprises the constructions and method hereinafter described, the scope of the invention being indicated in the claims.

DESCRIPTION OF THE DRAWINGS

In the accompanying drawings,

FIG. **1** is a simplified schematic view of a subglottic jet ventilation tube, incorporating one embodiment of the invention, in an installed position in a patient's airway;

FIG. **2** is a simplified perspective view thereof;

FIG. **3** is a sectional view taken on the line **3—3** of FIG. **2**;

FIGS. **4–6** are sectional views of other embodiments of the invention;