

NEW ENDOTRACHEAL INSTRUMENTS *

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DURING the past three years it has been one of my duties to anesthetize a large number of soldiers with severe wounds of the face and neck. Considerations of safety and comfort for the patients and convenience for the surgeons dictated the use of endotracheal technic in most instances.

The location and nature of these wounds have greatly complicated the procedure of intubation. The complicating factors of dense scars, restriction of jaw motion, displacement and loss of parts, fixed forward flexion of the neck, multiple deformities of the airway and the frequent presence there of purulent or sanguinous discharges have fortunately been overcome in each instance. In so doing, a rather radical revision of technics and instruments has been necessary.

Those instruments which have proved most useful over a sufficient period of time are herewith presented with the hope that they may be of service to others doing this work.

ENDOTRACHEAL TUBES

A flexible noncollapsible tube is an absolute essential in this work. The spiral wire latex tubes offer these qualities, but because of war shortages were unavailable and personal supplies were wearing out.

To meet this need a long series of manufacturing experiments was initiated. These experiments have continued throughout nearly three years. Tubes similar to prewar models were finally produced. They were satisfactory but deteriorated rather quickly because, if accidentally crushed, they could not be reshaped and made round.

A supporting substance which was in itself resilient was searched for to replace the spiral wire support. Finally, nylon monofilament ‡ was utilized and endotracheal tubes and connectors fabricated of this material and rubber have now been in use for two years in over 2,000 cases and have given complete satisfaction. They are usually sterilized by boiling and their average life in daily use is six months. Accidental crushing does not appreciably affect their contour.

As the manufacture of these has been a continuous process to supply our needs many improvements and changes in design, chiefly

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‡ Experimental supplies by courtesy of Mr. P. S. DuPont, 3rd., of E. I. DuPont de Nemours Inc., Wilmington, Del.

of the tip, have been made from time to time. The most versatile of these is illustrated (fig. 1).

This tube has a recess incorporated in it at the tip. This recess protrudes slightly beyond the tip and is designed to accommodate a curved introducer 4.5 mm. in diameter. The introducer should always be coated lightly with surgical lubricant before use to facilitate its withdrawal. The tapered shape of the tip offers free vision up to the moment of passage between the cords.

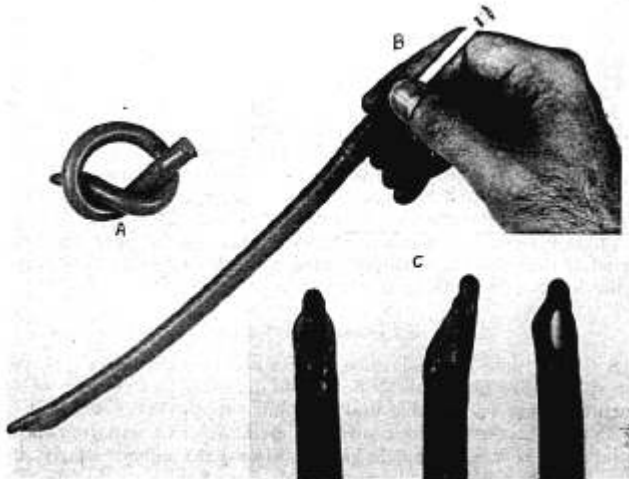


FIG. 1. New type of endotracheal tube illustrating: *A*, nonkinking characteristics; *B*, ready for use with stilet in place; *C*, details of the tip.

This tube may be readily directed where desired and, when properly lubricated, will pass the most spastic glottis with minimal trauma and with surprising ease.

LARYNGOSCOPE (FIG. 2)*

The Jackson laryngoscope has seen considerable use by anesthesiologists. Several modifications of it are now in use. The original instrument has many good features: excellent handle design, good balance, instantly changeable light carriers and lack of external plating. Since it lacks plating, the finish may be renewed with fine abrasive

* Manufactured by George P. Pilling & Sons Co., Philadelphia, Pa.

cloth; thus scratches are not allowed to persist to catch on teeth or abrade mucous membranes.

These features were preserved but several changes were made in this instrument, as follows:

1. A battery compartment which is hermetically sealed by screw cap and washer was placed in the upper handle.
2. The light carrier was moved to the left side and arranged to make electrical contact on insertion.
3. The blade was redesigned to allow use in very restricted spaces. A bite opening of 12 mm. is adequate for passing it into the mouth. All surfaces are gently rounded.

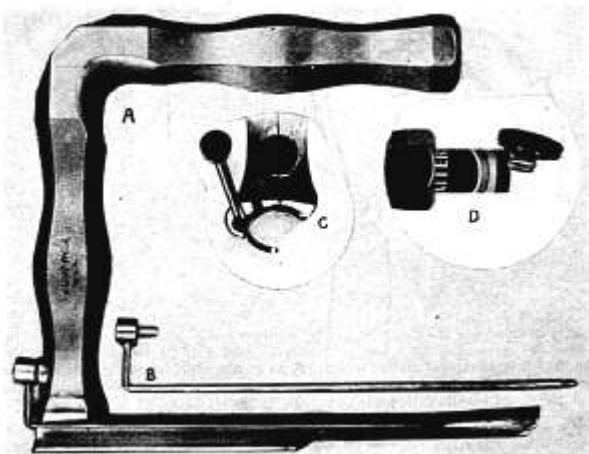


FIG. 2. *A*, laryngoscope described in text. *B*, extra light carrier and bulb. *C*, detail showing shape of blade and electrical contact. *D*, battery protruding from compartment and screw plug for closure.

In intubating with this scope the blade is inserted to the right of the curve of the tongue which is retracted to the left. The endotracheal tube is passed to the right of the blade and comes into the concavity of it near the tip. Vision is thus maintained until the tube passes into the larynx.

In addition to its application in anesthesia, this model has enjoyed a certain limited popularity as a general utility diagnostic and operating laryngoscope.

ENDOTRACHEAL SUCTION ELBOWS AND CATHETERS

Provision should always be made for suction through the endotracheal tube. In maxillofacial surgical procedures space is at a premium and connectors should be as small as possible with minimal protrusion into the surgical field. To accomplish these things a simple elbow was made with an oblong hole on top, near the middle (fig. 3).^{*} The lower edge of this hole was built up and configured in such a way as to hold a small roll of $\frac{3}{8}$ inch Penrose drain tubing with which the elbow is covered. By rolling it back and forth across the opening the tubing serves as a small, cheap, efficient and readily replaceable method of closure.

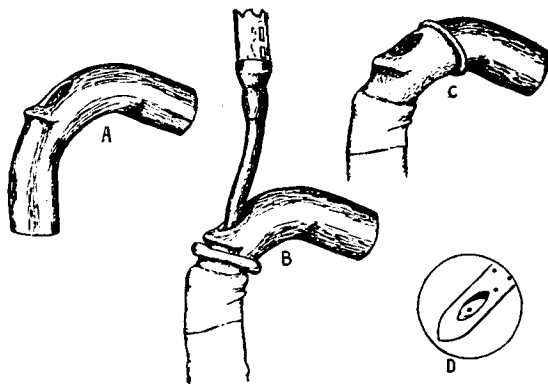


FIG. 3. *A*, endotracheal suction elbow. *B*, as in use when suction is required. *C*, as in use during anesthesia; suction opening is closed with a small roll of latex drain tubing. *D*, detail of the tip of suction catheter.

This opening also serves to admit the introducer used for directing the endotracheal tube.

Suction catheters may be made from urethral or bronchial catheters (fig. 3 *D*). Several minute holes are made near the tip with a leather punch. These holes do not materially reduce the vacuum, but serve to let in small streams of bubbles which break up very viscid mucus and allow aspiration of it when this would not be possible with an unperforated catheter of similar size.

TRACHEOTOMY TUBES FOR CLOSED CIRCUIT ANESTHESIA

Though there has been no case necessitating tracheotomy for anesthesia several patients have had tubes in place that could not be re-

^{*} Manufactured by The Foregger Co. Inc., New York City.

moved until obstructions above were relieved. Such tracheotomy wounds are too small to admit a catheter of a size sufficient for unobstructed breathing as the wall thickness of such catheters is much greater than the thin metal of the tracheotomy tube.

Insufflation anesthesia through tracheotomy tubes leaves much to be desired because of limited choice of agents and the inevitable excitation of tracheal reflexes.

To secure the advantages of closed anesthesia in these cases, a taper connection to join with standard anesthesia parts was fitted to the outer cannula of a tracheotomy tube (fig. 4).^{*} It thus serves for closed anesthesia, suction as needed during operation, and a recovery airway.

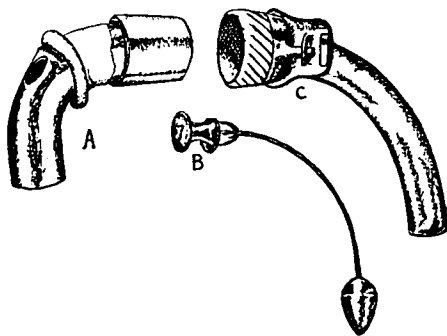


FIG. 4. Tracheotomy tube and connector for closed anesthesia. *A*, suction elbow with taper fitting. *B*, obturator for insertion of tracheotomy tube. *C*, tracheotomy tube with taper fitting to provide leak-proof joint with *A*.

SUMMARY

Certain instruments are described which were developed to facilitate endotracheal anesthesia for a large group of soldiers with severe, complicated and unusual injuries about the face and neck. The endotracheal tubes, connectors, and laryngoscope have proved equally valuable in uncomplicated cases.

Gratitude is herewith expressed to my associates, Wallace A. Reed, Captain, M.C., A.U.S., and John J. Graff, Major, M.C., U.S.A., for their work in connection with these developments.

^{*} Available as special item of manufacture from The Foregger Co. Inc., New York, N. Y.