A NEW METHOD FOR TRACHEOTOMY*

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A patent airway is of vital importance in every patient. The indications for tracheotomy in the treatment of respiratory obstructions have long been recognized. The technic is well established, and has been changed little if any during the past fifty years.

Tracheotomy as standardized is a surgical procedure, consisting of skin incision, dissection of the soft tissues, exposure of the trachea, incision of the cartilaginous rings and insertion of a silver tube into the trachea.

The standard operative method is satisfactory for elective tracheotomy for relief of a chronic tracheobronchial obstruction. As an emergency procedure it has several obvious disadvantages. Hospital facilities are required, as well as a complete set of surgical instruments. Considerable time is required, especially by those not familiar with the technic, which adds additional trauma to the patient already in critical condition.

Our interest in tracheotomy stems from the care of patients with serious acute head injuries. Associated fractures of the jaw or facial bones, as well as lacerations of the soft tissues of the face, mouth or pharynx result in excessive bleeding, much of which gravitates into the tracheobronchial tree, causing acute respiratory embarrassment. Spinal fluid escaping from basal skull fractures frequently adds to the obstruction.

A patient with a severe head injury is often deeply comatose, has lost his protective gag reflex and literally drowns in his own secretions. Lesser accumulations of blood and secretions in the bronchial tree may cause partial obstruction with secondary cerebral anoxia and increase in carbon dioxide sufficient to produce severe cerebral edema and a marked increase in intracranial pressure.

This vicious cycle can be interrupted only if the air passages are aspirated of all foreign material. The administration of nasal oxygen is of no value if the trachea or bronchi are obstructed. Aspiration through the nose is difficult as only occasionally can a soft rubber catheter be passed between the vocal cords into the trachea.

Tracheotomy in such patients is a life-saving procedure. The tracheotomy tube allows frequent adequate aspiration, assures a continued supply of oxygen, and prevents accumulation of carbon dioxide.

Many patients in dire need of tracheotomy are denied the benefits of an artificial airway because of the complexities of the present methods. If a simple, rapid means of tracheotomy were available, it no doubt would become a routine procedure, thus saving many hundreds of lives each year.

The method described below fulfills these requirements. The tracheotomy tube

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can be inserted rapidly and safely. No surgical instruments or hospital facilities are necessary. It can be used by any physician, or in the Armed Services could easily be used by hospital corpsmen.

**METHOD**

The instrument at the present time consists of four parts (Fig. 1):

1. A needle with a retractable barb that is first inserted to transfix the trachea (A). Thus the trachea can be elevated (B) against the overlying skin and lateral motion of the trachea can be prevented while the tube is being inserted.

2. A silver tracheotomy tube with three narrow slots in the tapered distal end.

3. A cutting trocar that slips through the tracheotomy tube and projects beyond the distal tapered end. The cutting blades are two in number. One is a long tapered spring steel blade sharpened on both edges. On the end of this blade is a small ball tip which prevents the tapered horizontal blade from piercing the posterior wall of the trachea. The second vertical
blade is short with a convex cutting edge placed at right angles to the long tapered blade.

4. A short #13 needle is required that has a portion of the wall ground away so as to leave a slot along the distal portion. The proximal end of this slot is enlarged to a circular opening large enough to admit the ball-like tip of the long tapered horizontal cutting blade.

Before introducing the tracheotomy tube, the patient is placed in a supine position on the table with the head hyperextended. The trachea is located and the first needle is passed through the skin into the lumen of the trachea (A). Pressure on the handle end of the trocar in this needle unlocks the barb flange which is opened by then pulling back on the end of the trocar. This flange protrudes as a blunt fishhook against the inside of the trachea. Traction on the needle now elevates and transfixes the trachea (B).

While traction is thus exerted, the second slotted needle is introduced through the skin into the lumen of the trachea (C). This needle is introduced about 2 cm. caudad from the first needle (D). The ball-like tip of the horizontal cutting blade is inserted through the spherical opening in this needle and the ball is passed down the lumen of the needle into the trachea (E). The blade itself slides in through the slot extending in the needle from the spherical opening to the tip (F). Once the long tapered horizontal cutter is within the trachea the needle is removed.

The cutting blades with the attached tracheotomy tube are then passed into the trachea. Once the tube is within the lumen of the trachea the cutters are withdrawn through the lumen of the tracheotomy tube leaving the patent tube in place to serve as an airway (G).

**DISCUSSION**

The instrument had been tested many times, using skin and subcutaneous tissues in the neck and elsewhere to determine the optimum length, shape and cutting surfaces of the horizontal blade. The short convex blade was tested with sections of trachea to judge the ease with which the right-angle incision could be made in the tracheal cartilage.

The most important step in the use of the instrument is the insertion of the #13 needle into the lumen of the trachea. We were concerned with the accuracy of placing the tip of the needle, although it seemed almost impossible for one to miss the trachea considering the large diameter of the lumen as compared to the average subcutaneous vein or even the common carotid artery deep in the neck.

Once the tip of the needle is in the lumen it is impossible to introduce the tube and cutters anywhere except into the trachea since they both follow the slot extending the length of the needle. The ball tip on the horizontal cutter prevents the instrument, once it has entered the trachea, from escaping from the lumen.

Finally it was tried clinically and found to function much easier through living tissue. The problem of the needle solved itself. The needle proved to be large enough for a marked exchange of air through the spherical opening on the side of the needle. One could easily hear the exchange of air and thus be certain that the needle was properly located in the trachea. The cutters and tube entered the trachea with very little effort.

The first patient on whom a tracheotomy was done by this method had a severe acute head injury, complicated by marked anoxia caused by tracheobronchial obstruction from mucopurulent secretions. The patient was deeply comatose and seemed to have little if any cough reflex present.

The total time required for the introduction of a standard #6 tracheotomy tube was less than 30 seconds. The patient made a slow but satisfactory recovery. There was some redness and slight edema about the tube for a few days but not enough to be of any clinical significance. The tracheotomy was allowed to function a little over
2 weeks and then the tube was removed. The opening closed promptly and with far less scarring than usually follows the usual open method.

We have not employed this method in children because the models developed have incorporated the large #6 tracheotomy tube used for adults. Smaller sizes can be made for children and should function equally well. The fact that the trachea in children is less rigid than in adults should offer no problem since the cutting edges follow the course of the needle, the tip of which is already within the lumen of the trachea. Therefore, the action on the trachea is one of cutting rather than pressure.

We no longer use the needle with the retractable barb (Fig. 1 B) to transfix and elevate the trachea. We have found that the cutting blades and tracheotomy tube are readily passed into the trachea when the head and neck are in maximum hyper-extension. The pressure required to introduce the instrument is exerted in a direction closely parallel to the long axis of the trachea, hence there is no tendency for the trachea to move laterally or to be compressed.

This instrument was developed for use in situations demanding immediate tracheotomy. From a neurosurgical standpoint, we have been concerned mainly with patients who have received severe head injuries.

We have employed the instrument in patients whose necks varied greatly in length and width. Even in patients with short, thick necks, there has been no difficulty in performing the tracheotomy.

The first tracheotomy by this method was done in December 1953. Since that time we have used it routinely without incident of bleeding, infection, tracheal injury or any other complications.

We are certain that technical improvements can and will be made on this basic model, but from a practical and clinical standpoint it already has afforded us a safe, simple and speedy method of insuring an adequate airway.*

*This instrument is in the process of being manufactured by the Sierra Madre Manufacturing Company of Sierra Madre, California. It is being licensed by the Research Corporation of America and will be in production within the next month or two.