USE OF ENDOTRACHEAL TUBE IN THERAPY OF POST-TRAUMATIC PULMONARY SECRETIONS

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The therapy of accumulated tracheal secretions incident to operation, narcosis or trauma has received repeated attention in recent years. It is now generally accepted that the air passages must be cleared by the patient himself and when this is not possible, by aspiration of the obstructing secretions. Accumulated tracheal secretions may be removed by means of a small suction catheter inserted blindly through the nose into the trachea (1), by bronchoscopy (2), by means of a small suction catheter passed through a large bore endotracheal tube (3, 4) or by means of tracheotomy. When it is anticipated that the inability of the patient to remove his own secretions will be present for a long time, then either a tracheotomy must be done or an endotracheal tube may be left in place, providing a good airway and permitting frequent aspiration. The question of the possible length of time that the tube can be left in the trachea and larynx without some damage has never been settled, but recently Gillespie (5) has reported a case in which an endotracheal tube was left in place fifty-one hours with no permanent damage following an operation for a fractured mandible.

It is hoped that the following case report will shed further light upon the use of the endotracheal tube for the aspiration of tracheal secretions over a period of several days.

First day. Pilot Officer G. C., a rear gunner, was involved in a plane crash and was thrown forward into the breech block of a Browning gun, sustaining a severe injury of the face, jaw and neck. There was a deep laceration of the lip which divided into two parts; one part extending over the left side of the mandible into the neck toward the larynx; the other part extending laterally into the neck between the angle of the mandible and the tip of the mastoid process. The force of this injury extended deeply and the left mandible was fractured in two places. Part of the bone was missing and a piece 2 cm. in length was later found in the airplane. There was a laceration of the left cheek with fracture of the aurium. The nasal bones were also fractured.

On admission the patient was conscious, but could not speak. Right hemiplegia was present. Moist sounds were heard in the trachea and he was coughing up blood from the pharynx. There was slight cyanosis. A plasma drip was started because of traumatic shock. Three hours after admission, owing to increasing respiratory obstruction from the presence of blood in the air passages, a soft rubber No. 8 Magill endotracheal tube was passed through the right nostril.

* From the Nuffield Department of Anaesthetics, Oxford University, Oxford, England.
into the trachea without the aid of laryngoscopy. The patient coughed vigorously and large amounts of blood and mucus were sucked out from the trachea by means of a small catheter inserted through the endotracheal tube. There was definite improvement in the color and in the character of the respirations, but there was increased restlessness due to the presence of the tube.

The patient was shortly afterwards taken to the operating theatre, a gauze pack was placed in the hypopharynx around the endotracheal tube and, under ether anaesthesia, the wound was explored. It was observed that the laceration of the neck which extended downward exposed the left side of the larynx and hyoid bone and also involved the base of the tongue on the left. The lateral extension of the wound exposed the jugular vein and the parotid and submaxillary glands. The wound was debrided, the mandibular fragments wired together and the skin edges lightly sutured.

The patient was returned to the ward with the tracheal tube in place and aspiration was performed at frequent intervals. The treatment of shock was continued and sulfathiazole was given in the plasma drip.

Second day. In the morning the tracheal tube was removed as it was thought to contribute to his restlessness. A stomach tube was passed for feedings and to give sulfadiazine. Gradually throughout the day there was an increase in the pulse rate and respiratory rate, and the patient became unconscious. Cyanosis appeared and oxygen was started by means of a small catheter inserted through the nose into the oropharynx. In the late evening, respiratory obstruction became severe and a soft rubber endotracheal tube was again passed. A small catheter was inserted through the endotracheal tube and vigorous suction was applied, removing 2 ounces of blood-tinged secretions. The pulse rate was 180 and the respiratory rate was 62. Examination revealed retraction on inspiration to be present in the left upper part of the chest. Subsequent roentgenologic examination disclosed a large shadow involving the outer part of the left lung and an enlarged heart. A regimen of digoxin 0.5 mg. every six hours was started and oxygen was continued by means of a catheter passed down into the endotracheal tube. Throughout the night his condition was grave. Fourteen ounces of bloody secretions were removed by endotracheal suction from 10 p.m. until 8 a.m. the next morning.

Third day. The patient's condition gradually improved. Pulse and respiratory rates became slower, his skin was no longer cyanotic in color, he appeared much quieter and could respond by opening his eyes. A roentgenogram taken in the afternoon revealed a definite decrease in the size of the shadow and in the size of the heart. In the evening, his condition had improved sufficiently for him to sit up. During the day 5 ounces of blood stained mucus were removed by tracheal aspiration.

Fourth day. Pulse and respiratory rates were much slower, but there was a slight increase in temperature. The patient was able to assist the nurses. The oxygen and digoxin were discontinued. Ten ounces of mucus were obtained by suction.

Sixth day. For the first time since intubation on the evening of the second day, after eighty-three hours, the tube was removed. It was left out for two hours but had to be reinserted because of the rapid accumulation of secretions.

Seventh day. The endotracheal tube was removed for six and a half hours during the day. In the evening it was reinserted for four hours and then withdrawn for three and a half hours. At 11:30 p.m., the patient was given the
tube and with some verbal instruction succeeded in intubation of the trachea himself. Throughout the night, it required occasional aspiration.

_Eighth day._ The tube was withdrawn in the morning. Patient was now alert and could understand, but had motor aphasia and agraphia. The prognosis for the right hemiplegia was looked upon as poor by the consulting neurologist. In addition to weakness of the injured facial, lip and tongue muscles the patient had a definite oral apraxia. He could not initiate a completely coordinated cough activity. Although he was able to produce the tussive squeeze by compression of the thorax he was unable to close the glottis and thus could not produce the tussive blast. The act of swallowing was also impaired. Reflex cough activity was, however, unimpaired.

_Ninth day._ The tube was inserted for half an hour at 2 a.m. in order to clear the accumulated secretion of the day. This was the last time it was used.

During the succeeding days the patient was able by powerful expiratory contractions to raise secretions which were removed from his mouth with gauze pledgets.

Neurologic examination was performed during the first week and subsequently by the neurologic consultants. There was a complete and persistent motor aphasia and marked agraphia in attempts to write with his nonparalyzed left hand. He became progressively able to understand the spoken word and to read. There was a complete flaccid paralysis with hemihyposthesia on the right of the body and bilateral extensor plantar response. The sensitivity of the throat appeared to be intact. The gag reflex was absent and the palate paralyzed. There was complete paralysis of the left vocal cord. He had aphony in addition to his aphasic mutism but later he was able to produce a barking noise. The left sternocleidomastoid muscle did not contract. He was able to move the tongue inside the mouth but protrusion was almost absent and when asked to protrude it, the tongue deviated to the left inside the mouth. It was concluded that the ninth, tenth, eleventh and twelfth cranial nerves on the left side had been directly injured when he received the wound in the left inframandibular region. Because of the hemiplegia, hemihyposthesia, oral apraxia, motor aphasia and agraphia it was concluded that there was a left cerebral hemisphere lesion probably as a result of occlusion of the internal carotid artery by a thrombus.

Laryngoscopic examination was carried out on the twelfth day by the consulting laryngologist. The cords were pale and glistening. The left vocal cord was paralyzed in the cadaveric position. There was no evidence of any damage to the vocal cords, larynx or trachea from the endotracheal tube. There were no lacerations, no inflammation, no oedema, no haematoma and no ulcerations.

Sixteen days after the accident the patient was moved to a nearby hospital. At the end of the first week in that hospital he underwent a three-hour operation for further fixation of the mandibular fragments. This was done under pentothal, nitrous oxide-oxygen anaesthesia by means of a nasal endotracheal tube. Previous to this operation the laryngologist had examined the larynx and noted that the right cord abducted on inspiration but did not move with commands to phonate or to cough. The left cord was fixed at all times. The appearance of the vocal cords and larynx was otherwise normal. It was his opinion that the inability of the right vocal cord to phonate was due to a central lesion and that the paralysis of the left vocal cord was due to a peripheral lesion of the tenth nerve.

The larynx was examined on two subsequent occasions and no changes were
noted. He gradually regained the ability to walk and on the sixtieth day after his injury he suddenly became able to speak again. Four months after the injury peroral laryngoscopy was performed and a long electrode was inserted into the intrinsic muscles of the larynx. The muscle action potentials were then recorded by means of a cathode ray oscilloscope connected to the electrode. Electromyograms disclosed normal motor unit activity on the right side of the larynx. On the left, there was no motor unit activity either on inspiration or expiration in the lateral and posterior cricoarytenoid muscles. Manipulation of the fibrotic left vocal cord with a probe did not reveal any limitation of movement in the cricoarytenoid articulation. These findings led to the conclusion that the left vocal cord was denervated.

![Chart showing temperature, pulse and respiration for the first twelve days in the case of Pilot Officer G. C. The length of time the endotracheal tube was left in place is indicated and the amount of sputum obtained each day is shown.](chart.png)

**DISCUSSION**

Excessive secretions persisted for so long a time that numerous aspirations were necessary. The repeated use of the bronchoscope to accomplish this would not have been feasible. Tracheotomy for the provision of an adequate airway and removal of secretions could have been done. Intubation was done instead, because initially it seemed a means to establish rapidly a good airway, remove secretions, to tamponade the trachea against the ingress of blood from the pharynx, and to maintain anaesthesia. It was not thought that the duration of the condition

* Electromyography was performed by Capt. G. Weddell and Dr. B. Feinstein of Oxford, England.
would be so persistent. The patient tolerated the endotracheal tube so well, once he became accustomed to it, that we were loath to remove it. Moreover, the operation of tracheotomy is not without its complications and sequelae. Inasmuch as the laceration extended deeply into the tissues of the neck, exposing the larynx on the left side, the presence of a tracheotomy opening would have created the possibility of infection in the wound. The presence of dressings over the wound and bandages for the purpose of splinting the jaw were further hindrances to tracheotomy. The removal of the endotracheal tube on the morning following the accident was certainly a mistake. Previous writers have repeatedly stressed the necessity of prevention and early treatment of atelectasis due to tracheobronchial secretion. It is possible that if the tube had been left in, secretions would not have accumulated, respiration would not have been obstructed, and his circulatory condition would not have become so grave.

Accumulation of tracheobronchial secretions in this patient was dependent upon a combination of factors. Early there was depression of the pulmonary cleansing mechanism incident to shock and anaesthesia. Lacerations of the muscles of the face, lips, tongue and neck and fracture of the mandible created a weakness in the ability to expectorate. Injury to the ninth, tenth and twelfth cranial nerves on the left produced paralysis of the muscles concerned in coughing, swallowing and expectoration. Lastly, the cerebral lesion was associated with an oral apraxia and impairment of the voluntary cough activity.

This case does not offer conclusive evidence that a long indwelling intubation tube can be tolerated in the human larynx without damage. Had the vocal cords not been paralyzed, it is possible that there might have been a continuous unconscious effort of the patient to adduct the vocal cords in the presence of the tube. The tube might have become an etiologic factor in laryngeal irritation. Further evidence is necessary, therefore, to determine clearly how long such a tube can be left in place without permanent damage to the larynx.

**Summary**

1. A case is presented, illustrating a mode of therapy in posttraumatic accumulation of secretions in the trachea.
2. The endotracheal tube was left in place continuously during a period of eighty-three hours. The tube was used for fifty-five and a half additional hours with intermission. Therefore, the tube was indwelling for a total period of one hundred thirty-eight and one-half hours. There were six intubations of the larynx.
3. This particular larynx under favorable conditions of paralyzed vocal cords tolerated the endotracheal tube and six intubations without damage.
4. The patient himself was able to intubate the trachea.
REFERENCES


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