

total provides good hypnotic effect and, in the presence of adequate nitrous oxide analgesia, it produces satisfactory muscular relaxation.

If too much reliance is placed on pentothal early in the anesthesia, depression of respiration will prevent saturation with the gas. This would result in an unsatisfactory anesthetic combination, and would necessitate further depression with pentothal to prevent muscular movement during surgical stimulation. Then, at the end of the procedure the patient would be markedly depressed for hours.

On the other hand, if pentothal depression is minimized at the beginning, saturation with nitrous oxide is more easily achieved and painful stimuli are properly blocked. Addition of excessive pentothal is not necessary.

#### CLINICAL PROCEDURE

*Step 1.* Induction of very light sleep with pentothal. Ideally, it would be best to avoid any pentothal at this time, but it is difficult to deny the patient the comfort of this type of induction. Either 0.5 per cent or 2.5 per cent concentration is used, and the drug is virtually stopped during the subsequent step.

*Step 2.* Administration of 80 per cent nitrous oxide is started as soon as the lid reflex becomes sluggish. A large volume (5 to 10 liters per minute) is necessary in order to wash the nitrogen out of the lungs and blood stream quickly. Step 2 cannot be abbreviated—we find five or ten minutes to be the minimal time. The non-stimulating portions of the preparation of the skin and draping may usually be done at this time. The keynote of this step is to supply adequate pulmonary ventilation

for a long enough time. If the anesthesiologist becomes impatient and adds more pentothal too soon, the decreased ventilation will only delay the achievement of saturation with nitrous oxide.

*Step 3.* Before the operation begins, pentothal is given rapidly, to the point where breathing is a little less vigorous. The surgeon is then asked to determine sensitivity with forceps or knife point. Muscular quietude should be adequate, but if the muscles become tense, more pentothal is added. We find very little addition is necessary when Step 2 has been adhered to as described.

*Step 4.* Maintenance. The total flow of nitrous oxide-oxygen may be reduced to 2.5 liters per minute, and the concentration dropped to 75 per cent or even 60 per cent if the patient needs extra oxygen. If a pentothal drip is in use, the rate is reduced to the point barely needed to keep the needle open. Additions are made in small "bursts" if respiration becomes accelerated, or if muscle tone increases annoyingly. Saline solution can often be substituted for the pentothal solution after the first hour. Intermittent additions of 2.5 per cent pentothal may be more satisfactory than the 0.5 per cent solution. Only rarely is more than 500 mg. of pentothal necessary for an orthopedic operation lasting one to one and a half hours. The patient usually awakens within five to fifteen minutes after the mask is removed.

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#### THE PROLONGED USE OF ENDOTRACHEAL TUBES: CASE REPORTS

The prolonged use of endotracheal tubes for the purpose of suction and maintenance of an airway in various types of cases has been reported previously. I wish to add to this collection 2 cases of head injury in which a tube remained in place for twelve and seventy-seven days respectively.

*Case 1.* A man, aged 45 years, of sthenic habitus was admitted to the hospi-

tal January 17, 1948. He had slipped on a polished stone floor and fallen backward, hitting his head. His breathing was stertorous. It remained so with an oropharyngeal airway in place unless the chin was supported continuously. Since this was not practical and since secretions were collecting in his trachea, a Magill red rubber endotracheal catheter was passed nasally with ease. Suction was frequently neces-

sary and oxygen was given by placing an oxygen catheter inside the endotracheal catheter. The oxygen was humidified. The clinical diagnosis was cerebral concussion with decerebrate reaction and no surgical procedure was done. A cough reflex was not elicited on passing the tube, although occasionally he coughed on stimulation with the suction catheter when it passed beyond the tracheal tube. The patient never regained consciousness and died January 29, 1948.

Necropsy revealed that he died of cerebral concussion from the fall. Pulmonary edema was present. The following is quoted from the gross description: "The mediastinum is in its normal position. The trachea is removed and at the point of the end of the tracheal tube, just before the bifurcation, is a marked erosion of the mucosa with secretions collecting in the area around the tube." The diameter and depth of the erosion was not described and unfortunately the anesthesiologist was not present at necropsy. At the time of death nearly twenty-four hours had elapsed since the tube had been changed. The tube had been removed, cleaned and replaced once daily.

Case 2. A man 46 years old, was admitted to the hospital after an automobile accident. He was of sthenic habitus, muscular and obese, weighing 240 pounds.

Physical examination revealed a decerebrate reaction and a comminuted fracture of the right femur.

On the day of admission, November 19, 1948, a right subtemporal decompression with drainage of a hygroma was done under local anesthesia. On November 21 secretions were present in his trachea and occasionally he coughed violently. Although the airway was not obstructed at the times when he was most rigid, at other times his jaw relaxed and the nurses had such difficulty keeping his airway patent that it seemed advisable to pass a nasotracheal tube. Under topical anesthesia a number 32 French red rubber Magill catheter was passed with difficulty because of his rigidity on any stimulation. Oxygen was given by B.L.B. mask. Since it was difficult to obtain a mask to fit his face and that the nurses could manage, a larger catheter, number 35 French, was passed on the following day and humidified oxygen

was given by placing a nasal catheter inside the endotracheal tube. The swallowing reflex was not intact and he aspirated saliva around the tube. On one occasion he regurgitated gastric secretions and aspirated them around the tube but they were immediately recovered by suction. The cough reflex was absent on stimulation of the larynx and upper trachea with the tube. The suction catheter stimulated coughing in the lower trachea and right bronchus. His condition remained continuously critical, with bouts of high fever. Most of the time it seemed likely that he would not survive.

The tube was removed and cleaned daily and sometimes more frequently. Several times attempts were made to remove the tube for a few hours to relieve pressure on the cords and trachea. A nasopharyngeal and an oral airway were tried. Each time the anesthesiologist received a hurried call from the nurses that the airway was partially obstructed, and the tube was replaced.

At the end of the first week a portex tube, number 9, was substituted for the rubber tube. It was noted that both the rubber and portex tubes soon became molded to the shape of the space they occupied. This lessened pressure, it was thought, and made the tube more easily replaceable. At no time was there any blood on the tube during passage or removal. The neurosurgeon did not consider that the patient's condition warranted a tracheotomy.

On December 30 the patient was seen by an otolaryngologist, who was unable to examine the larynx because of the rigidity of the jaws. However, since the tube adequately maintained an airway and because the patient's general condition was still very poor, the otolaryngologist advised against a tracheotomy at that time for fear that the procedure would precipitate a fatal outcome.

The patient continued his vegetative existence. Episodes of hyperpyrexia no longer occurred and his condition became static except for slow loss of weight. On February 4, 1949, after seventy-nine days of hospitalization and seventy-seven days of intubation, a tracheotomy was done under local anesthesia in the patient's room.

On March 22, 1949, he was transported by chartered plane to his home 400 miles away.

The patient is alive at present, his condition essentially unchanged neurologically. The tracheotomy is used for suction and he is being cared for by three special nurses. If he has tracheal and laryngeal damage because of the prolonged intubation it is not evident in his vegetative state.

#### SUMMARY

Two cases of head injury are reported in which endotracheal tubes were in place

for twelve and seventy-seven days respectively.

In Case 1, necropsy showed erosion at the point occupied by the tip of the endotracheal tube. The larynx was not examined.

Case 2 is alive at present in a vegetative state and any damage remains undetermined. It would seem, however, that any damage to the trachea has healed without serious sequelae.

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### AN IMPROVED CATHETER STOP \*

Generally the stilet has been used by anesthesiologists to aid in directing the insertion of endotracheal catheters. It is particularly useful in inserting cuffed tubes or in instances of distortion of the glottis. Many anesthesiologists use a simple wire as a stilet; however, the endotracheal tube is not held stable and there is always the danger that the wire will protrude beyond the opening of the endotracheal tube and cause damage to the cords or lacerate the soft tissues of the pharynx and larynx. To prevent this from happening it is essential that the introducer be placed so

that the end is a safe distance from the distal opening of the endotracheal catheter. It is necessary, therefore, that a stop be provided for the director so that it cannot possibly slip too far into the endotracheal tube. A stop which has been used previously has not proved entirely satisfactory because the screw tends to slip and allow rotation of the endotracheal tube so that a completely stable result is not obtained. Furthermore, no provision was made for that period during which the patient's airway is blocked by the stop immediately after the insertion of the tube into the trachea.

With the above considerations in mind, we devised an improved type of stop which has been used clinically and found to be satisfactory. Its main parts consist of:

\* This apparatus can be obtained on order from Mr. Carl M. Schwartz. At present, letters of inquiry should be addressed to: D. H. Haselbuhl, M.D., Harrisburg Hospital, Harrisburg, Pa.

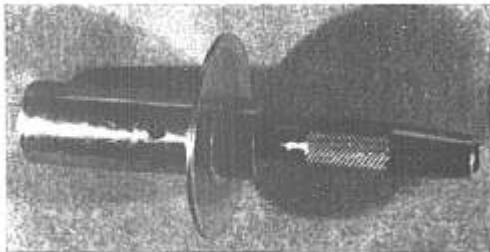


FIG. 1.