leaving the table: a useful trick in the case of children is to blow cigarette smoke over the patient's face.

After bronchoscopy all these patients are treated on return to bed with postural drainage, physiotherapy, and a suitable antibiotic. If removal of a foreign body has failed owing to its impaction in granulation tissue the patient is sent back to bed and treated in the same way as the others. This may allow the oedema to subside and permit a better view at the next attempt. Occasionally a small object which has

FIG. 5.—Case 2. Postero-anterior chest radiograph. Open safety-pin in right main bronchus.

FIG. 6.—Case 1. Postero-anterior chest radiograph. Pin in posterior basal segment of right lower lobe.

magnetism of alloys depends on the amount of heat received during the processing. Furthermore, the power of a magnet is inversely proportional to the square of the distance from its object, and, while intervening tissues do not impair magnetism *per se*, their presence makes contact difficult. On the whole, metallic objects in main bronchi are more easily removed by direct methods, and in deeply placed situations will usually require bronchotomy.

Prevention

Loose teeth in an anaesthetized patient should always be carefully watched. Children should not be allowed to eat nuts until they have a full set of teeth, or, if they are, the nuts should be finely ground. Small objects such as pins, buttons, and coins should not be left within an infant's reach. A parent should not set a bad example for a child by holding tacks and pins in the mouth. Children should

not be allowed to play while eating, or eat too quickly without proper mastication. The adage is still true that if nothing except food was put in the mouth the inhalation of a foreign body would be a rare accident.

Summary

Experience has been gained with 25 cases of inhaled foreign body, mostly in children. The early history of an inhaled foreign body is often missed; the later results may simulate almost any chest disease. The diagnosis is made from the history and the presence on clinical examination of atelectasis or obstructive emphysema, and from chest radiography. The importance of early removal of the foreign body by a team consisting of an experienced bronchoscopist and an experienced anaesthetist is stressed. The essential part of the anaesthetic is surface analgesia of the trachea and bronchi. If removal by bronchoscopy fails, thoracotomy and bronchotomy is justified, with the sacrifice of any destroyed lung. The majority of inhalation accidents may be prevented: nuts should not be given to young children who have no molars, small objects must be kept out of an infant's reach, and care should be taken with loose teeth in an anaesthetized patient.

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TRACHEOSTOMY, AND MANAGEMENT OF THE UNCONSCIOUS PATIENT

BY

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In recent years the indications for tracheostomy have been extended to include the management of tetanus, respiratory paralysis, and the unconscious patient. This simple operation has gained a highly valued place in neurosurgical practice, where the problem of maintaining a clear airway in comatose patients is often encountered. In the last four years in the Department of Neurological Surgery of St. Bartholomew's Hospital 16 tracheostomies have been performed. Selected cases are reported to illustrate the varying indications for the procedure. The mechanism whereby the normal gaseous exchange in the lungs is interfered with in these cases is discussed. The technique for ensuring adequate pulmonary ventilation and a satisfactory intracranial circulation in unconscious patients is also described.

Technique of Tracheostomy

It must be emphasized that so far as is possible this operation should be carried out as an elective procedure. It may be satisfactorily performed under local

analgesia, and this is particularly desirable if consciousness and breathing are depressed. It may be carried out with the patient in bed. If necessary, oxygen may be administered through a face-mask. Good illumination is essential, and the aid of an assistant is desirable. The neck must be held straight and extended as far as possible. A vertical midline incision is made, beginning at the cricoid cartilage and extending downwards for 1 in. (2.5 cm.). If desired a transverse incision can be used, but the subsequent more difficult dissection may outweigh the slight cosmetic superiority of the scar when the tube is removed. If the deep cervical fascia is incised strictly in the midline troublesome bleeding is avoided. The sternohyoid and sternothyroid muscles are separated by blunt dissection and held apart. A high tracheostomy has the advantage that the trachea is more superficially placed, and that there is less danger of the tracheostomy tube entering a main bronchus. As damage to the first ring may result in tracheal stenosis at a later date the thyroid isthmus must be retracted downwards or divided. In the latter case it must be divided after the application of artery forceps, as there may be bleeding from anastomotic branches of the superior thyroid arteries.

The incision into the trachea is made at the level of the second or third ring, and if a large tube is to be used it will be necessary to excise a small segment of the anterior part of the tracheal wall. A very large tube should be avoided, as there is a greater risk of trauma to the tracheal mucosa. The inner tube must be of such diameter that it will not be occluded by the passage of a No. 3 or 4 (English) Jaques catheter for suction purposes. It is undesirable to allow a large negative pulmonary pressure to occur during this manoeuvre for reasons that are given later. It has been found that tracheostomy tubes of sizes between Nos. 28 and 32 have been satisfactory. If there is a likelihood of the patient retaining mucoid secretions in the nasopharynx on account of dysphagia or unconsciousness, or should he be liable to vomit, then a cuffed tracheostomy tube will be advantageous, as it will prevent aspiration of these fluids. Penicillin powder may be dusted into the wound, which is not sutured; it is covered by a tulle grass dressing.

Maintenance of an Unobstructed Respiratory Tract After Tracheostomy

Suction.—The use of a mechanical suction apparatus is essential in order to remove secretions from the trachea and bronchi. A selection of sterile fine rubber (Jaques) catheters should be available. It is important to avoid the introduction of pathogenic organisms into the bronchial tree. Additional perforations near the end of the catheter will reduce the risk of trauma to the mucosa by small segments of this being drawn into the catheter. Lubrication is supplied by sterile water or a non-greasy jelly. The frequency of suction is gauged by the speed with which secretions are formed. This may be judged by whether breathing is noisy or by auscultation of the chest. If the mucus is very viscid and difficult to remove a detergent such as "alevaire," administered by a fine nebulizer, will make it more watery and easier to remove. If there is an established bronchitis or bronchopneumonia, resulting in cyanosis, oxygen may be given either in a tent or through a catheter placed in the tracheostomy tube.

Physiotherapy.—The patient should be turned from side to side every hour in the early days of the tracheostomy, as it is at this time that the secretions are most rapidly formed. Percussion of the chest will help to dislodge mucus retained in more peripheral bronchi, and areas of reduced air entry will indicate the site for this treatment.

Complications of Tracheostomy

A formidable number of complications have been reported by several authors. Davis *et al.* (1953) mention haemorrhage, pneumothorax, and mediastinal emphysema. Perforation of the oesophagus has also been noted. None of these complications occurred in the present series. Tracheal stenosis from damage to the first ring must be borne in mind, and might be the cause for the voice alteration in Case 6 (see below). Crampton-Smith (1955) has emphasized that the introduction of a tube into the trachea, particularly if it is made of rubber, may result in a purulent bronchitis, which in turn may cause obstruction of the bronchi. On the other hand, the management of a severe chest infection in a comatose patient is easier after the establishment of a tracheostomy. Brattström (1954) believes that acute pulmonary oedema may be precipitated by suction through a tracheostomy. He thinks that a high negative pressure may develop during this procedure and overcome the normal bronchoconstrictor control over the pulmonary alveolar pressure: a sudden lowering of the alveolar tension may cause a serous transudation into the alveoli.

Indications for Tracheal Intubation or Tracheostomy

An unobstructed airway may be maintained in comatose patients by posture—that is, by placing the patient on his side in a horizontal position to prevent the tongue falling back; secretions in the mouth and pharynx may be removed by suction. If desired, a Magill airway may be inserted into the mouth. For reasons given below, in neurosurgical practice it is often desirable to keep the patient's head and chest raised. This posture will serve to reduce cerebral congestion and to facilitate a freer respiratory excursion. If coma persists from intracranial causes, and there is difficulty in keeping the airway clear, endotracheal intubation with a rubber tube may be carried out. This has two disadvantages. Firstly, the tube should not be left in position longer than 24 hours for fear of damaging the vocal cords. Secondly, the passage of a fine catheter down the tube for suction may be difficult.

In the series of cases given below the main indications for tracheostomy were: (a) Coma persisting more than 24 hours, when frequent suction was required to remove secretions from the pharynx and trachea. Cases of severe head injury frequently come into this group: when this occurs tracheostomy has been reported by Echols (1949) to be of value; (b) Difficulty in performing tracheal intubation. (c) The development of a lower respiratory infection in stuporous patients. In connexion with this indication Pitman and Wilson (1955) have advocated tracheostomy in the treatment of acute chest infections in chronic bronchitis. (d) Shallow respiration. The total volume of air may become

Groups of Cases Requiring Tracheostomy

	Cases
1. Coma due to acutely raised intracranial pressure	3
2. Coma persisting or recurring in spite of relief of raised intracranial pressure	5
3. Coma following operations in close relation to the brain stem	5
4. Miscellaneous	3
(a) Lesion of cervical cord	
(b) Combined head and chest injuries	
(c) Subarachnoid haemorrhage	

dangerously low. By halving the dead space tracheostomy may give a relatively greater tidal volume (Pitman and Wilson, 1955; Mushin, 1955).

The patients requiring tracheostomy are classified into four different groups according to the varying circumstances indicating necessity for this operation (see Table). An additional indication—namely, respiratory paralysis from a cervical cord lesion—is included in this group.

Case Reports

As already stated, the cases have been grouped to emphasize the differing circumstances, whereby respiration may be depressed and consciousness altered, and when tracheostomy has been required. Tracheal intubation through the mouth or nose was either impracticable for reasons given in the histories or contraindicated because of the time the tube would have remained in place. Illustrative cases are given from each group.

Group 1

In the first group there were three patients whose respiration became depressed and obstructed as a result of brain-stem embarrassment from acutely raised intracranial pressure. Tracheostomy was carried out in the hope of improving the patient's condition by establishing a clear airway, and thus rendering him more fit for the surgical procedure required to relieve the intracranial hypertension. Two cases are briefly reported.

Case 1.—A married woman aged 50 had been suffering from headache for four months. In addition she had a troublesome smoker's cough with purulent sputum. Two nights before admission she took phenobarbitone sodium 1 gr. (65 mg.); the next morning she could not be roused. On transfer to the neuro-surgical department she was stuporous, her face was congested, and she was cyanosed; the respiratory rate was 20 a minute. Breathing was stertorous, and was obstructed by secretions in the pharynx and trachea; frequent suction was required. The pulse volume was poor and its rate was 120 a minute. Cerebral angiography indicated a right frontal meningioma. A tracheostomy was performed; there was a slight but immediate improvement in the level of consciousness, the cyanosis and congestion disappeared, and the pulse became slower and of better volume. The patient had been given a more favourable chance of surviving a major operation. Six hours later a craniotomy was performed and the tumour excised. Subsequent recovery was also facilitated, as suction through the tracheostomy tube probably prevented the development of a severe pulmonary infection from retained mucopurulent secretions.

Case 2.—A married woman aged 42 had had two episodes of spontaneous intracranial haemorrhage complicated by a right-sided hemiparesis and deep stupor in the previous six days. Carotid angiography revealed an aneurysm on the left middle cerebral artery. This was exposed by craniotomy and the aneurysmal neck occluded. Two days later the patient became progressively more comatose, with slow and stertorous breathing. Frequent suction of secretions from the pharynx was required. Because it was thought that this state might persist, a tracheostomy was performed. Respirations at once became quieter and there was an improvement in the peripheral circulation. The cranial wound was explored and an extremely oedematous frontal lobe herniated through the dural opening. There was no haematoma, so an internal decompression was performed by excising the frontal lobe. The patient failed to respond to these measures and died the following day from cerebral oedema, which was unrelieved by an internal decompression or by the injection of intravenous hypertonic solutions.

Group 2

In this group of five patients coma persisted or recurred in spite of surgical relief of raised intracranial pressure.

Case 3.—A man aged 23 sustained injuries to his head and face which resulted in a fissured fracture of the cranial vault and a compound fracture of the mandible. He was concussed, but after a lucid interval in hospital he developed evidence of cerebral compression and became rapidly comatose. The prompt evacuation of an extradural haematoma was followed by a partial return of consciousness. The next day his respirations became stertorous and obstructed, and he was cyanosed and showed signs of peripheral vascular failure. Secretions rapidly accumulated in the pharynx and trachea in spite of frequent suction, and his

level of consciousness deteriorated. The mandibular injury made suction difficult. After performing a tracheostomy there was an immediate lightening of the coma and improvement in the peripheral circulation; he made an uninterrupted recovery.

Case 4.—In spite of the evacuation of a post-operative extradural haematoma, this patient, a man aged 30, remained deeply unconscious the next day. His breathing was stertorous and his pulse rate 120 a minute. Lumbar puncture revealed evidence of a pressure cone, as the pressure was only 80 mm. of water and there was no rise on jugular compression. The cone was reduced by an intrathecal saline injection; afterwards there was an immediate improvement in consciousness. He then coughed more often and more vigorously, and required frequent suction to clear his nasopharynx, as swallowing was defective. Three hours later his respirations became increasingly obstructed from acute laryngeal oedema and an attempted tracheal intubation failed; an immediate tracheostomy was performed. At once there was a further improvement of consciousness; the tube was removed six days later, after he had made a speedy recovery.

Case 5.—A man aged 31, while convalescent from a mastoid operation, became increasingly drowsy and was transferred to the department in coma. A temporal lobe abscess was tapped, but, as little improvement followed, it was excised the next day. Over the next few days he developed a purulent bronchitis, which was later complicated by a basal pneumonia. Clearance of his airway became increasingly difficult and his level of consciousness and general condition began to deteriorate. Tracheostomy was performed six days later, and this was followed by a definite improvement in consciousness. His subsequent progress was slow because of the prolonged intracranial hypertension.

There were two further cases which were similarly improved after tracheostomy.

Group 3

The third group comprised five patients in whom surgical procedures were performed in close proximity to the brain stem. Consciousness was depressed for variable periods, and in addition there was impairment of coughing, swallowing, and respiration.

Case 6.—A boy aged 5 was admitted to hospital with a history of headache, sickness, and unsteadiness of gait for 12 months. Ventriculography indicated a cerebellar tumour. At operation a cystic astrocytoma was found in the antero-superior portion of the vermis: the tumour had herniated through the tentorial opening to compress the posterior aspect of the mid-brain. The day following this operation the patient had not recovered consciousness, and maintenance of the airway became increasingly difficult because of the tongue falling back and secretions accumulating in the pharynx and trachea. There was an accompanying early failure of peripheral circulation. Tracheostomy and endotracheal suction was followed by an improvement in peripheral circulation. Consciousness began to return within an hour. The patient then made good progress, although as a later complication there is some voice alteration. It is possible that the first tracheal ring was damaged.

Case 7.—A woman aged 51 had a large acoustic neurinoma which, among other disabilities, occasioned dysphagia and dysarthria. Removal of the tumour revealed that the pons had been severely distorted. The procedure was followed by prolonged unconsciousness and by peripheral vascular collapse, which was aggravated by respiratory obstruction from an accumulation of excessive secretions in the pharynx. She developed bronchopneumonia. Tracheostomy on the fourth post-operative day tided her over, and she gradually recovered consciousness and the pneumonia resolved. The brain stem had been severely embarrassed, however, and she died from decubitus three months later.

There were four more patients in this group in whom consciousness was slow to return after operation and whose condition deteriorated as a result of respiratory obstruction and depression. Tracheostomy made it possible for two of them to recover, but in the remaining two cases the operation was performed as a terminal measure. Necropsy findings here revealed only minimal pulmonary oedema.

Group 4

Case 8: Cervical Cord Lesion.—A married woman aged 57 developed a spastic tetraparesis due to spinal cord compression at the second cervical segment. A laminectomy was performed and a meningioma was excised from this level. This procedure

was followed by an early return of power to her limbs. The patient's breathing remained shallow and diaphragmatic, however, and she could only cough weakly. She was given breathing exercises; her lung bases were cleared by postural drainage. Over the next 10 days she became increasingly cyanosed, dyspnoeic, and drowsy. Some improvement followed intermittent tracheal intubation and oxygen therapy, but the peripheral circulation began to fail, and breathing became moist. Tracheostomy was carried out terminally. Post-mortem examination of the lungs revealed collapse of both lower lobes and severe pulmonary oedema of the upper lobes. The main bronchi and trachea contained only a little fluid.

Case 9: Combined Head and Chest Injuries.—A man aged 61 sustained a fissured fracture of his skull and four broken ribs on the right side. He was transferred to the neurosurgical department on account of increasing coma following a lucid interval. Exploration of the right middle cranial fossa was carried out and an extradural haematoma was evacuated. A splint was applied over the fractured ribs, where there was paradoxical movement with respiration. The next day he was conscious enough to complain of severe chest pain, and this prevented him from coughing adequately, and caused him to breathe shallowly. He retained an increasing amount of secretion in his bronchi and became progressively more cyanosed and stuporous. There was a speedy improvement after establishing a clear airway with a tracheostomy, and his subsequent recovery was uneventful.

Case 10: Subarachnoid Haemorrhage.—A man aged 21 had two subarachnoid haemorrhages within the space of five days. A general anaesthetic was required for carotid angiography, and after this he developed stridor and was unable to cough adequately. A fine lubricated catheter was passed between his vocal cords and the secretions were aspirated. This was followed by increasing stridor and cyanosis due to acute laryngeal oedema. Consciousness deteriorated. Endotracheal intubation failed because of the laryngeal oedema; tracheostomy became urgently necessary, and after its performance consciousness began to return, the peripheral circulation improved, and the cyanosis disappeared. The patient then continued to improve, but he subsequently died suddenly from a third intracranial haemorrhage.

These histories demonstrate that tracheostomy was life-saving in 9 of the 16 cases in which it was performed. Of the seven patients who died, three underwent the operation in a final attempt to save life. In Case 8 it should have been performed at least three days earlier and supplemented by intermittent positive-pressure respiration. The other three patients who subsequently died were temporarily benefited by the procedure, but their deaths were inevitable owing to the nature and severity of the intracranial lesions, and were not precipitated by tracheostomy.

Discussion

Unconsciousness is frequently accompanied by respiratory depression, and there is often a single pathological process responsible for the two stages. A lesion in the medulla oblongata or pons, from whatever cause, may readily alter or depress respiration and give rise to coma by interfering with the function of the reticular formation. As a result of coma the tongue falls back as the lower jaw sags, and respiration may become obstructed as well as depressed. Additional factors in the development of obstruction are the accumulation of vomitus, blood, and secretions in the mouth and pharynx. The more severe the obstruction the more stertorous will be the breathing.

Stertor.—At this stage it will be of interest to consider the mechanism of stertor. In this condition breathing is noisy and reminiscent of loud snoring. Inspiration is laboured and accompanied by obvious contraction of the accessory muscles of respiration, and the cheeks are indrawn. Expiration is slower and probably incomplete on account of the obstruction. This results in the chest being held in a state of expansion. The face appears to be congested and the neck veins to be engorged. The noisy breathing may be due to two causes. The first is that mucus lying on the vocal cords may cause them to vibrate, as movement of the mucus occurs during the respiratory excursion. The second is that the tongue may be in close contact with the soft palate, and a number of rapid "make and break" contacts between these two structures will contribute to the noise.

Factors in Respiratory Obstruction

The factors giving rise to obstructed or depressed respirations, and leading to inadequate blood oxygenation and carbon dioxide excretion in unconscious patients, appear to fall into two categories—namely, sudden loss of consciousness and prolonged coma.

1. **Sudden Loss of Consciousness.**—The causes of coma of sudden onset that are relevant to the present discussion include head injury, cerebrovascular accidents, and pressure cones from acutely raised intracranial pressure. Respiration may be stertorous. When unobstructed respiration has been difficult to maintain by posture and by an airway inserted in the mouth, and the coma has been of severe degree, an endotracheal tube has been passed with the aid of a laryngoscope. A striking feature in these cases has been that, whereas in the nose, mouth, and pharynx there has been only a small quantity of saliva, the larynx and upper end of the trachea have been filled with white frothy tenacious fluid. The laryngeal mucosa has appeared congested. The source of this fluid is of interest. Aspirated saliva might be one source. When the mouth and pharynx have appeared relatively dry, and laryngoscopy performed within a very few minutes of the onset of coma has shown its presence, then it would appear that some other explanation is required.

In a recent case of sudden loss of consciousness in a previously fully alert patient suffering from a tumour of the fourth ventricle, active steps were taken at once to prevent aspiration of saliva until the trachea was intubated. Death followed shortly after this. Post-mortem examination revealed frothy white mucus filling the bronchial tree. Similar post-mortem findings have been demonstrated in two cases in the present series. Altschule (1954) lists acute cerebral lesions among the causes of pulmonary oedema. In the cases under consideration the lungs were not oedematous and were well aerated. The fluid was contained in the bronchi. Two possible explanations for this accumulation of fluid present themselves. The first is that there is a reflex secretion from tracheo-bronchial mucous glands, of central or brain-stem origin. The presence of subarachnoid blood in the posterior fossa of cats has been found to result in mucus secretions in the bronchial tree (J. C. Seymour, 1956, personal communication). Cameron (1948) has found that placing human thrombin and fibrin in the fourth ventricle of rabbits causes secretions to collect in the trachea and bronchi, although he attributes this to pulmonary oedema. An alternative explanation is that an abnormally high negative intrathoracic pressure in the inspiratory phase of obstructed respiration causes the ducts of these glands to discharge their secretions into the trachea and bronchi.

2. **Prolonged Coma.**—The morbid processes whereby insufficient pulmonary ventilation leads to hypoxia and hypercapnia in cases of prolonged unconsciousness are more complex than in the former group. Again there are the two primary factors of respiratory depression and obstruction. Additional factors are the loss of the cough and swallowing reflexes, and the accumulation of saliva in the mouth and pharynx, and, finally, pulmonary oedema.

Obstruction of breathing is again brought about by the tongue falling back. Over a long period of time there is a greater risk of aspiration of saliva, particularly as the swallowing reflex is often lost. The secretion of mucus into the trachea becomes less obvious and is masked by aspirated saliva and by the frequent development of a broncho-pulmonary infection with the production of a copious mucopurulent sputum. The inability to cough adequately causes these fluids to be retained in the bronchi. The high negative pressure occasioned by obstructed breathing during the inspiratory phase may cause the more peripheral bronchi to become blocked. Areas of segmental pulmonary collapse ensue, and the ground is prepared for a severe pulmonary infection. In the presence of shallow breathing the tidal volume becomes dangerously lowered. The oxygen tension in the alveolar air falls, and the carbon dioxide tension rises.

It becomes apparent that the blood oxygen must fall and the blood carbon dioxide rise. After a period of respiratory stimulation, if these changes pass beyond a certain level then respiration will become depressed.

The effect of a poor respiratory excursion and obstructed respiration upon the circulation will initially be an inadequate venous return to the right side of the heart. This will cause a raised systemic venous pressure, and a particularly serious aspect will be cerebral venous congestion and perhaps cerebral oedema. Either the primary intracranial lesion may be accentuated or recovery from it delayed. It has been shown by White *et al.* (1942) that hypoxia increases cerebral intercellular fluid, and that hypercapnia causes cerebral venous congestion. These factors may inhibit brain-stem function, and by the further depression of respiration a vicious circle becomes established.

Pulmonary Oedema

Altschule (1954) and Hayward (1955) have pointed out that anoxia increases capillary permeability, and may cause pulmonary oedema. Another possible cause for this condition in cerebral cases is an abnormally high negative intrathoracic pressure accompanying the inspiratory phase when breathing is obstructed. When respiration is obstructed the pressure in the pulmonary veins and capillaries may be greater than the osmotic pressure of the blood; transudation may then occur into the pulmonary interstitial tissue and alveoli. This fluid may have a high protein content and, further, draw fluid from the blood into the alveoli.

In the present series gross pulmonary oedema was found at post-mortem examination only when coma was prolonged. In Case 8, a woman suffering from a high cervical cord lesion, respiration was shallow for a number of days, and the cough reflex was inadequate to clear her bronchi of retained secretions. Coma gradually developed, presumably from long-continued hypoxia.

From the foregoing observations it becomes clear that, in addition to maintaining a clear airway during coma, it is essential to ensure that there is a satisfactory respiratory excursion. This is necessary not only to prevent circulatory failure but also to provide for adequate gaseous exchange in the lungs. In certain cases intermittent positive-pressure respiration will be of help.

The position of the unconscious patient may tend further to diminish respiratory excursion and increase cerebral venous congestion. It is a common practice to keep the patient horizontal or even tilted head downwards to encourage secretions to drain from the lungs into the mouth, from which they can be removed by suction. Some authors believe that it is wrong to elevate the head and shoulders if the coughing mechanism is defective, for fear this position will increase pulmonary hypostasis and embarrass respiration still further. Elevation of the head and shoulders, however, has the merit of allowing a greater respiratory excursion, encouraging the return of blood to the right side of the heart from the head, and reducing cerebral venous congestion. It would be unwise to adopt this position in acute head injuries, which are often complicated by bleeding into the nasopharynx or mouth and by vomiting; there is a real danger of these fluids being aspirated. Shock would be another contraindication. Elevation of the head and shoulders becomes indicated in the group of cases with prolonged coma when these complications are often absent.

It is rare that the cough reflex is completely lost. If a tracheostomy has been established, the aspiration of secretions may be prevented by a cuffed tube. Mechanical suction, which will stimulate coughing as well, will be a more efficient means of clearing the bronchial tree than the physiologically disadvantageous position of lowering the head below the heart level.

Summary

The importance of maintaining a clear airway in comatose patients is again stressed. When consciousness

is suddenly lost this may be achieved by placing the patient in a horizontal position and inserting a Magill airway into the mouth. If this is inadequate the trachea may be intubated through the mouth or nose.

If coma is prolonged there is usually a coincidental depression of respiration and of the coughing and swallowing mechanisms. Secretions may be aspirated and retained in the smaller bronchi. The blood oxygen tension falls and carbon dioxide tension rises. Secondary circulatory changes occur, and these may lead to cerebral venous congestion and oedema, and to pulmonary oedema. Tracheostomy is of value in these cases, as it halves the dead space air and allows for ease in the mechanical suction of the trachea and bronchi. A cuffed tube is advantageous in preventing the aspiration of secretion from the pharynx. The raising of the head and shoulders allows a fuller respiratory excursion by reducing the weight of the abdominal contents on the diaphragm. Venous return to the heart is thereby improved; the danger of cerebral venous congestion is reduced.

The source of the fluid accumulations in the lungs is discussed. When consciousness is suddenly lost from acute intracranial lesions it is believed that the fluid is secreted by the tracheo-bronchial mucous glands. The possible mechanisms for this are discussed. When coma is prolonged the fluid is thought to be due to the same secretions, but additional factors are the development of a purulent broncho-pulmonary infection and, terminally, pulmonary oedema.

It is emphasized that in cases of coma tracheostomy should be an elective procedure, and its performance should not be delayed until the patient has become cyanosed or has begun to develop peripheral circulatory failure. Selected case histories are described from a series of 16 patients in whom this operation was performed.

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King Edward's Hospital Fund for London Hospital Catering Advisory Service have issued a second edition of their memorandum entitled "General Hospital Diets." This is a guide to the cost of feeding patients in general hospitals based on the average wholesale and retail prices of 1955. The new edition contains a section on the extra cost of feeding maternity patients—about 3s. 6d. a week each. 36 weekly menus are given, three for each month of the year, the first set being more expensive than the other two. 662 recipes are included at the end of the book, giving ingredients for 100 portions. Copies of the booklet are obtainable from King Edward's Hospital Fund for London, 10, Old Jewry, E.C.2, price 5s., post free.