PRESENT STATUS OF TRACHEOTOMY

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Introduction:

The performance of tracheotomies has become commonplace in recent years. In fact, one can readily name over fifty different medical and surgical conditions for which the operation is now recommended. For decades tracheotomy has been performed in patients who have shown high respiratory tract obstruction and this operation was recognized as the only satisfactory means of establishing an airway. In spite of this absolute indication, the operation has been considered dangerous and fraught with hazards and was advocated in many instances only as a lifesaving measure. When one considers that tracheotomy was usually performed in desperately ill patients and often done hastily and without proper illumination and suction, one understands why the operation was regarded in this light. There is rarely a physician, whether a general practitioner or specialist, who at one time or another in his medical career will not encounter a patient who needs this operation. The recognition of the fact that accumulation of secretions in the lower respiratory tract causes obstruction to pulmonary ventilation which leads to primary lung pathology and secondary asphyxial changes within the body constitutes the main factors responsible for the changing concepts of tracheotomy. The medical literature in recent years abounds with reports of the successful use of tracheotomy and it is to these authors¹⁻²⁵ that the undersigned gives full credit and acknowledgement not only for the help rendered in the treatment of patients but also in the preparation of this manuscript.

It is the purpose of this discussion to point out the rationale for the widespread use of tracheotomy and to enumerate some of the routine procedures used in the performance of the operation, to emphasize salient complications and finally to outline the postoperative care recommended for these patients.

Indications for tracheotomy:

The indications for tracheotomy in high respiratory tract obstruction are usually well defined in the child or adult. This is particularly true if the patient is seen when the classical signs are present. Tracheotomy is usually performed in these cases without hesitation. However, if patients with acute high respiratory tract obstruction are seen relatively late, they may present signs of exhaustion and partial asphyxiation. In such patients although tracheotomy should be performed immediately, it is often unduly delayed because the signs of exhaustion and asphyxiation may be misleading.

Local pathological changes within the lungs are brought about by a patient's inability to cough secretions from the lower respiratory tract. It is estimated that the normal individual swallows between 1200 and 1500 cc. of mucus and saliva during a twenty-four hour period. In addition the cilia of the tracheobronchial tree propels secretions along the trachea until they are normally expelled to the pharynx by coughing. If these normal mechanisms are interfered with by disease, new growth, trauma, etc., the patient will undoubtedly slowly but surely drown in his own secretions from asphyxiation. Not only may the patient aspirate saliva from the pharynx but vomitus is frequently aspirated as well. Filling of the alveolar spaces, bronchioles and bronchi

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with thick viscid secretions tends to interfere with pulmonary ventilation and gas exchange across the alveolar membranes. The patient's vital capacity will fall if the secretions are sufficient and if the accessory mechanisms of respiration are interfered with such as occurs in crushing injuries of the chest. Provided the patient has the strength to continue to live, other local pathological changes can occur in the lungs such as atelectasis, pneumonia, abscess, cavitation and fibrosis.

In addition to the local changes that occur within the lungs, widespread changes occur within the body and these changes will be considered now. Since the accumulation of secretions within the tracheobronchial tree and alveoli prevents exchange of oxygen across the alveolar membrane, anoxemia develops. If anoxemia develops rapidly, there is rapid loss of consciousness. A good example of this is noted when an aviator ascends too rapidly. Actually in this instance the supply of oxygen in the inspired air is diminished. When secretions accumulate within the lungs, there is a reduction in transference of available oxygen to the arterial blood. Lack of oxygen in the arterial blood, if not too great, may lead to an increased rate of breathing and increased pulmonary ventilation in an attempt for the body to compensate for this lack. However, if anoxemia is allowed to go unchecked, there is increased capillary permeability associated with irreparable damage in the central nervous system, heart muscle and other organs, and pulmonary edema.

Concomitantly with anoxemia, hypercapnia develops. The exchange of carbon dioxide across the alveolar membrane is regulated principally by the partial pressure gradients of the venous carbon dioxide and the alveolar carbon dioxide. Normally, this transference goes on rapidly and successfully because of the gradient of the two gases between the blood and the alveolar spaces. However, when secretions within the lungs interfere with this gradient, carbon dioxide is not transferred and accumulates in the arterial blood. Excess of arterial carbon dioxide is a powerful stimulator of the breathing mechanism via the respiratory centers. In contrast to oxygen lack, increased accumulation of carbon dioxide in the blood leads to headaches, restlessness, confusion, apprehension, narcosis, and to marked respiratory depression, even to failure of the respiratory centers and circulatory collapse.

As respiratory anoxemia and hypercapnia progress, respiratory acidemia also develops. When the hydrogen ion concentration of the blood tends to rise, as it does in asphyxia, pulmonary ventilation is increased in an attempt to eliminate excess carbon dioxide from the blood. Alveolar carbon dioxide tension regulates the amount of carbonic acid in the arterial blood, so if the alveolar carbon dioxide tension is shifted above 40 mm. of mercury, this increase of tension is reflected directly in the arterial blood as carbonic acid both in the free and the combined forms. This accumulation tends to shift pH of the blood towards the acid side. In order to combat this shift of blood pH, pulmonary ventilation is increased and the kidneys conserve the bicarbonate ion.

In summation, it may be stated that lower respiratory tract obstruction from secretions which cannot be coughed out by an ill patient leads first to local changes within the lungs, and to secondary widespread body changes from respiratory asphyxia. Excessive secretions within the lungs influence the exchange of oxygen and carbon dioxide across the alveolar membranes. The central nervous system cannot withstand the lack of oxygen for long periods of time without irreparable damage. This also applies to nervous tissues in general, to the heart muscle, the kidneys, the liver, and other body organs. The body tends to reverse these changes by increasing the rate and depth of respirations. However, if this cannot be done and asphyxia continues, there is a depression of the respiratory center which in turn decreases the respiratory efforts and pulmonary ventilation, which results in further lack of oxygen, accumulation of carbon dioxide, and shift of the hydrogen ion concentration.

In addition to these effects already noted, the increased efforts of the patient to breathe against lower respiratory tract obstruction causes increased intrathoracic venous pressure which in turn is reflected as increased intracranial venous pressure. Increased intracerebral venous pressure slows circulation which increases the carbon dioxide content of the blood, shifts the hydrogen ion concentration, and produces fur-

ther lack of oxygen. These changes tend to produce increased capillary permeability, exudation of fluid, increased intracranial pressure, cerebral edema, and further depression.

Thus in the process of respiratory asphyxiation, there are many changes occurring in the body that tend to prevent the the adequate supply of oxygen to the tissues. On the other hand, the body is attempting to make compensations to combat these changes and if the respiratory obstruction is relieved early, these changes are entirely reversible. If the obstruction is not relieved, all phases of respiratory compensation mechanisms will be overshadowed and asphyxiation and death will supervene. Tracheotomy should be performed early to prevent asphyxia or to combat it if it has developed. Unfortunately, there are no satisfactory laboratory tests to aid the clinician in determining exactly when tracheotomy should be done in a patient, so the clinician must rely on his experience and judgment. A safe rule to follow is to perform a tracheotomy when it can reasonably be predicted that some time during the course of the patient's illness, lower respiratory tract obstruction will develop. Tracheotomies should be performed in other patients who already have developed the inability to cough secretions out of the lower respiratory tract and who are unable to swallow their own secretions.

It is not within the realm of this paper to list all of the diseases that require tracheotomy, but rather to point out some of the diseases in which tracheotomy has been efficacious in preventing asphyxia.

Patients with bulbar or spinal poliomyelitis, or a combination of the two, may require tracheotomy. The tracheotomy should be done early in the course of the disease and frequently on a prophylactic basis. This dictum applies to a patient whether in need of respirator care or not. If a patient with poliomyelitis shows progressing paralysis which prevent the swallowing of secretions and the coughing of secretions from the chest, then tracheotomy should be performed early. Only rarely can conservative methods be relied on for the continued mechanical removal of secretions in these progressively ill patients. Lowering of vital capacity in a patient with poliomyelitis is also an added indication for tracheotomy. The body changes from asphyxia may be the cause of death rather than the virus infection in these patients.

Comatose patients may require tracheotomy, and often this procedure may be lifesaving in itself. This statement applies to patients who are in a coma from any cause over long periods of time. Thus patients showing barbiturate poisoning, eclampsia, tetanus and botulism infections, head injury, brain tumor, brain abscess, cerebrovascular accidents, and others fall in this category. The lower respiratory tract in these patients must be protected at all costs and tracheotomy appears to be the procedure of choice.

Patients with traumatic injuries about the face, jaws and neck may have sufficient upper and lower respiratory tract obstruction to require tracheotomy.

Tracheotomy has been used successfully in patients with crushing injuries of the chest to help clear the tracheobronchial tree of secretions and blood. In these patients tracheotomy further helps to alleviate pain, lessen mediastinal flutter, and reduce paradoxical motions of the thoracic walls. Performance of tracheotomy is not contraindicated even in those patients with pneumothorax, pyothorax, or hemothorax.

Tracheotomy may be a lifesaving measure in patients who have undergone thyroid surgery and show the complications of recurrent laryngeal nerve paralysis or post-operative bleeding.

Patients with inhalation burns of the tracheobronchial tree may have enough edema of the mucosa to require tracheotomy; as do some patients with chemical burns in the same region.

It is a common practice in major surgical operations of the head and neck to perform tracheotomies prophylactically, not only to alleviate impending high respiratory tract obstruction, but to aid in clearing the lower respiratory tract of secretions.

Operative techniques:

Conservative methods directed at removing secretions from the pharynx and lower respiratory tract should not be used for long periods of time and should definitely not

be used to the point of causing excessive trauma to the larynx, hypopharynx, trachea, and bronchi.

When possible, a patent airway should be maintained by a bronchoscope or endotracheal tube during the performance of the operation since this often prevents serious complications. During tracheotomy some patients are able to maintain sufficient airway, while others may have to have breathing continued by mechanical means during the operation. This is done through an endotracheal tube by the anesthetist. These patients may require an extremely high percentage of oxygen insufflation during the procedure.

When possible, local anesthesia is the agent of choice. However, in children and in some adults, inhalation anesthetics such as cyclopropane, ethylene, or nitrous oxygen are used.

If an emergency tracheotomy must be performed, it can often be done satisfactorily by opening the trachea directly through the neck tissues. If this is not feasible, then opening of the cricothyroid membrane should be done to save the patient's life. Later when the patient's condition permits, the tracheostomy opening should be moved to the area of the 2nd and 3rd tracheal rings.

The horizontal incision has had many advocates in recent years, although the vertical incision perhaps would serve the novice better and produce a more favorable cosmetic result. The isthmus of the thyroid gland as a rule must be clamped, cut, and ligated; in other instances it may be pushed either upwards or downwards. Prior to entering the trachea, all bleeding is controlled and frequently in an adult 2 cc. of 5% cocaine hydrochloride solution is injected directly into the tracheal lumen to help abolish cough reflexes. In an adult, a window is cut out of the cartilage of the 3rd tracheal ring thus creating an opening into the trachea slightly smaller than the tracheotomy tube to be inserted. In infants and children, however, a vertical incision is made in the 2nd and 3rd tracheal rings and no cartilage is removed. In the course of the operation, care is taken not to open the tissues of the neck widely so as to protect the superior mediastinum from emphysema and infection. Tracheal and bronchial secretions are removed by suction and during this maneuver coughing is produced even in an anesthetized or comatose patient. During the coughing, the wound is inspected for spontaneous hemorrhage. An appropriate sized tracheotomy tube is inserted into the trachea and the tube is held securely in place by tying cloth tapes about the neck. The wound is not sutured and may be packed lightly with gauze if desired.

Patients who require respirator care and who need a tracheotomy are intubated, removed from the respirator and the operation is performed while forced respirations are being carried out by the anesthetist. After the tracheotomy tube is inserted into the trachea, forced respirations are continued manually through the tracheotomy tube until the patient can be returned to the respirator.

Complications:

During the performance of tracheotomy, hemorrhage may be difficult to control, particularly if an emergency tracheotomy is being done. In this latter circumstance, it is better to attempt to control the hemorrhage after the tracheotomy tube has been inserted into the trachea. During tracheotomy if the patient struggles or fights for air against a closed airway and the tissues of the neck are open, the patient may develop mediastinal emphysema and uni- or bilateral spontaneous pneumothoraces. This complication can be avoided if the patient's airway is kept patent during the operative procedure. In general, the 1st tracheal ring is not disturbed during tracheotomy unless the patient is to have a laryngectomy following tracheotomy, and then it is permissible to use the 1st tracheal ring as a site for tracheotomy.

In young infants and children, the pleural domes may expand into the tracheotomy wound and cover the trachea and must be pushed aside to avoid rupture of the parietal pleura.

Probably the most frequent complication following tracheotomy is subcutaneous and mediastinal emphysema. Subcutaneous emphysema can be extensive and may involve the subcutaneous tissues of the entire body. Pneumothorax may develop uni-

laterally or bilaterally and if it is the simple type it can be treated by aspiration of air from the pleural spaces. However, if tension pneumothorax develops, underwater drainage has to be instituted in order to re-expand the affected lung. Secondary hemorrhage in the tracheotomy wound can be serious, particularly if the blood tends to gravitate into the tracheobronchial tree. An improperly fitted tracheotomy tube may cause ulceration of the trachea even to the point of rupturing a large blood vessel.

Expulsion of the cannula from the trachea by coughing soon after completion of tracheotomy can cause death if not re-inserted into the trachea promptly. Tracheotomies jeopardizing the integrity of the cricoid and thyroid cartilages may cause later stenosis.

When a patient is ready to be decannulized, the wound should not be primarily sutured, and if it is done illadvisedly can lead to subcutaneous emphysema, mediastinal emphysema, and pneumothorax. This statement does not apply to fistulae that develop at the site of the tracheotomy wound after enough time has elapsed for the mediastinal tissues to be sealed off. In this instance, plastic closure of the fistulae can be done safely and satisfactorily. In fact, some fistulae can be closed by the endoscopic removal of granulation tissue from the trachea.

Aftercare of the tracheotomy patient:

The recently tracheotomized patient should not be returned to the ward unless there are trained personnel to carry on the postoperative care. Nurses are instructed to change and cleanse the inner tracheotomy tube each hour without disturbing the outer tube. The nursing staff suctions the patient's cannula only to the depth of the tracheotomy tube and is further instructed not to suction the trachea unless an emergency arises. The doctors in charge of the patient are expected to keep the tracheobronchial tree free of secretions by suctions, forced coughing, postural drainage, irrigations, etc. Moisture in the form of cold vapor is usually supplied and is supplemented by a wetting agent when indicated. The vapor and wetting agent can often be supplied by oxygen in a tent or croupette. The outer tracheal cannula is not changed until the 3rd postoperative day. Nourishment of the patient is supplied either orally or parenterally. Specific antimicrobial therapy is given. Finally, a complete set of tracheotomy instruments is kept at the patient's bedside.

Summary:

The increasing indications for tracheotomy have been pointed out. Teamwork between members of the medical and nursing staffs is essential. Indications for tracheotomy are usually clean-cut in high respiratory tract obstruction, whereas the indications for tracheotomy in lower respiratory tract obstruction are less well defined. In the performance of a tracheotomy there are greater advantages and fewer complications in the planned, orderly procedure as contrasted with the emergency operation.

Conclusion:

Early or even prophylactic tracheotomy should be recommended in selected patients who are unable to cough secretions from the lungs, in order to avoid local pathological pulmonary changes and secondary physiopathological changes within the body thereby reducing the effects of respiratory asphyxia as an added factor complicating the primary disease.

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Present Status of Tracheotomy

by Walter P. Work, M. D.

近年では気管切開を行う事は平凡な事になつて了つてゐる。實際、今日気管切開が推奨されている内科的、外科的症候は優に 50 種以上も挙げる事が出来る。上部気道閉塞のある患者に対して此所数十年来気管切開が行われて来た。而も此の手術は氣道を確立する唯一の満足すべき手段であると考えられていた。此の絶對的適応にも拘らず気管切開は危険で有害であると考えられ、多くの例に於てただ救急処置としてのみ推奨されて来た。気管切開は通常重症の患者に、而も屢々急いで、十分な照明も吸引もせずに行われていた事を考えると、此の手術が何故危険であると考えられたかが分るのである。一般診療医であると、専門医であるとを問わず大抵の医師は生涯に何時かは気管切開を必要とする患者に遭遇するであろう。下部気道内の分泌物淤溜が、一次的肺病変や引いては体内の窒息性変化に至る肺の換氣障礙を起す事實を認めた事が、気管切開の概念が変化している主要な因子となつてゐる。近年の医学文獻には気管切開の成功例の報告が多く見られ、此の論文の著者は患者の治療のみならず、此の原稿を準備する際に於ても援助を与えられた事に対して 1-25 の著者に満腔の信頼と、感謝を捧げるものである。本論文の目的は、気管切開が広く行われている事に対して理論的根拠を与え、又日常用いられる手術法の幾つかを列挙し、著明な合併症を強張すると共に、最後に患者に対する推奨すべき術後処置の概略を述べる事にあるのである。

気管切開の適応：

上部気道閉塞に際しての気管切開の適応は、子供でも成人でも通常明確である。此の事は患者が典型的な症状を示す場合は特に明確である。此等症例では通常躊躇なく気管切開が行われる。然し乍ら、若し、急性の上気道閉塞を有する患者が比較的時期が経つてから現われた場合、患者は消耗と部分的窒息の症状を呈しているかも知れない。此の様な患者に於ては直ちに気管切開を行うべきであるが、消耗と窒息の症状のために誤診する事があり得るので、気管切開を行うべき時期が屢々不当に遅れるのである。

患者が下部気道から分泌物を咯出する事が出来ない為に部分的肺病変が起る。正常個体は 24 時間に 1200-1500 cc の粘液と唾液を嚥下すると概算されている。その上正常の状態では咳嗽によつて咽頭へ咯出される様に気管支の顫毛が分泌物を気管の壁に沿つて推し出している。若し此の正常の機能が腫瘍、外傷、其他の疾患のために侵されると、患者はきつと、徐々にではあるが確実に窒息のために患者自身の分泌物に溺れる様になるであろう。患者は咽頭から唾液を吸い込む事があるが、そのみならず、屢々同様に吐物も吸引する。肺胞腔、小気管支、気管支が濃い粘潤な分泌物で満たされると、肺換氣や肺胞膜を通してのガス交換が妨げられる様になる。分泌物が多量であつたり、胸部の圧挫による外傷の際の如く補助呼吸の機能が障害されると、患者の体力は低下するであろう。若し患者に生延びる力があると、無氣肺、肺炎、膿瘍、空洞形成、纖維増殖等の様な、別の局所的肺病変が起り得る。

肺臓内に起る局所病變の他に体内各所に病變が起る。此所に於ては此等の病變に就いて考察して見よう。

気管、気管支や肺胞内に分泌物が蓄積すると、肺胞膜を通しての酸素交換が妨げられるので、血中酸素欠乏症が起る。血中酸素欠乏症が急速に起ると、速かに意識が喪失する。此の好例は飛行士が急速に上昇を試みた場合に見られる。事實此の例では吸氣中の酸素が減少している。分泌物が肺内に蓄積すると動脈血中への酸素移行が減少している。動脈血中の酸素欠乏は高度でないにしても之を代償するために呼吸数と肺換氣の増加が起り得る。然し乍ら血中酸素欠乏をそのまま放置すると中枢神経系や心筋、其他の臓器の不治の障害と共に毛細管透過性の増加と肺水腫が見られる。

血中酸素欠乏に附随して炭酸ガス蓄積が起る。肺胞膜内外の炭酸ガス交換は主として静脈血中、及び肺胞

内の炭酸ガス分圧の差によつて規定される。正常者に於ては両者間の分圧差によつて此の移行は速やかに且十分に行われるものである。然し乍ら肺臓内の分泌物が此の分圧差による移行を妨げると炭酸ガスの移行が行われず、動脈血中に炭酸ガスが蓄積する。動脈血中の過剰の炭酸ガスは呼吸中枢を経て呼吸機能を強く刺激する。酸素欠乏に比して血中の炭酸ガスの著しい蓄積は、頭痛、不安、昏迷、昏恍、昏睡や又高度の呼吸抑制、更には呼吸中枢の麻痺、循環経路もひき起すに至る。

呼吸性の血中酸素欠乏と炭酸ガス増加とが加わるにつれて呼吸性アシドーシスも又進行する。窒息の時の様に血中の水素イオン濃度が高くなると、血液から過剰の炭酸ガスを除くために肺換気が増加する。肺胞内の炭酸ガス張力は動脈血中の炭酸の量を規定する。それ故若し肺胞中の炭酸ガス張力が 40mm Hg 以上になると、この増加は動脈血中に遊離、及び結合状態の炭酸として直ちに反映する。此の蓄積は血液 pH を酸性側に變化させる。此の血液 pH の變化に打勝つために、肺換気は増加し、又腎臓は重炭酸イオンを保存する様に働く。

総じて患者が分泌物を咯出出来ないで下部気道の閉塞が起ると、先づ肺臓内の局所變化が起り、ひいては窒息の為に身体各所の変化が起ると言えるであろう。肺臓内に過度に分泌物が蓄積すると、肺胞膜を通しての酸素と炭酸ガスの交換に影響を及ぼす。中枢神経系は酸素欠乏に対して長い間耐える事が出来ずに不可逆性の障礙を起す。此の事は一般に神経組織、心筋、腎臓、肝臓及び其他の臓器に就いても言える事である。人体は此等の変化に対して呼吸の数と、呼吸の深さを増す事に依つて對抗しようとする。然し之が出来ないで窒息状態が持続すると、呼吸中枢の抑制が起り、次第に呼吸機能が低下し、又肺換気も減少する。その結果更に酸素欠乏が高度となり、炭酸ガスが蓄積し、又水素イオン濃度の變化が甚しくなる。

既に述べた此等の結果に加えて下部気道閉塞のために患者の呼吸への努力が増すと、胸腔内の静脈圧が上昇し、引いては頭蓋内静脈圧の上昇が起る。頭蓋内静脈圧が高くなると循環速度が低下し、その結果血液の炭酸ガス含量が増し、水素イオン濃度が變化して、更に酸素欠乏を助長する。此等の變化によつて毛細管の透過性の増大、水分の滲出、頭蓋内圧上昇、脳の浮腫、衰弱の増加等が起る。

斯の如く気道性窒息の経過中に組織への適当な酸素供給を障害する様な種々の變化が体内に起る。一方人体は此等の變化に打勝つて代償しようとしている。若し此の呼吸障害が早期に除かれれば、此等の變化は全く恢復するが、若し除かれなければ呼吸の代償作用の全段階に悪影響を及ぼし、続いて窒息と死が起るであろう。窒息を防ぐために、或は窒息が進行していたなら之を除くために早期に気管切開を行うべきである。不幸な事には患者に気管切開を行うべき時に確実な之を決定するのに医師の助けとなる様な満足な検査法がないのである。それ故医師は、自身の経験と判断とに頼らなければならない。無難な標準はといへば疾患の経過中に何時かは下部気道の閉塞を起しそうだと予知出来る時には気管切開を行うという事である。其他患者が既に下部気道から分泌物を咯出出来ない様な状態になつていたり、分泌物を嚥下する事が出来ない状態の時は気管切開を行うべきである。本論文中に気管切開の必要な全疾患を挙げる事は紙数が許さないが窒息を予防するのに之が有効な疾患の幾つかに就いて述べて見よう。

延髄性或は脊髄性小児麻痺或は兩者の合併した場合は気管切開が必要であろう。此の場合気管切開は疾患の早期に行うべきで、屢々予防的意味に於て行うべきである。この事は respirator (所謂鉄の肺) を必要とする患者についてもそうでない者についても言える事である。小児麻痺の患者に分泌物の嚥下や咯出が出来ない様な麻痺が次第に進行している場合には、早期に気管切開を行うべきである。此等漸次悪化する患者に分泌物を機械的に持続吸引するという保存的処置に頼れる場合は極く稀である。小児麻痺の患者の元気が衰える場合も又気管切開の適応症である。此等の患者にとつて Virus 感染よりも寧ろ窒息による變化の方が死因となる。

昏睡状態の患者に気管切開が必要な事もあり、屢々此の手術はそれ自体救急的な処置となり得る。此の事は如何なる原因によるものでも長い間昏睡状態にあるものについて当てはまる事である。それ故バルビタール剤中毒、子癇、破傷風、ボツリヌス菌感染症、頭部外傷、脳挫傷、脳膿瘍、脳血管障礙、其他の疾患は此のカテゴリーに入るものである。此等の疾患にあつては是非とも下部気道閉塞を防止せねばならないが、気管切開は之に対して良好な処置であると考えられる。

顔面、頸、頸部の外傷を有する患者にも気管切開が必要な程に上部及び下部気道閉塞が起り得る。胸部の圧迫外傷を有する患者に気管気管支から分泌物や血液を除去するのに気管切開が有効に用いられて来た。此等の患者には更に疼痛を軽減したり、縦隔振動を少くしたり、胸壁の奇異運動を減ずるのに有効である。気管切開は気胸、膿胸、血胸等を有する患者に対しても禁忌ではない。甲状腺の手術を受けて反回神経麻痺、或は術後出血等の合併症が有る患者には気管切開は救急処置となり得る。

吸入による気管、気管支の火傷を有する患者には気管切開を要する程の浮腫が粘膜に起ってくる。同様の事が気管気管支の化学的火傷の際にも起る。

頭部や頸部の大手術の際には独に危急な上部気道閉塞が起るのを防ぐためばかりでなく、下部気道の分泌物を除去するためにも気管切開を予防的に施行する事が広く行われている。

手 術 法：

咽頭及び下部気道から分泌物を除くために保存的療法を長期間行うべきではないし、又喉頭、下咽頭、気管、気管支等に対して過度の外傷を起す様な所には絶対に保存的療法を行ってはいならない。気管切開を施行する間、若し可能な場合には、気管支鏡或は気管内チューブを挿して気道を開いておくべきである。何故なら、かくする事によつて屢々重篤な合併症が防げるからである。気管切開を行う間或る患者は十分気道が開いているが、一方他の患者は術中機械的方法で呼吸を続けさせなければならない者もある。之は麻酔医が気管内チューブで行う。此等の患者には術中非常に高濃度の酸素送入が必要であるかも知れない。

可能な場合には局所麻酔が優れた方法であるが、子供とか成人の或者に対してはサイクロプロペン、エチレン、或は笑気等の吸入麻酔剤が用いられる。

救急的な気管切開を行わねばならない時は、屢々頸部組織を通して直接気管を開く方法を行つて満足な結果が得られる。之が行えない場合には患者の生命を助ける為に輪状甲狀膜切開を行わねばならない。後になつて患者の一般状態が許せば、気管切開口を第2及び第3気管輪の部に移すべきである。恐らく垂直切開の方が、初心者にとつて行い易く、又審美的にも良いであろうが、最近水平切開を推奨する人が多い。甲状腺峡部は原則として鉗子で締めて切断し、結紮せねばならない。然し他の場合には上方或は下方へ圧排しても良い。気管に入る前に止血を完全に行い、又屢々成人に於ては咳嗽反射を除くために5%塩酸コカイン2ccを直接気管腔内に注入する。成人では第3気管輪の軟骨を窓状に切除する。かくして、挿入するカニューレよりも少し小さい気管切開口を作る。然し乍ら乳児や小児では、第2及び第3気管輪に垂直切開を行い、又軟骨は除去しない。

手術中は上部縦隔洞の気腫や¹感染を防ぐために頸部組織を余り広く開かない様に注意する。気管、気管支の分泌物は吸引して除去する。この際麻酔下にある患者、或は昏睡状態の患者に於ても咳嗽を起させる。咳嗽中に創面からの自発的出血の有無を良く観察する。適当な大きさのカニューレを気管に挿入してその部にきれの紐でしつかり固定する。創は縫合せず、又必要なら軽くガーゼを詰めてもよい。respiratorが必要である患者に気管切開を行わねばならぬ際には、挿管を行つてからrespiratorから出し麻酔医によつて人工呼吸を行いながら気管切開を行う。気管内にカニューレを挿入した後は再び患者をrespiratorに入れる迄カニューレを通して手で人工呼吸を続ける。

合 併 症：

気管切開を行つている際出血が止め難い事があり得る。特に緊急な気管切開を行つている場合にそうである。後者の場合には、気管内にカニューレを挿入してから止血を行う方がよい。術中患者が気道閉塞のために空気を渴望してもがきながら努力呼吸をしている場合、頸部の組織が開かれていると、縦隔気腫や一側或は両側の自然気胸を起す事がある。この合併症は術中気道を確保しておけば除く事が出来る。一般に第一気管輪に対しては後に喉頭摘出を行う場合を除き侵襲を加えないが、喉頭摘出を行う場合には第一気管輪に切開を加えてもよい。

乳幼児では肺炎部肋膜が気管切開創内迄膨脹して来て気管にかぶさる様な事がある。此の場合は壁側肋膜

が破れない様にするために、わきへ圧排しなければならない。

気管切開後の合併症中最も多いものは恐らく皮下や縦隔の気腫であろう。皮下気腫は高度に起る事があり、全身の皮下組織に起る事もある。気胸は一側或は両側に起る事があるが、[若し単純なものであれば、肋膜腔から空気を吸引する事によつて治療出来る。然し若し緊張気胸を起した場合には罹患肺の再膨脹を促すために水を通しての排気を行わねばならない。次に気管切開創の出血が重大である。特に血液が気管や気管支へ下つて行きそうな時には尚更である。カニューレの挿入が不適当だと気管壁に潰瘍を形成するし、又時にはこのために大きな血管が破れる事さえある。

気管切開が完了した直後に咳嗽のためにカニューレが気管からぬけ出すと、すぐに入れ直さないと死亡する事がある。気管切開の際に輪状軟骨や甲状軟骨を傷つけると後に狭窄を起す事がある。カニューレを抜去しても良い時期が来ても、気管切開創を一次的に縫合すべきではない。やたらに縫合すると皮下気腫、縦隔気腫、気胸等を起す事がある。この事は縦隔組織が閉鎖される迄の時期が経過してから気管切開孔に対しては当てはまらない。此の場合には、縫合を行つても大丈夫であるし、満足な結果が得られる。事実或る例に於ては、内視鏡で気管の肉芽組織を除去してからでないと縫合出来ないものである。

患者の術後処置：

気管切開を行つて日の浅い患者は、病棟に術後処置に慣れた職員がいない場合には、病棟へ帰すべきではない。看護婦にはカニューレの外管を動かさずに内管を一時間毎に交換し、清掃する様に教えておく。看護婦はカニューレの長さ以上に深く入れて吸引しない事と、更に危急な場合以外には気管から吸引を行わない様に注意しておく。受持ちの医師は吸引や、咳嗽を促したり、体位による排液、灌注等を行う事によつて気管、気管支に分泌物が溜らない様にせねばならない。通常、冷い蒸気の形で湿気を与えるが、又必要な場合には湿潤剤を追加する。蒸気や湿潤剤はテント或は Croupette の中へ酸素によつて度々与える事が出来る。術後第3日迄は外管は交換しない。患者の栄養は経口的に或は非経口的に与える。又特殊化学療法を行う。結局患者の側には何時も気管切開の器械全部を用意しておかなければならない。

摘 要：

気管切開の適応が増した事について述べて来た。此の手術は医師と看護婦との協力が必要である。下部気道閉塞に対する気管切開の適応症については余り良く決められていないが、上部気道閉塞の場合は明確である。緊急な場合の気管切開に比して予めよく計画し、秩序正しく行つた場合の気管切開には、より大きな利益があり、合併症は少いものである。

結 論：

分泌物を肺から咯出出来ない様な患者に対しては局所的肺病変と体内に二次的に起る機能的器質的变化とを防ぐために早期に或は予防的意味に於てさえ気管切開を行う事を推奨すべきである。かくて原病を複雑にする続発因子としての気道閉塞による窒息のための障害を少くする事が出来る。

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