Tracheotomy & Laryngotomy

Lancelot Armstrong.
Of all the operations in which the hand of the surgeon is the means of saving life none can take precedence of this, & in no one is the immediate benefit more marked, and whether we look at it with regard to its simplicity or the small amount of danger incurred by the patient from, and the instant relief experienced in most cases after its performance, we are puzzled to find a reason why it should have met with so much opposition from many eminent men in earlier times—however there were even at that time some who more skilful or bolder than their fellows, undertook the operation with confidence.

The danger of suffocation from acute Laryngitis was known to Hippocrates, who
practised a rude method of guarding against it, by passing a tube down the trachea to afford a free passage to the air. Asclepiades was the first who fully considered the subject, and proposed to make an artificial opening into the trachea, for the patient to breathe through. Celsus though evidently acquainted with the opinions of Asclepiades on some diseases and citing him as an authority on certain affections of the neck, yet strange to say does not mention his practice in this instance, his own treatment of quinsy as regards any operation being confined to making incisions under the jaw; if the disease did not yield then, he considered the case hopeless. "Si quis si non fuerit aper adjutus, sine leget a male victim epi.
In D. Freind's History of Physick we find that the Arabians were acquainted with this operation. Alhazen, a physician of that country, mentions it, and though he had never performed it, he considered it practicable, being chiefly led to this conclusion by having under his notice a case of cut throat, in which the wound opened the trachea, and yet it healed in a very short time only leaving a slight huskiness of the voice, so that he was impressed with the fact that wounds of this organ were not necessarily fatal. By all the writers of that time, however, tracheotomy was only regarded as a dernier resort, but in the 16th century Habest of the University of Paris, who had been in the habit of inserting a tube in accidental wounds of
of the trachea, performed the operation in the earlier stage of threatened suffocation and with the happiest results. Though the utility of this operation might after this be considered as fully established, yet it was still performed in an imperfect way owing to the prevalent idea that the rings of the trachea if divided, being cartilaginous, would not reunite, therefore if the trachea itself was opened, it was done between two of the rings, the fact that the cut cartilages will quickly heal is now so well known, that in cases where a tube causes very great irritation, it is proposed to take a small slip out of the tube. It is rare however for a tube to be a source of much distress in this way, from the fact that the trachea is much less sensible, at this part
and indeed in its whole length, than just at the glottis. This fact may be a cause of much danger to a patient by exciting doubts in the mind of the surgeon as to the presence of a foreign body, and to preventing him employing the proper means of relief, for the body having lodged in one of the less sensitive parts of the tube as the Ventricles, unless large enough to obstruct the passage of air, may cause little or no irritation, but it is at any moment liable to be distodged from its resting place, carried by the force of the air against the cheek of the glottis, causing violent cough convulsions &c., perhaps even sudden death by Apnoea, if it should yet in the grasp of the muscles which will spasmodically contract, like any other muscular tissue.
when so irritated. The lining membrane of the air passages, like other mucous membranes, when placed in extraordinary circumstances becomes somewhat modified and has a certain power of adapting itself to various changes, this is very well seen in persons with disease of the lungs, who inhale chlorine, the gas at first excites a good deal of cough but after a short time is inspired with perfect ease.

In cases calling for the performance of this operation it should be done as soon as the necessity for an increased supply of air becomes apparent, because the blood in health the more richer of the tissues is fast becoming a deleterious poison, totally unfit for its office; that the whole system is keenly aware of the necessity of free inspiration to keep it in health, is shown by the wide
range of connection of the centre of respira-
tory action: besides the pneumogastric nerves
which are the chief agents in conveying the
intelligence of want of air to the brain, the
experiments of Volkmann seem to show that
all centripetal nerves have in some degree
a like sensibility and that imperfectly
arrested blood, coming in contact with these
acts as a stimulus, which is conveyed to the
medulla oblongata and this responds by
setting in action all the muscles of respiration.
Whatever be the cause of the dyspnoea, delaying
the operation diminishes the chance of success
as the blood becomes more impure with every
successing minute, and this accounts in a
great measure for the variable results after
tracheotomy. In some cases a patient apparently
dying is snatched from the jaws of death.
whilst in others who are still gasping, the operation though beneficial for a time does not ultimately save them. I believe the cause of this is to be found in the length of the interval between the occurrence of urgent dyspnoea and the removal— the slow or rapid completion of the strangling process. Thus when the obstruction is serious but incomplete and the patient continues much in the same state for some time, respiration goes on however imperfectly, but the brain becomes affected, the circulation sluggish, the lungs are flooded with unarterialized blood and choked with serous effusion; so that when the obstruction is removed, the system does not rally as in a more sudden cases of asphyxia where the lungs and nervous centres are less deranged. Therefore supposing the surgeon
to be at hand in two cases of apneum, the first slow in its progress, the latter rapid, the latter would stand the best chance of recovery. If the case requiring the operation arises from some small body such as a fish bone sticking in the larynx, the sooner it is removed the better, for, putting out of the question the inflammation it will cause in the part itself, the violent cough produced by the irritation is a source of the greatest danger; for this reason that the strength of the blood's impulse in the arteries is increased during expiration, in which act the chest is contracted, and the large nerves in consequence compressed, this increase is well shown in the greater pain and throbbing of an inflamed part during coughing, and in the frequent retort
of diseased arteries during violent expectoratory efforts, so that although a few fortunate cases have occurred in which a foreign body such as a corn has luckily passed out through the sputa of the patient, after a time, Mr. Brunel's case was one of the most extraordinary yet instances of this happy kind are too few and far between, to justify us in trusting to such a chance.

In the normal state the blood returning from the systemic circulation by the two cavae passes into the right auricle, thence into the ventricle of the same side, and from this cavity is propelled through the lungs, in the capillaries of which organs it discharges as carbonic acid & water the impurities which it has collected in its course, and is thus again rendered fit for renovating the various tissues.
of the body; after this it is returned through the left auricle into the left ventricle, whence it is sent through the aorta to perform its allotted purposes. When respiration is impeded, something very different takes place.

First. The deoxygenated blood corpuscles cluster together in the capillaries of the lungs and at length stop entirely, for it has been shown by directing a stream of carbonic acid on the web of a frog's foot, that this gas has such an effect on the circulation, but this stoppage does not take place at once, nor is it due to the venosity of the blood alone. On the contrary, if the heart continued to act with its accustomed force, the blood though macerated would yet traverse the lungs.

Secondly. The blood insufficient in quantity and improper in character is received into
the left auricle.

Thirdly. — The blood I suppose now to have passed into the left ventricle — here in consequence of its altered state it does not stimulate the ventricle to contract with that vigour which distinguishes it in health, the immediate result of this is an imperfect supply of blood to the system, the nervous centres participate in the general want, their function is also impaired by the kind of blood, so that they secondarily affect the irritability of the heart.

Fourthly. — The right auricle receives this poisoned blood and would pass it on to the right ventricle, but this cavity is no longer in a condition to admit it, being now joyed with venous blood that it cannot transmit thro’ the pulmonary artery in
consequence of the congested state of the lungs and thus the right auricle becomes foxyed. And prevents the return of venous blood.

In this manner the circulation is brought to a stand still, the nervous centres are congested and life is extinguished.

The post-mortem appearances are such as might be expected from what I have said. No engorgement of the right heart, of the substance of the heart—of the lungs and nervous centres. The left heart being empty.

The respiratory sounds are changed according to the extent and position of the obstruction whatever that may be, whether some change substance which has accidentally slipped into the trachea, fibrinous exudation or serous infiltration, or again some cause of pressure altogether outside the windpipe but compressing...
the sides is to prevent an obstacle to the entrance of air...A round body just filling up one of the bronchi would effectually prevent air reaching the corresponding lung, and of course to destroy all respiratory murmur, but the chest over that part would still be resonant from confined air. The result of complete stoppage of air is sudden death. If the calibre of the tube is only diminished, not absolutely closed, the breath is drawn in with a harsh sound, ranging between hissing and crowing inspiration; the voice is changed in tone or reduced to a whisper, often peculiarly thrilling sometimes scarcely audible. When a portion of the lung only is rendered incompetent pulmonary respiration is heard in the other parts.

The evident signs of suffocation are lividity of the face, suffusion of the eyes which also
project in an unnatural manner, do not require any remark, but there is one very characteristic symptom of the strangling proof which must be noticed, this is the filling up of the supraclavicular spaces. This circumstance especially occurs when the case has lingered on for some days, during which time fits of violent suffocative cough have frequently come on; the result of this is that the air cells of the lungs are ruptured, the substance of the lung becomes emphysematous and then the air insinuated itself between the pleura and the lung into the cellular tissue connecting the two and may show itself above the clavicles.
Concerning tracheotomy, therefore, I have come to the following conclusions.

First. That circumstances though different altogether in themselves, yet bringing about the same result — viz. want of breath — require this operation.

Secondly. That the necessity of performing it may be recognized, from the sound of the air in the trachea — the alteration of the natural tone of the voice to a harsh hoarse sound or a scarcely audible whisper — in some cases from pain and difficulty of swallowing — from the dimness which respiratory murmur and from the presence of no other disease which could cause such symptoms and from the history of the case.

Thirdly. That it is necessary to perform it before matters have gone too far, the state
of the patient rapidly progressing from bad to worse, the impediment in the trachea being itself a source of great irritation, in consequence of the insufficient supply of air the congestion of the lungs increases from minute to minute until the patient may sink, although the dyspnea is at length relieved, and convulsions are likely at any moment to come on and tend greatly to weaken the patient, much lessening his chance of ultimate recovery.

This operation may be called for in acute laryngitis. This disease usually arises from exposure to wet and cold, but may be brought on by the contact of irritating fumes or scalding water or it may supervene on chronic laryngitis especially when connected with disease of the cartilages, when aggravated by the first
mentioned causes. Its approach is accompanied by sore throat, difficulty and pain in swallowing.
Dyspnæa comes on with uneasiness at the situation of the tonsil and ala, accompanied by husky cough and great tenderness on pressure over the larynx. The voice is changed or entirely lost; the dyspnæa increases and the patient exhibits the characteristic appearance of one struggling for breath. These symptoms are owing to inflammation of the laryngeal mucous membrane which first causes thickening of that membrane and then if not checked, infiltration of the subjacent circular tissue and so narrows or shuts up the space between the chordæ vocales and brings about the various events noticed before.

The following case which occurred in private practice, was of an extremely distressing nature,
Not only from the lingering course of the symptoms, but also from the unfortunate termination to which it came when hope of success seemed probable,

Eliza Jones, aged 14 years, of interesting appearance, dark hair and eyes came under my notice on the 18th June 1849. She complained of indigestion, loss of appetite, and a tickling cough especially in the morning, but was frequently seized through the day, with violent paroxysms of coughing, scarcely to be distinguished from hooping cough, but there was no well marked difficulty of breathing even on walking up hill; a short time before I saw her she had had a very severe attack of hemoptysis, but as the menses had stopped about three months previously to this, the blood spitting was looked upon by her medical man, as vicious in its nature.
I found that on applying pressure over the larynx, she experienced a good deal of uneasiness and an increased disposition to cough. On percussing her chest no marked dulness was detected in any part of the chest, but on listening to her breathing a very slight lengthening of the expiratory sound was thought to be perceived under the right clavicle, and a certain amount of purulent respiration over the remaining surface of the chest; still these symptoms were by no means so prominent as to have excited suspicion of any pulmonary disease, had it not been for the coexistence of indigestion debility and the cough before mentioned.

On examining the urine I found the density to be 1.012 and by testing with heat and nitric acid, detected a small amount of albumen; there was one thing however which struck
ills and as the appetite improved with the use of these remedies, the ability to undergo fatigue increased, the menses also returned but more sparingly than could have been desired: yet it was remarkable that the cough never left her—indeed if anything, the paroxysms became more frequent, and although she did not appear to be exhausted by them, I resolved to try some means to relieve her from this distressing symptom; having failed to benefit her at all by repeated applications of mustard liniments early in November I applied a blister over the larynx; the blister rose in six hours and healed in a few days, and from that time until she left the country three months after I saw little of her, as she was so much improved both as to her general health and the diminution of her cough, that she did
not require constant attendance. All this time she had taken cod liver oil, but had left off the toned medicine some weeks before. I advised her to continue the oil, leaving it off for a day or two if her stomach got out of order.

The now as I afterwards learned took a situation in some domestic capacity in London and I lost sight of her, until the following March when I was called to see her one morning and found her suffering from sore throat, difficulty of swallowing, and dyspepsia. Her face was flushed, she had a hot skin, pulse 96 in the minute and strong. Her account of herself was that she had been pretty well during her stay in town but she began to feel not so well about three weeks before her return to the country, she coughed...
on getting up in the morning but had no
such paroxysms as before, she was troubled
with slight diarrhea for a few days
but it was stopped by some medicine she
had from some medical man, she obtained
permission to come home for a short time,
she started off by the train, but was obliged
to go some miles across the country in an
open cart, during her ride it rained and
she got wet; she was put to bed as soon
as she got home, but in the evening became
feverish, felt her throat sore and began to
cough. The slept during the night but was
awakened early in the morning by a
choking fit of coughing. Be and shortly after
I found her in the state I have described.
She was thinner than when I last saw
her and her face wore an anxious look.
Knowing the tendency to debility in her constitution I was unwilling to bleed her from the arm but ordered twelve leeches to the throat. She had a pill consisting of colonel gr. ii - opium gr. ½ - indica hemp gr. ½ to be taken every two hours; the last ingredient was combined with a view to allay spasm of the glottis if that might be the cause of the dyspnoea. She was a good deal easier for some hours after this and slept a short time but in the early part of the evening, the dyspnoea returned and rapidly increased so much so that at 9 p.m. I was sent for. I found her gasping for breath, her countenance very anxious and covered with perspiration. She could scarcely whisper and was constantly shifting about. Her face was dusky and rapidly becoming livid, under
these circumstances it was clear that the only chance was tracheotomy as the case was too urgent to wait for the action of other remedies. The operation was therefore performed at once by the gentleman whose assistant I was at the time.

Operation. A incision 1/2 inches in length was made in the median line, just below the cricoid cartilage and the sterno-hyoid and sternothyroid muscles being separated the upper rings of the trachea were laid bare, there was no arterial hemorrhage to delay the operation and a little venous oozing was disregarded. The three upper rings of the trachea were cut through, and then air being drawn in, a forcible expiration followed which expelled a quantity of frothy tenacious mucus mixed with blood, the natural tint of
the face was restored and she breathed well through a tube which was now inserted and caused no irritation; cough was almost entirely absent, and she was able to tap up the great relief she felt. This hopeful state lasted for six hours during which time she obtained some sleep, but between 4 and 5 a.m. an unfavorable change came on and she began to sink rapidly, her pulse became weak & fluttering, diarrhoea set in, she went into a state of low delirium and death occurred four hours after the change, in spite of the assiduous administration of stimulants. The unfortunate termination of this case, will I think be sufficiently accounted for by the various facts elicited at the post-mortem examination, which took place the following day.
Sectio. Without going into the minor details of the dissection, I shall only give a brief account of those morbid appearances which I believe to have been principally connected with the death of the patient.

Lungs. In the apex of the right lung the bleches were discovered, but just beginning to soften down the rest of the lung substance was healthy there was an adhesion of the pleura of some extent at the upper and back part.

A slight pleuritic adhesion was found nearly in the same situation on the left side the substance of the left lung was healthy throughout.

The stomach and intestines were healthy.

Liver was found increased in size, pale in colour both on the surface and section, it was
left firm in consistence than usual, and was
greasy to the touch, altogether showing fatty liver
which had existed sometime.

Kidneys were both about the normal size, the
capsules were stripped off with facility, the
color was paler than natural, on section the
same paleness was exhibited, together with increase
in the proportion of the cortical part and an
appearance of granular degeneration, these
appearances were most marked in the
right kidney.

On splitting up the larynx and trachea, the
mucous membrane of the former was
found congested and swollen up by serious
effusion, so as nearly to close the chinks of the
glottis; an irregular cicatrix nearly three quarters
of an inch in length, measured from its extreme
points, with an alter not quite half an inch
in its longest diameter, occupying the centre of its area was found on the lining membrane of the right side of the thyroid cartilage — the cartilages themselves were not diseased.

In this case, though the patient was known to be phthisical, there was no reason for supposing that her death would take place in the way it did — the symptoms of phthisis had been held in abeyance and she was not to be allowed to die of suffocation because her life was not likely to be a long one — with regard to the disease of the larynx there had evidently been a strong attempt to repair the breach if not an entirely successful one, the ulcer was as if it were situated on a cicatrix and from the accounts of the case I should say that this cicatrix had at one time complete but that ulceration had begun again.
The evidence of Pleuritis, occurring as it did on both sides was interesting, as tubercles were only found on the right side, which circumstance rendered it probable that the inflammation of the pleura, arose as it often does in the course of Bright's disease. The existence of fatty degeneration of the liver I take to be an additional proof of the strong but somewhat latent phthisical tendency.

To sum up, I think, the patient would have recovered, if she had had only the disease of the lungs and larynx, and that her death was to be attributed not to the operation or its effects, but to the peculiar state of her constitution, which prevents her system from rallying from the condition to which she was brought by the dyspepsia.
The admixibility of this operation in the disease called bronchitis is not so evident. The marked feature of affection of the air tube is the formation of a false membrane in the trachea, and this often extends up the larynx and down through the bronchi. Dr. Watson mentions two cases in which it might be beneficial. One is where the preternatural membrane extends but a very little way down the trachea and is chiefly confined to the larynx, the other case is where there is no preternatural membrane at all or only a very slight coating in some part of the trachea, the impediment to breathing arising mainly from thickening of the mucous membrane and the presence of tenacious mucus — so that if the patient's life were in danger from inability to take a sufficient inspiration to effect the expulsion
of the collected mucus, an opening in the trachea by supplying the want, would assist him in coughing it up; but as we cannot tell before death to what extent the trachea is affected in this disease, there is so great a chance of the operation being unavailing that its performance is scarcely to be advised, it is often however the only chance and unfortunately this chance is diminished by the fact that the membrane if expelled, may reform in seven or eight hours and suffocation ensue as a consequence.

A source of danger to life from obstructed respiration is sometimes caused by the ingestion of meat or some other article of food in the pharynx; this is particularly prone to occur among lunatics who are paralysed generally, or epileptics, but especially
among the first-mentioned class, those from their glutinous method of eating, are very apt to get masses of meat or impacted in the esophagus, partly in the pharynx, and partly in the mouth pressing on the epiglottis. I have had two such cases myself, but in both succeeded in dislodging the meat without much difficulty.

E. L., a lunatic with general paralysis, was observed while at dinner, to leave off eating suddenly and fall forward on the table. I was immediately called and suspecting the nature of the supposed fit, and finding the man black in the face, I pushed my finger into his mouth, when I discovered a large mass sticking in the pharynx, which with some difficulty I succeeded in extracting with the end of my finger, then dashing
cold water on his face, he gave one or two convulsive gasps and shortly regained his consciousness. The other case was of much the same nature, occurring in a female epileptic and under the same circumstances and with a like result. Now in such cases as these I think tracheotomy may be required, for though happily the obstruction can generally be hooked out with the finger, yet it may exist just beyond the reach of this useful instrument, and be of such a size that it could not be forced down the esophagus by means of a probe without the greatest difficulty— I should hardly feel justified in saying this, if I had not seen a case of this kind, luckily for the patient in this instance the obstruction was situated too low in the esophagus to cause dyspnoe, but until it was discovered gave rise to some symptoms not
easily accounted for; the accident happened to James Romano, a lunatic, at 26 years of age; attention was first called to him by his refusal of food; the attendant said he had taken none the whole day; he was examined but did not appear to be suffering from any bodily disease and looked perfectly well in the face; as the patient was at all times particularly obstinate and would never answer any questions, it was supposed he would probably take his food as usual on the following day; still however he refused his food and as he had now taken nothing for thirty-six hours, it became necessary to feed him with the stomach pump; the attempt was accordingly made to inject some warm milk into the stomach, he made no resis-
tance but after a very small quantity had been thrown through the tube, the fluid
began to swell out again at his mouth; this excited suspicion of the presence of some obstruction and accordingly the tube was pushed on but was soon stopped by an obstacle of some kind, which effectually resisted any attempt to displace it with this instrument. A probe was now passed into the esophagus and after some time was pushed beyond the stoppage, on being withdrawn some small pieces of straw from 1/2 to 1 inch long were discovered sticking to the end. The conclusion drawn was that the patient had been amusing himself with a practice very common among lunatics of his class by biting into small pieces and swallowing some of the straw contained in the mattress of his bed and that this adhering to the sides of the esophagus had in some curious way become affixed with small portions of meat be
this patient I may mention was also in the habit of swallowing small stones, not apparently with any view to suicide but from mere wantonness, whether the obstruction was in part formed of these was not ascertained. Some milk was injected into the stomach with perfect ease and no bad effects followed this case which occurred three years back - the patient being perfectly well in health now. From the distance the probe passed into the oesophagus before it came in contact with the obstruction this must have been situated quite towards the termination of that tube. — but I think it possible that the stoppage might have occurred in the upper part of the gullet and so caused a considerable and very likely fatal derangement of the respiratory functions.
With regard to the situations in which the windpipe is opened - as a general rule I think the trachea is the best. Laryngotomy is however better adapted when the foreign body is situated in the Larynx in the upper part of the trachea, or is small and passing readily up and down the tube. But if dyspnea arises from inflammation of the mucous membrane of the back of the mouth and larynx or more particularly from plastic inflammation, it is obviously proper to operate as far from the seat of inflammation as possible - both to avoid cutting into an diseased part and also in the diphtheritic disease to stand a better chance of opening the obstructed tube below the lining of false membrane.

Still in desiring to do this it must be born in mind, that a high division of the innominate artery, or the position of the left innominate vein across the lower part of the neck, would place
the patient's life in great danger if in the hands of a careless operator, the lowest thyroid artery running as it does up the middle of the neck, may be larger than usual and give rise to troublesome hemorrhage. Sometimes the incision is extended through a part of the thyroid body, as in a case a short time back, at King's College Hospital, in which Mr. Ferguson finding the opening first made not sufficient enlarged it upwards, cutting exactly in the median line through the isthmus of the thyroid body, and without any apparent bad consequence; this may be necessary but I think is full of danger and to be avoided if possible. The after treatment of laryngotomy or tracheotomy consists in keeping patent the wound if this is necessary by means of a tube and preventing the entrance of any irritating substance as dust by covering the orifice with a piece
of fine gauge, the temperature of the apartment should also be carefully regulated. If after the extraction of a foreign body there is no object in keeping the wound open, a light dressing of lint is quite sufficient.

Since writing the above a case has occurred in the hospital under Dr. Syme, in which I think it probable the foreign body a piece of tobacco pipe cannot be extracted even by the performance of tracheotomy. The patient a child about two years old, has got a piece of tobacco pipe an inch and a quarter in length, into the air passage; this caused a good deal of dyspnoea at first but the breathing is at present much easier. Dr. Syme tried shaking with the head hanging downwards, but this did not have the effect of dislodging the substance. The length of the pipe precludes
the notion of its being fixed transversely in the bronchus, though it might have lodged across the bifurcation of the trachea, but in that case I think the obstruction to breathing would be more marked, but I believe that favored by its form and weight the substance has descended into one of the bronchial tubes where it remains as if it were fitted in the passage and this explains why the dyspnea is slight, because in this situation although it shuts up a small portion of the lung, yet it does not interfere so much with the function of that organ generally as if lying one of the larger tubes, although not of such a size as to fill the passage. If situated where I suppose the piece of pipe to be, I doubt whether it can be reached by any forceps or at all events laid hold of by such means.

L. Armstrong

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