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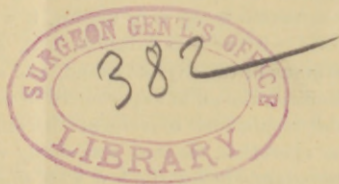


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TRACHEOTOMY IN DIPHThERITIC CROUP.

Read January 21, 1885.

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IN the following paper I desire to record briefly the histories of five cases of tracheotomy, performed for the relief of respiratory obstruction consequent upon diphtheria, and to make some remarks upon the operation in this affection:—

CASE I.—On April 15, 1882, I was called to see James D—, aged 3½ years, an inmate of the Southern Home for Destitute Children, who at the time was under the care of Dr. Samuel F. Hazlehurst. The patient was convalescing from an attack of measles, when he suddenly developed marked croupous symptoms. When I saw the case, the symptoms of laryngeal obstruction being very urgent, it was decided to perform tracheotomy at once. Ether was administered, and the trachea was opened below the isthmus of the thyroid gland, and a tracheotomy tube introduced without difficulty; the child experienced immediate relief from his extreme dyspnoea, the respiratory movements becoming quiet and natural. The day after the operation, the case was doing well, but it was observed that the lymphatic glands below the jaw were much enlarged, and that an exudation had appeared upon the surface of the wound in the neighborhood of the tube. On the third day, symptoms of respiratory obstruction again appeared, the tube was withdrawn, and attempts were made to remove the exudation from the trachea without success; the tube was then replaced, but the child grew gradually worse and died some hours later, with symptoms of increasing dyspnoea.

CASE II.—On April 20, I was called to see Ella M—, aged 5 years, an inmate of the same institution, under the care of Dr. Hazlehurst. The history of this child, prior to the operation, closely resembled that of the preceding case. When I saw her, she presented marked symptoms of laryngeal obstruction, but, unfortunately, in this case much delay was experienced in procuring a tracheotomy tube, and when this was finally obtained the child was markedly cyanosed, very restless, and presented all the symptoms of dyspnoea in a most aggravated form.

She was put upon the table, and a small amount of ether was administered, and the incision was made, but before the trachea could be exposed, the respiration suddenly ceased, and the pulse failed. The trachea was then hurriedly opened, and in doing this some of the thyroid veins were wounded and bled profusely; the tube was introduced and artificial respiration was practiced for some minutes, but the respiratory action could not be re-established.

In this case I think I erred in two respects; first, in not performing the operation sooner—I should have opened the trachea, and depended upon keeping it patulous by means of retractors or sutures introduced through the edges of the trachea, until I could have obtained a tracheotomy tube; and secondly, in administering ether where the respiratory action was already so much embarrassed.

CASE III.—On May 12, 1882, I was called to see Eddie M—, aged 2 years, an inmate of the same institution, who was, a few days before I saw him, attacked with diphtheria, which was followed by symptoms of laryngeal obstruction. When I saw this case, the respiratory obstruction was very marked, and the condition of the lungs seemed to indicate an involvement of the parts below the seat of the proposed operation.

Prof. Ashhurst, who kindly saw the case with me, thought it justifiable to open the trachea. The operation was accordingly done and a tube introduced, and the child obtained immediate relief from the urgent symptoms which he had previously presented, the respiration soon becoming quiet and natural. The child's condition for the next few days was very favorable, but at the end of a week it was noticed that fluids taken into the mouth escaped in part from the tracheotomy tube; this condition gradually improved, and on the fifteenth day after the operation the tube was permanently removed, and a week later the wound was entirely healed. A short time after this date, the child began to exhibit signs of paralysis, and one morning, three weeks after the wound had entirely healed, in rising from his bed he fell suddenly backwards, and when the nurse reached his side she found him dead.

CASE IV.—Mary Rischer, aged 6 years, born in Germany, was admitted to the Children's Hospital on the afternoon of June 11, 1883, with symptoms of dyspnoea, complicating an attack of diphtheria. Her condition at the time of admission was not threatening, and upon consultation with Dr. Morris Lewis, who at the time was on duty in the medical wards of the hospital, we decided to await the development of more urgent symptoms before resorting to tracheotomy, especially as the case could be under con-

stant medical observation. During the succeeding night the symptoms of dyspnoea became so marked that I was summoned, and, as the child's condition had become very critical, with the assistance of Dr. Lewis and the resident physician, who administered a small amount of ether, I opened the trachea below the isthmus of the thyroid gland and introduced a tracheotomy tube; no trouble was experienced from hemorrhage, one small venous trunk only requiring a ligature.

After the introduction of the tube the child's color rapidly improved and the respiration soon became natural.

The improvement in this case was rapid and continuous, and the temperature had become normal by the eighth day after the operation, and the wound had granulated as far as the sides of the tube. The tube was removed at intervals and the child was allowed to breathe through the wound and mouth.

On the thirteenth day I removed the tube permanently, as the child appeared to breathe well through the natural passages. Two hours after its removal, while speaking, the child was suddenly seized with symptoms of respiratory obstruction, and, owing to the contraction which had occurred in the wound, some delay occurred in the re-introduction of the tube, and the child rapidly perished.

CASE V.—Edwin W.—, aged $2\frac{1}{2}$ years, was admitted to the Children's Hospital on the morning of June 13, suffering from laryngeal obstruction consequent upon diphtheria. This patient was sent to the hospital by Dr. William M. Welch, who had had the case under observation for a few days. The child, on admission, presented symptoms of dyspnoea in so marked a degree that it was decided to perform tracheotomy at once, as it seemed to afford the only chance of saving life.

In this case no anæsthetic was administered, as the respiration was so much embarrassed. I exposed the trachea as rapidly as possible, although some delay was caused in displacing the numerous enlarged thyroid veins which presented themselves in the wound, and opened the windpipe below the isthmus of the thyroid gland, and introduced a tracheotomy tube. After the introduction of the tube the respiratory act ceased and it was only by the aid of artificial respiration that it was finally re-established. A number of fragments of membrane were removed from the tube and were coughed up for some hours after the operation.

This case improved slowly after the operation, the temperature not reaching the normal until the nineteenth day.

The tube was permanently removed on the twenty-fourth day after the operation, and the patient was discharged from the hospital, with the wound entirely healed and in excellent condition, on July 28, 1883.

I have reported the preceding cases, because I think it important to report all cases of tracheotomy done for the relief of respiratory obstruction consequent upon diphtheria, for until within a very recent period, in this country, the operation in this disease

was looked upon with marked disfavor, but I am glad to say that it is now growing in favor with the profession.

The operation of tracheotomy, if carefully done, does not, in my judgment, complicate the case, but averts an immediate tendency to death, and offers a chance of recovery to a class of cases which, left to themselves, almost invariably terminate unfavorably.

The results of expectant treatment in these cases, where symptoms of respiratory obstruction are present, have been so unsatisfactory, that the operation of tracheotomy, which in the vast majority of cases prolongs life, and is in itself seldom a cause of death, seems to be most clearly indicated.

It must also be remembered, that the operation is not generally proposed until full trial has been made of the various forms of medicinal treatment which may be considered appropriate to the symptoms presented.

The statistics of this operation in diphtheritic cases are difficult to estimate, as in many of the collections of cases membranous croup and diphtheritic croup are used as synonymous terms.

Prof. Hensch, of Berlin, reports sixty-six tracheotomies for diphtheritic croup with sixteen recoveries; a little over 24·3 per cent.

These statistics agree very closely with Prof. Cohen's observation, that one case out of four recovers when the operation is performed for diphtheritic croup. Mackenzie quotes Trousseau's statistics of 466 cases of tracheotomy occurring in the Children's Hospital of Paris, in which 126 recoveries took place, or about one recovery in every four cases. My own limited number of cases furnishes two recoveries out of five cases, though one perished ultimately from diphtheritic paralysis.

To form a correct diagnosis between diphtheritic croup and membranous croup is at times a very difficult matter; for instance, in Case I, the symptoms pointed to a false croup, which occasionally complicates measles, but on the day succeeding the operation the glands of the neck became greatly swollen and the tracheotomy wound was covered with a diphtheritic deposit.

The diagnosis in cases where the pharyngeal lesions antedate the symptoms of dyspnoea is comparatively easy, except in the case of very young children, where a satisfactory examination of the fauces is often impossible.

I myself am a believer in the non-identity of the membranous

and diphtheritic croup, but, as far as their surgical treatment is concerned, I can see that an exact diagnosis makes little difference; the same indications exist in both diseases, namely, to relieve the dyspnœa which threatens life, and this is to be overcome by the same operative procedure.

As regards the age of the patient, there is no doubt that the chances of recovery, after the operation of tracheotomy, are better after the age of three years, but examples of recoveries in the second and even the first year are not wanting, and in my own successful cases the patients were aged two and two and a half years respectively.

The shortness of the neck, the depth of the trachea, the comparatively larger extent of its surface, which is covered by the isthmus of the thyroid gland, the possible presence of the thymus body, and the danger of wounding the left innominate vein in very young children, are all elements which render the operation of tracheotomy more difficult, and cause its performance to be accompanied by more immediate risk than in the case of older children where these conditions do not obtain.

G. Chaym* has collected a number of cases of tracheotomy in children under two years of age, and gives the following statistics: In fifty-six cases of children one year old, the mortality was eighty-four per cent.; in nine hundred and twenty-one cases where the age was two years, the mortality was eighty-five per cent. Archambault,† of the Children's Hospital of Paris, presents some statistics bearing upon the results of the operation at different ages:—

976	cases in children from 1-3 years	gave 104 recoveries.
822	“ “ “ “ 3-4 “ “	175 “
736	“ “ “ “ 4-5 “ “	174 “
497	“ “ “ “ 5-6 “ “	148 “
547	“ “ “ “ over 6 years “	198 “

The time at which the operation should be performed is a matter of the greatest importance; if we wait until cyanosis, coldness of the extremities, and extreme dyspnœa are present, it is often too late, so that I think it is generally conceded that it is advisable to operate when the local signs of laryngeal stenosis are well marked and are increasing, as will be shown by continuous

* Med. News, Aug. 2, 1884, p. 125.

† Archives of Pediatrics, June 18, 1884, p. 415.

stridor in the breathing and retraction of the supra-sternal fossa and the lower ribs.

But upon this latter point there is a wide scope for the exercise of individual judgment, some surgeons recommending the operation where others would consider it hopeless; even the presence of pneumonia is not considered by some authorities as a contra-indication to operative measures.

The steps of the operation are too well known to require any detailed consideration; the question of the point at which the trachea should be opened, whether above or below the isthmus of the thyroid gland, is one which the surgeon should decide for himself, and, I think, depends somewhat on the size of the isthmus of the thyroid, and the ease with which it can be displaced upwards or downwards. The opening of the trachea above the isthmus of the thyroid gland is generally accomplished with more ease, as the trachea is more superficial at this point, and there is less risk of wounding important vessels, especially in young children.

In some cases where it is impossible to displace the isthmus of the thyroid gland, either from the extent of the trachea which it covers, or its immobility, it may become necessary to ligature it on either side of the trachea, and expose the latter by an incision between the ligatures which can then be accomplished without fear of dangerous hemorrhage.

The size of the tracheotomy tube to be introduced, is a matter of some importance, and I think it is considered an advantage to use as large a tube as possible, that is one which closely fits the calibre of the trachea, this not only furnishes as much breathing space as possible, but has less tendency to cause ulceration of the trachea, such as is occasionally seen after the use of loosely-fitting tubes.

The tracheotomy tube most commonly used is a double one, constructed of silver, and the outer tube contains a fenestrum which is intended to communicate with the cavity of the trachea when the inner tube is removed, but in my experience it is generally useless as regards this object, for the fenestrum is placed so far from the end of the tube that it is outside of the tracheal wound. For this reason the non-fenestrated tube recommended by Prof. Little,* which is constructed of aluminium, which has the

* London Lancet, August, 1883.

advantage also of great lightness, seems to possess advantages over those in general use.

With the modification of the operation which has at various times been suggested of dispensing entirely with the tracheotomy tube, by removing a portion of the trachea, or by holding the wound open by sutures introduced through the edges of the tracheal wound, I have had no personal experience, but as a temporary procedure I should think it might, under some circumstances, be adopted with advantage.

In very young children, when the trachea is very soft and pliable, and presents very much the characteristics of a membranous tube, the use of the tracheotomy tube seems to me to be almost imperative, for I can recall one case of the operation in a young child in which I assisted Prof. Ashhurst, in whom, as soon as the trachea was exposed and opened, inspiratory efforts caused a flattening of the trachea, so that no air could enter, and it was only after the introduction of the tracheal canula that respiratory action was satisfactorily established.

The use of an anæsthetic in tracheotomy is recommended by many surgeons, among whom is Erichsen, who always administers chloroform, thinking that it relieves the spasmodic condition, which is a factor in the dyspnœa; other operators prefer ether; for myself, I must say that I am opposed to the use of any anæsthetic, unless it be in the very early stage of the operation, and in cases which are not extremely urgent.

The use of ether in cases where the respiration is much embarrassed, I think adds an additional complication by increasing the laryngeal irritation, and I am confident that in one instance at least I have seen death result from this cause; on the other hand, the sensibility of the parts is so much blunted that I believe little pain can be referred to the operation after the incision of the skin has been accomplished. The immediate results of the operation are, as a rule, most encouraging. The patient, who previously exhibited the most distressing symptoms referable to his extreme dyspnœa, now becomes quiet, improves in color, the respiration becomes slower and more natural, and he generally falls into a quiet and peaceful sleep; but, unfortunately, this period of comfort is, in many cases, in a few hours or days followed by an increased rapidity of the pulse and frequency of the respiration, with recurring dyspnœa due to an extension of the membrane into

*collapse
of wall*

the trachea below the seat of operation, or to the development of a bronchitis or broncho-pneumonia. But even the occurrence of these complications after the operation, I take it, should not militate against operative interference in suitable cases, for they cannot be directly traced to the performance of tracheotomy, as they occur with corresponding frequency in cases in which medical treatment alone is employed.

A favorable sign after the operation is, as remarked by Prof. Cohen, the occurrence of coughing and the expectoration of false membrane and tracheal mucus through the canula; the cases in which these symptoms exist are more apt to end in recovery, than those in which the opposite conditions obtain.

The after-treatment of cases in which tracheotomy has been performed is a matter of the greatest importance, as the successful issue of the cases depends largely upon the care and watchfulness exercised in this respect.

The first indication requiring attention is the removal or escape of false membrane from the trachea, this may be coughed up and escape from the tube or may be removed by a camel's-hair brush or a feather, and to prevent the inspissation of these discharges a warm and moist atmosphere is generally maintained, this may be accomplished by the use of the ordinary steam atomizer in which lime-water may be used as the spray, or by having water boiling in open vessels in the room, or by the slaking of lime in large quantities. In the Children's Hospital of this city we have a room especially arranged for the treatment of these cases, which is fitted with steam apparatus by means of which the air of the tracheotomy room can be filled with a vapor of steam in a few minutes, and maintained at an even temperature.

It is also a matter of the first importance to have the case under careful and continuous observation for some time after the operation, for at any moment the tube may become obstructed by mucus or detached membrane, requiring the removal of the inner or even the outer tube; for this reason, the presence of a trained assistant or a nurse skilled in the management of these cases, is almost indispensable. Of the medical treatment of these cases I will say little, as much diversity of opinion exists upon this point and the operation itself does not necessarily conflict with any form of treatment which may have previously been instituted, for my own part, I prefer the administration of carbonate of

ammonium, in small and repeated doses, for the first twenty-four hours after the operation, believing that by its use the risk of heart-clot is much diminished.

The permanent removal of the tube is a matter of the greatest importance, and sometimes I think causes more trouble and anxiety than its original introduction. The time at which this should be attempted varies considerably in individual cases: it has been removed permanently as early as the third or fourth day; in other cases it has been weeks or months or years before this could be executed, and in a few cases its permanent removal has never been successfully accomplished; many elements may combine to render this an easy or difficult undertaking.

The importance of dispensing with the tube in cases of tracheotomy done for temporary laryngeal obstruction as soon as the cause has been removed, is generally admitted: the bronchial catarrh, the danger of its displacement when competent assistance is not present to replace it, and the injury which it may inflict upon the trachea, all point to the importance of its early removal.

The growth of granulations in and ulceration of the trachea produced by the end of the tube, in cases where it has been retained for some time, have both caused troublesome and dangerous complications.

A case having a direct bearing upon this subject and presenting a rather unusual complication, causing death after tracheotomy, has recently been reported at a meeting of the Société Médicale des Hôspitaux de Paris, by M. d'Heilly,* who showed the specimen taken from a case in which tracheotomy had been performed for diphtheria, and in which the patient died from hemorrhage on twelfth day after the operation. The hemorrhage in this case arose from ulceration of the trachea which had extended to the innominate artery, and was caused by the end of the tracheotomy tube. The reporter states that he could find only two similar cases which were recorded in Guy's Hospital Reports.

As soon as the patient can breathe without the aid of the tube it is, of course, important to get rid of it, and to ascertain this fact its external opening may be plugged, or it may be removed, and a wet compress of lint laid over the wound in the neck; if under these conditions the patient breathes comfortably, showing

* British Med. Journal, May 24, 1884, p. 1017.

*relatively
tube*

*death from
hemorrhage
of
innominate*

that the air passes freely through the trachea and larynx above the wound of operation, its permanent removal may at any time be attempted. The plan which is recommended by many authorities of removing the tube each day for a few days, before its final withdrawal, and allowing the patient to breathe without its use for an increasing period of time at each removal, is on the whole a very good one, and one which I have generally adopted.

That the final removal of the tube need never be entirely despaired of, is shown by numerous recorded cases, where, even after it had been worn for periods varying from three or four months to several years, its use had finally been dispensed with.

The difficulty produced by the removal of a tube which has been worn for some time, is to be explained by several circumstances, among which may be included the healing of the external wound as far as the presence of the tube will permit, and its adhesion to the trachea which causes it to assume a valvular action during the inspiratory acts. The growth of excessive granulations at the margins of the tracheal wound, or from the surface of the trachea impinged upon by the lower end of the tube, are also obstacles to the permanent removal of the tube, until their destruction is accomplished by appropriate treatment. Another element which I think has a very important bearing upon this subject has been pointed out by Mr. Thomas Smith,* who has shown that tracheotomy, whether performed for diphtheria or acute laryngitis, is liable to cause undue irritability and disorderly action of the muscles of the glottis so as to interrupt their usual rhythm; this, perhaps, is the effect of enforced cessation of all exercise of function in the larynx, which the operation entails.

Prof. Cohen † says that the explanation of these phenomena seems to reside in the fact that the laryngeal muscles had lost the habit of contracting harmoniously for the needs of respiration; the patients being somewhat in the condition of those with paralysis of the vocal cords.

In explanation of those cases where the tube can be dispensed with except during sleep, Smith suggests that the influence of the will may be necessary to regulate and secure the due action of these muscles, the perfection of whose movements has been im-

* *Medico-Chir. Trans.*, vol. xlviii, p. 227.

† Cohen, *Croup in its Relations to Tracheotomy*, p. 53.

paired, and that on this account inspiration through the larynx during sleep is impossible.

To restore to their normal involuntary character the impaired functions of the disused laryngeal muscles, he recommends exercise of these functions during sleep, the removal of the tube, the case of course being carefully watched, so that upon the development of dangerous symptoms it can be re-introduced. By this means, after repeated trials in the most obstinate cases, the parts have resumed their normal condition and the use of the tube has finally been dispensed with.

This condition I have seen to occur after the removal of tracheotomy tubes and to cause the patient to exhibit the most alarming symptoms of dyspnoea until the tube was replaced. The unfortunate termination of Case IV was, I think, due to this cause; here, it will be remembered, the symptoms of dyspnoea came on suddenly two hours after the removal of the canula, upon the occurrence of some excitement, and quickly terminated in death before the tube could be replaced. In this case, after death, I introduced the tube without difficulty, and could find no cause of obstruction in the trachea.

