

T H E S I S.

AN INQUIRY INTO THE COMPARATIVE
VALUE OF INTUBATION AND
TRACHEOTOMY IN LARYNGEAL
DIPHTHERIA.

by

Thomas Downie Hunter, M.A., B.Sc., M.B. Ch.B.

ProQuest Number: 13915846

All rights reserved

INFORMATION TO ALL USERS

The quality of this reproduction is dependent upon the quality of the copy submitted.

In the unlikely event that the author did not send a complete manuscript and there are missing pages, these will be noted. Also, if material had to be removed, a note will indicate the deletion.



ProQuest 13915846

Published by ProQuest LLC (2019). Copyright of the Dissertation is held by the Author.

All rights reserved.

This work is protected against unauthorized copying under Title 17, United States Code
Microform Edition © ProQuest LLC.

ProQuest LLC.
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106 – 1346

A B S T R A C T.

In this thesis on the operation of election in laryngeal diphtheria, I shall first consider the merits and demerits of the rival operations apart from their results. The difficulties encountered in the performance of Intubation, such as pushing down of membrane, entrance of the Intubation tube into the oesophagus, and hooking up of the epiglottis, shall be considered. The dangers associated with the operation of Tracheotomy shall then be discussed, i.e., haemorrhage during the operation, and the danger associated with the position of the thyroid body. Examples will be given from observed cases illustrating the difficulties mentioned.

(a). I shall consider under this heading the disadvantages associated with the accidental expulsion of the Intubation tube. A table, giving all the intubated cases in our series and the number of times the tube was expelled in each case, is inserted. Other writers' opinions are stated and criticised.

(b). The average number of times the Intubation tube required to be re-inserted will be contrasted with the average number of times the tracheal cannula had to be replaced. A table is inserted showing the age periods of all our intubated cases and the average number of times the tube was inserted in the respective age periods.

(c). The average time the Intubation tube was required

will be compared with the average time the tracheal cannula was in position. A table is inserted showing the average number of days the Intubation tube and tracheal cannula were respectively required.

(d). The incidence of laryngeal stenosis in the two rival operations will then be considered. Many cases illustrative of this complication will be described in detail, and special mention will be made of the treatment of stenosis and its results. A table is inserted giving all the cases of laryngeal stenosis following Intubation, and a note on the present condition of those I managed to see and examine.

(e). The incidence of broncho-pneumonia in the two rival operations is then discussed.

(f). The mortality rates in the two rival operations are then dealt with, and a comparison is made between our own death rate and that of other countries.

(g). Various opinions for and against these respective operations are then cited. A table is given showing the results of over 40 old cases of Intubation and Tracheotomy, with a view to forming an estimate of the ultimate condition of those who have undergone either of these operations. The conclusions, I have formed from this inquiry into the comparative value of Intubation and Tracheotomy in laryngeal diphtheria, are then stated.

**AN INQUIRY INTO THE COMPARATIVE VALUE OF
INTUBATION AND TRACHEOTOMY IN LARYNGEAL
DIPHTHERIA.**

The two rival operations, Intubation and Tracheotomy, which have been practised for many years for the treatment of laryngeal diphtheria, constitute a subject over which there has been considerable controversy. During the time I have been Assistant in the County Hospital, Motherwell, I have had experience of both operations, and I propose to discuss their relative value.

In the first place I shall describe the advantages and disadvantages of the rival operations, irrespective of their results. I shall then treat the subject under the following headings:-

- (a). Coughing out of tube.
- (b). The average number of times the Intubation tube was inserted for each child, compared with the average number of times the Tracheotomy cannula required to be replaced.
- (c). The average number of days the Intubation tube was required, contrasted with the average number of days the Tracheotomy cannula was necessary.
- (d). Stenosis of the larynx in Intubation compared with Tracheotomy.
- (e). The incidence of broncho-pneumonia in the rival operations.

(f). A comparison of the mortality rates.

(g). Conclusion.

References from various writers on the subject will be included.

Tracheotomy has been practised for many centuries, yet the first successful case on record is one by Dr. André of London in 1782. (Memoirs of Diphtheria, 1859, Guersant on Croup). Bretónneau performed the operation successfully five times out of seventeen cases. (Memoirs of Diphtheria, 1859). Trousseau, the distinguished pupil of Bretónneau, succeeded nine times in thirty-four cases. (Memoirs of Diphtheria, 1859).

The operation had been much practised in the fifteenth century in serious cases of angina, but there is no record of success. In fact, so unsatisfactory had been the results before the first success by Dr. André in 1782, that the operation was forbidden by the Académie de Médecine. It is apparent from the writings of these early physicians, however, that they understood the essentials of the operation. Bouchut, who was well aware of the importance of keeping to the middle line of the neck in performing Tracheotomy, traced with a burnt cork or with ink a line from the lower part of the thyroid cartilage to the superior notch of the sternum. (Bouchut, Memoirs of Diphtheria, 1859). He took care to expose the

rings of the trachea before he made his incision. In the year 1835, i.e. ten years after Bretonneau met with his first success, there were 18 cases of cure out of 60 operations.

Bouchut, in the year 1858, conceived the idea of relieving severe laryngeal diphtheria by introducing a tube into the larynx. His efforts only met with the ridicule of his contemporaries. Had he received any encouragement from his fellow surgeons, it is possible that we might have been using Bouchut's Intubation tubes to-day instead of O'Dwyer's.

Before the introduction of anti-diphtheritic serum, Tracheotomy, though it had been perfected to a great extent, was a dreaded operation. In New York Foundling Hospital, no case of laryngeal diphtheria recovered during the years 1868 - 1880. (Nothnagel's Encyclopaedia of Practical Medicine, 1902). O'Dwyer, encouraged by his contemporaries, determined to make Bouchut's conception a practical proposition. "If I do real honour to the author of Tracheotomy, what honour will he not deserve who shall come to deliver us from it?" (Malgaigne, Nothnagel's Encyclopaedia of Practical Medicine, 1902). O'Dwyer's efforts ultimately resulted in the introduction of the Intubation tube. O'Dwyer's first tube was of the nature of a bivalve speculum. It was not a success, as the tubes were usually retained, and Tracheotomy had to be done as a secondary

operation. O'Dwyer's next tube was a short oval one of about one inch in length. It, however, was no more successful than the first one. He then experimented with longer tubes, which reached to the bifurcation of the trachea. Six cases were intubated with this long tube, but all died. After many experiments on the cadaver, O'Dwyer introduced the tube with the retention swell, which is in use at the present time. O'Dwyer's tubes consist of vulcanite, and are supposed to cause less irritation than any other variety. Consequently they can be used for longer periods without inconveniencing the patient. The tubes are made of different sizes to suit the ages of the patients. O'Dwyer's efforts resulted in the introduction of the Intubation tube, and it became a serious rival to the old established Tracheotomy. Bouchut's conception had materialized. Medical men in Britain and on the Continent soon became interested in this rival operation, and in a short time it was being practised in all the leading hospitals. At the present time it is universally performed in America. In the County Hospital, Motherwell, Intubation was the operation of election for many years. The results are interesting compared with those of Tracheotomy.

Intubation has been regarded as an operation of great simplicity. H.W. Carson,¹ Senior Surgeon, Prince of Wales' General Hospital, London, writes "The operation is one of great simplicity, once the knack is acquired" On the

contrary, A.L. Hoyle, writing in the American Medical Journal of May 7th., 1921, states "Few medical students receive any instruction in the art of Intubation, and many text-books would have one believe that it is a very simple matter to insert a tube into the larynx. As a matter of fact, there is probably no more difficult operation in surgery than an Intubation properly performed". Intubation is generally performed on the child lying flat on his back, but in America many operators adopt the sitting position, as they hold it is much easier to intubate in this position. In the County Hospital, Motherwell, Intubation has always been performed on the child lying in the recumbent position, as it is the natural position for a child suffering from diphtheria. In order to intubate in the upright position, the child is held tightly on a nurse's knee, and another nurse stands behind and steadies the head, while the operator takes up his position in front of the nurse seated in the chair. However, as the recumbent position is the natural one for a child suffering from laryngeal diphtheria, it is the one that has always been adopted in the County Hospital, Motherwell. Claude Ker², in his Infectious Diseases Text-Book, says "There is no justification for adopting the sitting position in a disease like diphtheria". The child is stripped of its clothing and placed in the recumbent position. A blanket is wrapped tightly round the patient in order to prevent any movement by him. It is, in my opinion, essential for proper Intubation that the child

should lie flat, with the head and back on the same level. Two or three nurses are required to hold the child down. The head is held by a nurse in the position indicated. Extension of the head during Intubation is almost certain to cause the operator to fail. The nurse should therefore endeavour to prevent any extension of the head, which the child usually attempts to do while being intubated. No anaesthetic is required. This is regarded as one of the advantages of Intubation over Tracheotomy. A self-retaining gag of suitable size is inserted on the left side of the mouth. The operator stands on the right side of the child. A tube is chosen to suit the age of the patient, and, having been rendered sterile, is attached to the introducer. When the mouth has been opened, the operator inserts his left forefinger until the epiglottis is reached. This structure is hooked up. It is important that the epiglottis should not slip from the forefinger of the left hand. If the operator lose his grip of the epiglottis, he will fail to intubate. Having secured the epiglottis, the operator passes the introducer along the left forefinger until the tip of the finger is reached. He then raises the handle of the introducer, which should pass into the larynx easily and without the application of force. The left

forefinger retains the Intubation tube in position, while the introducer is being withdrawn. The banjo string, which is attached to the head of the Intubation tube, is coiled round the ear of the child, and fixed in position with adhesive plaster. A characteristic sound, due to the air rushing through the Intubation tube, indicates that the manipulation has been successfully carried out.

The difficulties of Intubation.

To the skilled operator Intubation is generally a simple operation, and need not occupy more than thirty seconds. However, difficulties occasionally arise which baffle even the most accomplished. The difficulties are well known to those who have practised Intubation for a considerable time.

The mere insertion of the gag into the mouth of a child suffering from laryngeal diphtheria may have serious consequences. Dr. Basan mentions a case in which the opening of the mouth by the gag produced symptoms which necessitated immediate performance of Tracheotomy, but failed to save the child. (The Lancet, June, 1913).

Forcible opening of the mouth often increases the dyspnoea, and, according to Dr. G. Hunter Mackenzie, may even cause death. (Edinburgh Medical Journal, Volume 36, page 925). "In my whole series of cases", states Claude Ker,³ "only one patient died while being intubated apparently from cardiac failure!" "This is an accident which occasionally occurs, and in some cases it seems to

result from the forcing open of the jaws with the gag". The following case in our series illustrates this occurrence. W.H., aet. 4 years, who was admitted to the County Hospital, Motherwell on 13th. November, 1921, stopped breathing when the gag was inserted, and died on the table. This child had been coughing out the tube repeatedly, and he was probably weakened by the number of times he had to undergo re-intubation.

Cases of death during the operation are mentioned by Dr. J.B. Ball in the *Lancet*, November 26th., 1892, page 1216, case 16, and by Dr. H.G. Turney in St. Thomas's Hospital Report, 1889, page 85, case 1.

The hooking up of the epiglottis by the forefinger of the left hand may be extremely difficult. It is most important that it should be hooked up, and this step may be regarded as the "sine qua non" of Intubation. Should the forefinger lose its grip of the epiglottis, the Intubation tube will pass into the oesophagus instead of the larynx. The epiglottis may be difficult to reach, or it may be so small that it slips easily from the grasp of the forefinger. In those cases, where the epiglottis cannot be raised and retained in position by the left forefinger, Intubation becomes an impossibility. I have had personal experience of this difficulty. Intubation failed in the following cases: D.R., aet. 2 years, was admitted to the County Hospital, Motherwell on 9th. March, 1921. On account of the impossibility of hooking up the epiglottis. Tracheotomy had

to be performed.

K.D., aet. 3 years, who was admitted to the County Hospital, Motherwell on 12th. July, 1920, was intubated with great difficulty on account of the epiglottis being difficult to lift up.

J.McN., aet. 2 years, who was admitted to the County Hospital, Motherwell on 27th. January, 1919, was extremely difficult to intubate. In this particular case, the finger could scarcely be got behind the epiglottis. The vertebral column appeared to lie very close to the larynx.

The importance of hooking up the epiglottis cannot be over-estimated. I have always failed to intubate when I lost hold of the epiglottis. The left forefinger should be inclined to the left as much as possible to allow the introducer to pass beneath the tip of the digit into the glottis. The passing of the introducer beneath the tip of the finger is a delicate part of the operation, and considerable dexterity is required to be successful on every occasion.

The slipping of the gag generally results in a failed attempt, and not infrequently the fingers of the operator may be severely bitten. A nervous nurse holding the head militates against a successful Intubation.

The pushing down of membrane.

Writers on the subject of Intubation hold that the Tracheotomy instruments should be at hand, while an Intubation is being performed. The Tracheotomy instruments may be required when the Intubation tube pushes down membrane before

it. The detached membrane may completely block the trachea, and, if Tracheotomy is not immediately performed, death may occur. Membrane that is loosened and pushed down by the Intubation tube, may, on the other hand, be coughed up and the child may obtain complete relief. This, however, seldom happens, though F.V.G. Scholes,⁴ Medical Superintendent, Infectious Diseases Hospital, Fairfield, Melbourne, states "In 19 cases out of 20, this peeling off of membrane is the best thing that can happen. The membrane and tube are expelled together by the patient, or you pull them out together, and all is well. In the twentieth case, as soon as the tube is inserted, respiration ceases, the patient struggles for air, pulling out the Intubation tube gives no relief, and you have to do a very rapid Tracheotomy, which may or may not be successful. The 19 magnificent recoveries must be weighed, however, when judging the objection, and, as far as I can see, the balance rests in favour of Intubation." This statement of F.V.G. Scholes is not in accordance with results obtained in the County Hospital, Motherwell, from a series of Intubations lasting over a period of five years. While a few patients may be quite well after coughing up of membrane and require no further treatment, the great majority of them are in need of Intubation in a short time, if not immediately. Looking over the records of intubated cases, I have no difficulty in finding examples of immediate Tracheotomy from this cause. In our series there are several instances

of temporary relief after coughing up of membrane. In some cases, however, expulsion of membrane completely relieved the dyspnoea. In the following cases, Tracheotomy had to be immediately performed on account of pushing down of membrane.

J.G., aet. 3 years, who was admitted to the County Hospital Motherwell on 1st. February, 1920 suffering from laryngeal diphtheria, was intubated and membrane was pushed down necessitating immediate Tracheotomy. The child recovered.

J.G., aet. 3 years, was admitted to the County Hospital, Motherwell on 12th. July, 1915 suffering from laryngeal diphtheria. Intubation was performed, but the child stopped breathing immediately, probably from pushing down of membrane. Tracheotomy was performed, but the child died.

The following cases show how little effect the expulsion of membrane may have on the patient's breathing.

J.W., aet. $1\frac{1}{2}$ years, was admitted to the County Hospital, Motherwell suffering from laryngeal diphtheria. The tube was blocked after Intubation, and it was pulled out. A large cast of the trachea was expelled, but even after the removal of this large portion of membrane there was no relief to the breathing, and the child had to be re-intubated.

J.R., aet. 5 years, was admitted to the County Hospital, Motherwell suffering from laryngeal diphtheria on 23rd. May, 1915. The tube was coughed out shortly after Intubation was performed bringing with it a large piece

of membrane. The tube was left out. The breathing was much easier for a time, but Intubation was required 12 hours later.

W.McD., aet. $3\frac{1}{2}$ years, was admitted to the County Hospital, Motherwell on 5th. June, 1919 suffering from laryngeal diphtheria. Intubation was performed, but the tube was coughed out twice, bringing a portion of membrane with it on each occasion. After the second time the obstruction seemed to be partially cleared away, as the breathing was much easier. The child slept for several hours, but was awakened by respiratory embarrassment, which necessitated Tracheotomy.

A.W., aet. 15 months, was admitted to the County Hospital, Motherwell on 6th. January, 1920 suffering from laryngeal diphtheria. On insertion of the tube a large piece of membrane was felt all over the epiglottis and glottic region. Large pieces of membrane were coughed up. The tube was removed to find if the child could do without it, in consequence of the expulsion of so large a piece of membrane. Re-intubation, however, had to be immediately performed.

T.McA., aet. 3 years, was admitted to the County Hospital, Motherwell on 12th. December, 1920 suffering from laryngeal diphtheria. The tube was inserted, but no relief was given. On its withdrawal a large piece of membrane was coughed up, which relieved the breathing.

The child remained comfortable for a few hours, when the breathing became more laboured, necessitating Tracheotomy.

J.S., aet. 8 months, was admitted to the County Hospital, Motherwell on 29th. March, 1921. During Intubation a large piece of membrane was coughed up, and the tube was removed. In consequence of this the child's breathing improved, but on the following day it again became so impeded that re-intubation had to be performed.

These cases, that have been referred to, show that even after coughing up large pieces of membrane, re-intubation may have to be performed.

On the other hand, complete relief may be obtained, as in the following cases:-

J.B., aet. 2 years, was admitted to the County Hospital, Motherwell on 13th. March, 1919. The child was intubated, but coughed out the tube together with a large piece of membrane. The breathing was quite easy afterwards, and the tube was not again required.

J.P., aet. 5 years, who was admitted to the County Hospital, Motherwell on 26th. October, 1919, was intubated and a large piece of membrane, which had separated in the process of intubation, was coughed up. The child was very well, and did not require re-intubation.

The conclusion, I have formed from observed cases, is that complete relief after coughing up of membrane is rare, and that temporary relief or no relief at all is a

usual occurrence. No doubt, when complete relief does occur, it is a great advantage. Ker states "Four of my Intubations were momentary only, the tube being coughed up with membranous casts, complete relief being thus obtained. I regard this possibility as one of the advantages of Intubation over Tracheotomy, such a satisfactory result being obtained with so little risk to the patient?" (The Scottish Medical and Surgical Journal, June, 1907). The number of cases quoted by Ker, however, is exceedingly small, and as I have shown above, this satisfactory termination is too rare to form a strong argument in favour of the operation.

The possibility of the Intubation tube entering the oesophagus may be regarded as remote in skilled hands, but in the hands of the unskilled it is an accident which not infrequently occurs. Even operators of considerable experience and dexterity may occasionally insert the Intubation tube into the gullet instead of the larynx. As a rule, the entrance of the Intubation tube into the oesophagus is not attended with serious consequences, as the tube can be immediately withdrawn by the attached string. The repeated introduction of the tube into the oesophagus, however, is of serious import, as the child suffers a brief asphyxia each time Intubation fails. Extreme exhaustion soon follows failure to insert the tube, and the child may become so deeply asphyxiated that Tracheotomy is necessary.

The operation of Tracheotomy, on such an occasion, is so urgent that the child may die on the table, before the trachea has been opened. The sound of the air rushing through the tube, at once informs the operator that he has successfully placed the tube in the larynx. The characteristic note, however, may not be immediately forthcoming, especially when the throat is filled with a muco-purulent exudate. When the operator is convinced that he has placed the tube in the larynx, but no characteristic sound is heard, he should swab away the mucus from the fauces and pharynx, when the true metallic note may be elicited. He should not pull out the tube until the mucus has been cleared away from the throat.

The chief cause of the tube entering the oesophagus is the slipping of the epiglottis from the tip of the forefinger. One cannot emphasize too strongly the importance of keeping the epiglottis heeked up. An unskilled operator may require to maintain the epiglottis in this position for a considerable time, a circumstance which favours the escape of this structure from the finger. In such a case Intubation is certain to fail, as the tube cannot do otherwise than pass into the oesophagus.

A tube, without a ligature, that has been inserted into the oesophagus, may be swallowed, and passed per anum. This

accident has not come under my notice, as a ligature, by means of which the tube may be withdrawn, is attached to its head. American surgeons do not use a ligature as a means of extubation; they prefer to remove the tube by means of the extractor. In *Tubage et Tracheotomie*, 1900, (Sargnon), one reads "One has noted several cases of swallowing of the tube after it was in position". However, a tube properly inserted in the larynx can only be swallowed if it be previously coughed out into the child's mouth. Accidents of this kind have been noted by O'Dwyer (1886), who published the results of a post-mortem examination, which revealed the presence of a tube in the stomach, and by Huber (1887), Derroud (1894), Massei (1892), Rabot (1898) and Variot (1895). The latter records four such cases. (*Tubage et Tracheotomie*, 1900, Sargnon). Swallowing of the tube is not followed by serious consequences, and I have heard of no cases where death has occurred.

Vomiting during Intubation.

Vomiting frequently complicates the operation of Intubation, especially if the child has been fed a short time before. The tube is frequently expelled with the vomit, necessitating re-intubation. Care should be taken to keep the head of the child to the side while vomiting, to prevent any particles passing into the trachea by way of the Intubation tube.

I have not seen a case where convulsions complicated the operation of Intubation; though M. Rabot reports four cases in a series of three hundred Intubations. (Tubage et Tracheotomie, 1900, Sargnon).

The advantages of Intubation.

Celerity is its great advantage. Should no accidents or difficulties be encountered during the operation, such as pushing down of membrane, slipping of the gag, inability to hook up the epiglottis, vomiting or convulsions, Intubation should be accomplished in almost thirty seconds. Anaesthesia is not required; and there is no scar on the neck as a cutting operation is avoided.

The operation of Tracheotomy.

Tracheotomy consists in opening the trachea and inserting a cannula, which is fixed in position by tapes. Opinions differ as to whether an anaesthetic should be administered. Should it not be administered, the child must be held down. The surgeon is more likely to perform the operation successfully on a child that is under the influence of a general anaesthetic than on a struggling child. The hurry associated with holding down the child usually interferes with the success of the operation.

In the County Hospital, Motherwell an anaesthetic is administered. Care should be taken to avoid deep anaesthesia in a child undergoing the operation of Tracheotomy. If the

child is anaesthetised deeply, and the operator has considerable difficulty in exposing the trachea, the breathing not infrequently stops before the completion of the operation. Should this contingency arise, the trachea should be immediately opened and the cannula inserted. The forcible restraint of holding a child down during the operation of Tracheotomy may be more harmful than an anaesthetic properly administered. The child is placed in position on the table with a sandbag beneath the neck. The head of the table is lowered so that the child's head is somewhat extended. By so doing, the trachea is pushed forward. A nurse holds the head in the proper position. It is essential that the head should not incline to one side. It should be held definitely in the middle line. An antiseptic, such as Tincture of Iodine, may be applied for the skin of the neck. The success of the operation greatly depends on the incision being exactly in the middle line. The method of blunt dissection is the one adopted in the County Hospital, Motherwell, but in cases of extreme urgency it may not be suitable, as the trachea may require to be opened at once. In very urgent cases, the operator may require to cut right down to the trachea, the left forefinger acting as his guide. In such cases the

operator should not stop on account of haemorrhage, as this generally ceases when the trachea is opened. The thyroid gland may be accidentally divided, but this matter will be referred to later. In cases where the opening of the trachea is less urgent, however, blunt dissection will probably give the most satisfactory results. It was said of Intubation, as previously mentioned, "that there is probably no more difficult operation in the whole of surgery." This may be said with equal truth about its rival operation - Tracheotomy. A steady hand and a cool head are necessary to anyone who may attempt this operation. Should there be sufficient time to perform the operation of blunt dissection, it should be the method of choice. The surgeon makes a vertical incision, about one inch to one and a half inches in length, in the middle line of the neck, beginning about the level of the cricoid cartilage. Bringel, in Medical Annual 1924, advocates a transverse incision, but this will again be referred to. Having severed the cervical fascia, the operator, if he has adhered strictly to the middle line of the neck, should observe the interval, which is indicated by a white line between the sterno-hyoid muscles on either side. The muscles are separated by blunt dissection, and retractors may be used to hold them apart. Good light is essential, and any large veins that may be encountered should be drawn

aside by small retractors. It may be necessary to pull down the isthmus of the thyroid gland or to pull it up. The exposed trachea may be steadied by inserting a sharp hook into it. It may then be opened, but there should be no undue hurry to insert the cannula. When the incision is made in the trachea, the dilators should be inserted to retract its edges. The cannula is then inserted, and secured in position by means of tapes tied round the neck.

The difficulties of Tracheotomy.

Haemorrhage is the chief danger. The blunt dissection method certainly minimises the amount of haemorrhage. Haemorrhage is generally due to tearing or cutting of the veins, such as the anterior jugular vein or the thyroid veins. The median line of the neck should be strictly adhered to. The innominate vein in a child frequently crosses above the sternum, and may be opened if a low Tracheotomy is performed. Care should be taken, therefore, to avoid making the incision too low. It is rare, however, to wound one of these large vessels. The haemorrhage, which may alarm the operator, usually arises from the smaller veins, and terminates as a rule with the opening of the trachea. On certain occasions,

however, so profuse may be this bleeding, that the operator may imagine that he has wounded one of the great vessels. The trachea should not be opened until the bleeding has ceased, as the blood may be sucked into the trachea at each inspiration, and forming a suitable nidus for organisms, may set up a fatal broncho-pneumonia. This rule, however, cannot be adhered to in cases of emergency. If in very urgent cases the haemorrhage does not cease when the trachea is opened, the vessels may have to be gripped by pressure forceps. A case of fatal haemorrhage is generally due to wounding one of the great vessels. I have only seen one such case.

Haemorrhage, undoubtedly, is the one great disadvantage of Tracheotomy. Even if the method of blunt dissection is adopted, there may be some haemorrhage. It may be the determining factor in one's choice of Intubation instead of Tracheotomy as the operation of election.

Bleeding may occur after the operation. For example:- S.F. was admitted on 29th. December, 1914, and Tracheotomy was performed. The tube was removed on 1st. January, 1915. On 13th. January, 1915 the child took a sudden and severe haemorrhage, which proved fatal. A post-mortem examination revealed some granulation tissue in the region of the old wound. This tissue extended

downwards to the common carotid and ulcerated through its wall.

In another case, recorded by Treves and Keith (Surgical Applied Anatomy, 1919), the tip of the Tracheotomy tube pressing on the front of the trachea produced an ulcer that opened the innominate artery. In this instance the vessel crossed the trachea higher up than in an adult.

The difficulty associated with the position of the thyroid gland.

The position of the thyroid gland with its isthmus crossing the second, third, and fourth tracheal rings increases the difficulty of the operation. The surgeon may accidentally divide the thyroid gland, while performing urgent Tracheotomy. This may result in profuse haemorrhage, and some blood may be sucked into the trachea. Even when the blunt dissection method is adopted, the operator may have great difficulty in circumventing the thyroid gland. The slightest pull by the retractor on one side more than on the other may bring a lobe of the thyroid gland into the field of operation, and may thus enhance the difficulty of locating the trachea. In this way, an otherwise simple operation may be rendered one of considerable difficulty. In some cases the operator may have to divide the thyroid gland, and control the resulting haemorrhage by pressure forceps. One patient, on whom I operated, ceased breathing before the trachea

was opened. This was accounted for by the time I spent in circumventing the thyroid body. This child, who was not too seriously ill at the commencement of the operation, was resuscitated by artificial respiration. It is of the greatest importance, therefore, not to exert undue and unequal traction, as this tends to disarrange the normal anatomical relationship in the field of operation.

The actual incision of the trachea may present certain difficulties. If the method of blunt dissection is adopted, the trachea may be steadied, and thus there should be no difficulty in making the incision. In an emergency operation, however, the surgeon may not make the incision exactly in the middle line. His incision may open the lateral wall of the trachea, and he may thus have great difficulty in inserting the dilators. Further, should he lose the opening, he may not readily find it again. The haemorrhage, which is usually profuse in an urgent Tracheotomy, increases this difficulty, and in the excitement of the moment the surgeon may make many futile attempts to insert the dilators, while the child becomes more and more asphyxiated, and may die on the table.

Bringel holds that the opening is not so easily lost if a transverse incision is made as the wound gapes widely. The operator should use a sharp knife, as he will find it much easier to cut through the tracheal rings. Care should be taken not to deviate to either side. The knife

may be turned at right angles when the trachea is opened, and the dilators may be passed along the blade into the wound. The tracheal cannula may then be inserted.

There should be no difficulty in doing so, unless a false passage exists, which is usually due to the incomplete division of the fascia covering the trachea. The incision in the trachea should not be too low, as the cannula may not remain in position. In one of my cases the incision was placed so low that the tracheal cannula was easily tilted out of its position.

The disadvantages of Tracheotomy, then, are (1) haemorrhage; (2) the position of the thyroid gland. Other disadvantages are of minor importance. Many prefer Intubation to Tracheotomy on account of the danger associated with severe haemorrhage.

The chief disadvantages of Intubation are, as I have previously mentioned, (1) pushing down of membrane; (2) the insertion of the tube into the oesophagus. The first is rare, and I have not met with a case where death was due to this accident, though I have referred to one that occurred in this hospital. The insertion of the tube into the oesophagus is a more common occurrence. Theoretically, with a skilled operator, this contretemps should not occur, but an epiglottis difficult to raise, a head improperly held by a nervous nurse, or excessive oedema of the parts are each sufficient to cause an operator of considerable skill, to

insert the tube into the oesophagus. Repeated failures to insert the tube are detrimental to the child, and in some cases may give rise to cardiac failure.

However, I consider that the danger, arising from haemorrhage in performing Tracheotomy, is far greater than any danger that may arise from the insertion of the Intubation tube into the gullet, or from pushing down of membrane. When the necessary skill is acquired, Intubation is a much easier operation than Tracheotomy. It is my opinion, therefore, that Intubation, considered apart from its results, is preferable to Tracheotomy.

(a). COUGHING OUT OF THE INTUBATION TUBE.

This is one of the great disadvantages of Intubation. It is the usual practice in this hospital to use a smaller tube than the age of the child indicates. For example, No. 2 tube is chosen for a child of three years, and so on. A small tube prevents undue irritation of the laryngeal mucosa, and consequently tends to minimise the incessant coughing, which may result from the use of too large a tube. Nevertheless, a tube that is coughed out immediately may with advantage be substituted by a larger one. Immediate ejection of the tube is not infrequent. This accident renders it necessary that an operator, competent to replace it, should be at hand.

A nurse cannot replace it. In many cases, a tube that is forcibly expelled may not require to be inserted for two hours or even more, but in other instances it may have to be replaced immediately. In some of our cases where the tube was expelled, rapid onset of asphyxiation led to a fatal termination. Repeated insertion of the tube is harmful to the child, and not infrequently has serious consequences. From an investigation of all our intubated cases, I have found that one child in every four expels the tube. The number of times, it is coughed up, varies. In those cases, where it is persistently coughed up, Tracheotomy may have to be performed to relieve the exhaustion consequent on repeated Intubation. I give below the total number of our cases that were intubated during the years 1915 - 1922 (1916 excluded), and the number that coughed up the tube. The number of times the tube was expelled is also stated.

<u>Year.</u>	<u>No. of cases intubated.</u>	<u>No. that coughed up the tube.</u>
1915	19	7 { 6 (coughed up tube 6 (coughed up tube once. 1 (coughed it out five times.
1917	17	6 { 3 coughed it out once. 3 coughed it out twice. 1 coughed it out six. times.

<u>Year.</u>	<u>No. of cases intubated.</u>	<u>No. that coughed up the tube.</u>
1918	15	3 { 2 coughed it out once. 1 coughed it out three times.
1919	23	7 { 6 coughed it out once. 1 coughed it out three times.
1920	25	5 { 2 coughed it out twice. 3 coughed it out three times.
1921	27	4 { 1 coughed it out once. 1 coughed it out twice. 1 coughed it out ten times. 1 coughed it out eleven times.
1922	17	5 { 1 coughed it out once. 1 coughed it out twice. 1 coughed it out three times. 2 coughed it out seven times.

Approximately, one child in every four expelled the tube. The consequences of coughing out the Intubation tube may be serious, as the following cases demonstrate.

Case of W.D., aet. 6 years. The child was admitted on 19th. January, 1922. No. 5 Intubation tube was inserted about 2 a.m., and the child coughed incessantly till morning.

On 26th. January, 1922, the tube was removed, but it was immediately required. It was withdrawn again three days later, but it had to be replaced in a short period of time. Two days afterwards, in the course of the night, the tube was again coughed out, and death occurred almost immediately. So rapid was the onset of asphyxiation in this case, that it is questionable if even a rapidly performed Tracheotomy would have saved the child.

Case of A.W., aet. 1 year. The patient was admitted on 28th. December, 1921. No. 1 Intubation tube was inserted. The temperature and pulse rate subsided to normal on the fifth day, and the tube was removed, but it had to be replaced after a short interval. On 9th. January, 1922, the patient coughed out the tube four times during the night, and it had to be re-inserted on each occasion. The temperature and pulse rate rose after the replacement of the tube. On 17th. January, 1922, the child coughed out the tube again, and almost died during the performance of Intubation. There was again a marked rise of temperature and pulse rate. Broncho-pneumonia supervened, and the child died in a few days. In this case it is worthy of note that an elevation of temperature corresponded with re-intubation. It is probable, therefore, that repeated Intubation may be a factor in the causation of broncho-pneumonia.

Case of C.H., aet. 3 years, admitted on 2nd. March, 1922. On admission, No. 3 Intubation tube was inserted. It was coughed out four days later, with a corresponding rise of temperature and pulse rate. On 17th. March, 1922, the tube was coughed out again three times during the night. On this occasion also there was a decided rise of pulse rate. Forcible expulsion of the tube again occurred on 23rd. March, 1922. On this occasion, there was a marked increase of pulse rate. On 24th. March, 1922, the tube was coughed out twice in the course of the night, and on the second occasion I failed to insert it. The child died during the performance of Tracheotomy. The accompanying chart shows the elevation of temperature and pulse rate following re-intubation.

Case of W.H., aet. 4 years, admitted on 13th. November, 1921. On admission, No. 3 Intubation tube was inserted. The tube was removed on the third day, but it had to be re-inserted. On 21st. November, the child coughed out the tube five times in the course of the night, and re-intubation was performed on each occasion. The child coughed it out frequently after this, but it had always to be replaced. On 6th. December, the tube was coughed out in the morning, but it was not re-inserted, as the breathing did not indicate re-intubation. In about an hour, however, the child was seized with sudden respiratory embarrassment, and on my arrival I found him

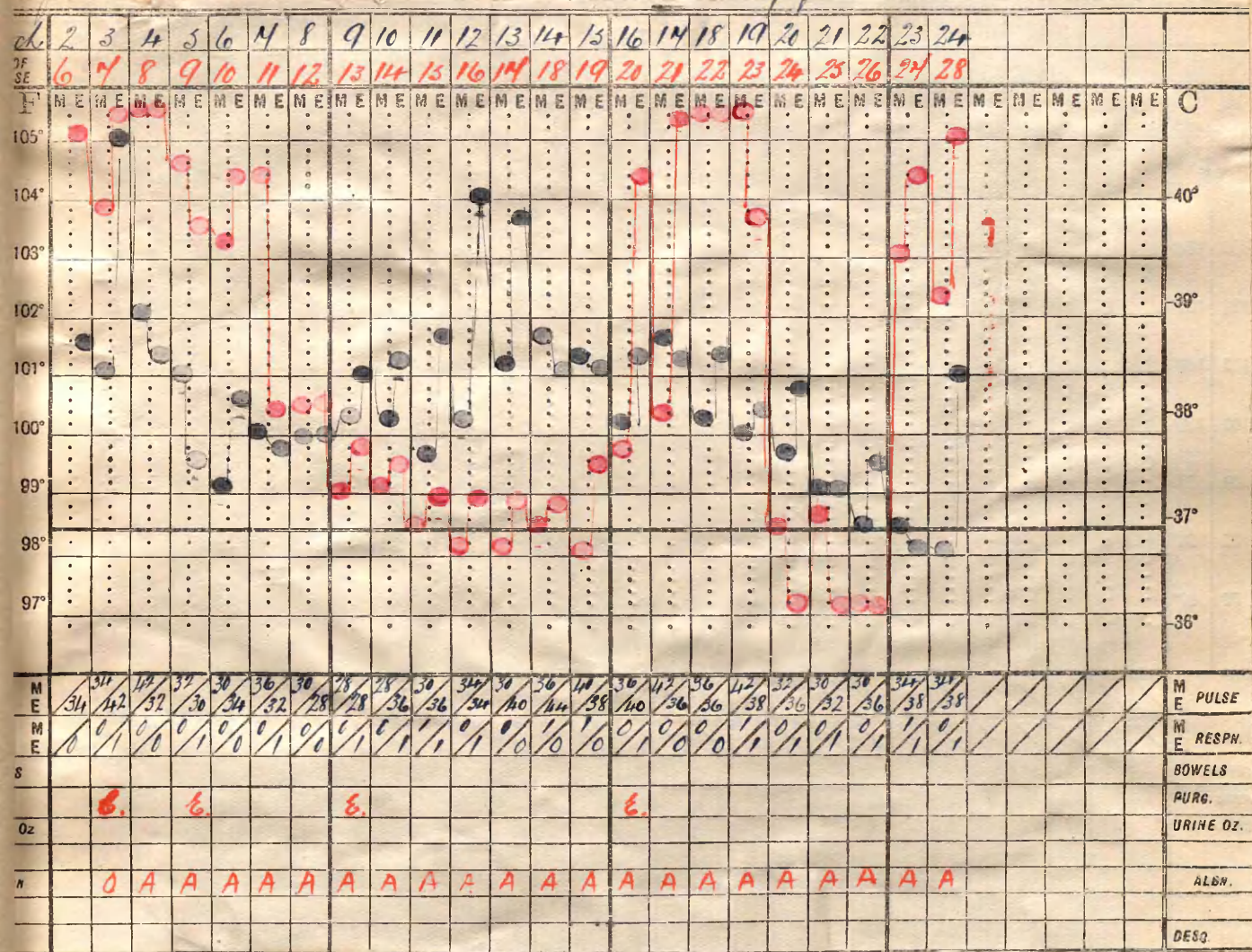


Chart of C. H. admitted. 2nd March. 1922.
 showing elevation of pulse rate on 17th and
 23rd corresponding with re-intubation,
 and elevation of T₀₁ pulse rate on
 6th corresponding with re-intubation.

deeply asphyxiated. On the insertion of the gag, the breathing ceased. I failed to insert the Intubation tube, with consequent death of the child. I had intubated the patient on several occasions previous to this, but failed to do so in this particular instance, on account of the difficulty encountered in elevating the epiglottis. In a dying child, it is very difficult to raise the epiglottis on account of its flaccid condition. This child was of a nervous disposition, a type, which, in my opinion, is not suitable for Intubation.

Case of J.K., aet. 1 year, admitted 17th. June, 1922. The child was intubated on admission, but coughed it out in a short time. Re-intubation was performed. The child expelled the tube several times after this, but it had always to be re-inserted. On 13th. July, the child again coughed out the tube. Rapid asphyxiation followed, and death occurred before the tube could be re-inserted.

It is evident from these cases, that have just been described, that coughing out of the tube is too frequently attended with serious results. Some writers on the subject of Intubation contend that accidental expulsion of the tube is so rare, that it need not be regarded as a serious disadvantage. For example, H.A.T. Fairbank, in an article in the *Lancet* of June, 1903, states that coughing out of the tube is seen but rarely. Scholes⁴ also states, in his treatise on diphtheria, that coughing

out of the tube has been much overrated. However, Sargnon gives 20 to 25 per cent. as the proportion of those, who cough out the tube, which is in complete agreement with our experience. I contend, therefore, that coughing out of the tube is one of the great disadvantages of Intubation, on account of the frequency of its occurrence, and that sudden death is often due to this cause.

- (b). **THE AVERAGE NUMBER OF TIMES THE INTUBATION TUBE WAS INSERTED FOR EACH CHILD WILL NOW BE COMPARED WITH THE AVERAGE NUMBER OF TIMES THE TRACHEAL CANNULA WAS REQUIRED.**
-

The tube is usually removed on the third day.

However, there is no definite time for its removal, as it depends entirely on the child's condition. The tube may not be required again, or it may have to be replaced immediately after its withdrawal, or some hours later. In some cases it may have to be re-inserted on the following day. Scholes⁴ holds that children over four years scarcely ever require re-intubation, and in consequence he would intubate all children, suffering from severe laryngeal diphtheria, over four years, whether in hospital or in private practice. A table giving the relative ages of our intubated cases, and the average number of times the tube required to be re-inserted, is added

in order to demonstrate that the statement made by him, is not borne out by results that have been obtained in this hospital.

<u>Age.</u>	<u>No. of Intubations.</u>	<u>Total No. of times tube was inserted.</u>	<u>Average No. of times tube was inserted.</u>
Under 1 year,	2	4	2.0
1-2 "	31	83	2.6
3 "	32	97	3.0
4 "	26	67	2.5
5 "	17	47	2.8
Over 5 "	35	61	1.7

The average number of times the tube required to be replaced in children over 4 years was 2.1. It is, therefore, impossible to agree with Scholes that children over four years scarcely ever expel the tube, nor do I approve of Intubation in private practice, on account of the uncertainty of the tube remaining in position in the larynx, whether the child be under or over four years.

The above figures also demonstrate that 143 of our intubated cases required the Intubation tube inserted 359 times, i.e. an average of 2.5 times for each. This figure will now be compared with the average number of times the tracheal cannula required to be inserted.

In the year 1913, there were 18 cases of Tracheotomy. In those cases the cannula was inserted 32 times, i.e. an average of 1.7 times for each.

In the year 1914, the tracheal cannula was inserted 61 times in a series of 27 cases, i.e., an average of 2.2 times for each.

In the year 1923, the tracheal cannula was inserted 17 times in a total of 15 cases, i.e., an average of 1.2 times for each.

The average number of times, therefore, the tracheal cannula required to be inserted, in the years mentioned above, was 1.7 for each. It was demonstrated, however, that the average number of times the Intubation tube was necessary for each child was 2.5, so that it would appear that the advantage is on the side of Tracheotomy. Further, Tracheotomy has the great advantage that the tube can be replaced by a nurse. Re-intubation, on the other hand, renders it necessary that a skilled operator should be at hand. Re-intubation, moreover, tends to exhaust the child, and may favour the development of broncho-pneumonia, while the re-insertion of the tracheal cannula has no such effect. For these several reasons, therefore, I consider that Tracheotomy is much to be preferred.

(c). THE AVERAGE NUMBER OF DAYS THE INTUBATION TUBE WAS REQUIRED, CONTRASTED WITH THE AVERAGE NUMBER OF DAYS THE TRACHEAL CANNULA WAS NECESSARY.

The following table shows the number of cases intubated, the total number of days the tube was required, and the average period the Intubation tube was in position during the years 1915 - 1922 inclusive.

<u>Year.</u>	<u>No. of cases intubated.</u>	<u>Total No. of days the tube was required.</u>	<u>The average period the tube was in position.</u>
1915	19	80	4.2 days.
1916	6	26	4.3 "
1917	17	133	7.8 "
1918	15	83	5.5 "
1919	23	75	3.2 "
1920	25	156	6.2 "
1921	27	220	8.1 "
1922	17	191	11.2 "

Therefore, the average number of days the tube was required, calculated on the total number of cases, was 6.4.

This average will now be contrasted with the average number of days the tracheal cannula was found to be necessary in the years 1913, 1914, and 1923.

<u>Year.</u>	<u>No. of cases on whom Tracheotomy was performed.</u>	<u>Total No. of days the cannula was in position.</u>	<u>The average No. of days the cannula was required.</u>
1913	18	96	5.3
1914	27	197	7.2
1923	15	56	3.7

Therefore, the average number of days the tracheal cannula was required, calculated on the total cases, was 5.8. It would appear, therefore, that the average time the tracheal cannula is required is less than that for the Intubation tube. Statistics, however, based on epidemics of diphtheria of various years may be of uncertain value, as the type of diphtheria may vary. However, it has always appeared to me that an intubated child is more nervous than one in whom Tracheotomy has been performed; a circumstance which may favour the earlier removal of the cannula.

(d). THE INCIDENCE OF LARYNGEAL STENOSIS IN INTUBATION AND TRACHEOTOMY.

Stenosis of the larynx in general is attributable to such causes as subglottic laryngitis, exuberant granulation tissue, cicatricial contraction, absorption of cartilage, or abductor paralysis. The Intubation tube, when in position in the larynx, may act as an irritant to the laryngeal mucosa, resulting in abrasion or ulceration of the membrane, and subsequently in excessive growth of granulation tissue, cicatricial contraction, or a laryngitis of the subglottic region. Consequently, a suitable tube should be chosen to avoid undue irritation of the laryngeal wall. The irritation due to too large a tube not infrequently produces incessant coughing. However, I have known cases,

where even a tube of smaller size than the one indicated produced some irritation of the laryngeal wall. It is our practice, in order to minimise irritation of the laryngeal mucosa, to use a smaller tube than that which is indicated by the age of the child. According to Baudraud,⁵ the principal cause of ulceration of the larynx resides in the pressure exercised upon the laryngeal mucosa by the tube, which indeed plays the part of a foreign body. O'Dwyer mentions friction of the tube against the laryngeal wall as the chief cause. (*Tubage et Tracheotomie*, 1900, Sargnon). Bouchut produced ulceration on dogs by inserting his tubes; Trousseau demonstrated its occurrence on the third or fourth day; Northrup, in 1887, remarks on the frequency of ulceration at the lower part of the trachea; Brook, in 1894, in 15 post-mortem examinations notes ulceration, but does not regard it seriously. (*Tubage et Tracheotomie*, 1900, Sargnon). It is recorded by Dillon Brown⁶ that stenosis occurs approximately once in every 100 cases. In any particular case it is impossible clinically to state whether stenosis is due to exuberant granulation tissue, subglottic laryngitis, absorption of cartilage, or abductor paralysis. In fact, the real nature of the condition can only be revealed by a post-mortem or bronchoscopic examination.

In the year 1922, in the County Hospital, Motherwell, the incidence of laryngeal stenosis following Intubation

was phenomenal in its frequency. In this year, severe laryngeal stenosis following Intubation complicated 7 out of 17 of our cases. This extraordinary figure, 41.1 per cent., does not agree with that recorded by Dillon Brown, or with that recorded by Meara, 5 per cent. (The Treatment of Acute Infectious Diseases, 1916), Meara.

The following table indicates the number of cases of laryngeal stenosis after Intubation in the years 1915 - 1922 (1916 being excluded):-

<u>Year.</u>	<u>No. of cases of laryngeal diphtheria.</u>	<u>No. of cases of laryngeal stenosis.</u>	<u>Percentage</u>
1915	19	2	10.5
1917	17	2	11.7
1918	15	1	6.6
1919	23	1	4.3
1920	25	3	12.0
1921	21	3	14.2
1922	17	7	41.1

The average percentage for these years, therefore, is 10.

The treatment and results of these cases of laryngeal stenosis following Intubation will now be considered.

Case of M.W., aet. 4 years, admitted 2nd. October, 1921. Intubation was performed on admission. The tube was coughed out in a short time, and a larger tube, No. 4, was inserted. On the third day the tube was removed, but it had to be replaced. Two days later the tube was again removed, but

it had to be replaced shortly afterwards. It was removed on several occasions following this, but re-insertion was always necessary. On the 17th. October, the tube was again removed. On this occasion there was slight recession of the chest wall, but not enough respiratory difficulty to indicate re-intubation. The tube was, therefore, not replaced. This slight retraction of the chest wall, however, persisted for about three weeks, and the pulse was somewhat irregular. The dyspnoea increased and the child's condition became grave. Intubation was accordingly indicated, but on attempting to insert the tube it was found that there was almost complete occlusion of the lumen. Accordingly, Tracheotomy was performed. Was this occlusion of the lumen following the use of the Intubation tube due to cicatricial contraction, or was it accounted for by excessive growth of granulation tissue? The child's condition improved after Tracheotomy was performed, but naturally the cannula could not be removed. The parents consented to further operation, when it was explained to them that it was the only means by which the child might be able to dispense with the cannula. An anaesthetic was administered, and the wound was opened up, thus exposing the part of the trachea where the stricture was located. A vertical incision was made through the stricture, and No. 4 Intubation tube was placed in position in the larynx. On removal of the tube 5 weeks after this

there was no indication of any respiratory difficulty, and it was consequently not replaced. In a week's time, however, the breathing again became embarrassed, and the tube had to be re-inserted. On this occasion some difficulty was experienced in intubating, the tube apparently being impeded by a partially stenosed larynx. The tube was allowed to remain in position for 6 weeks, but the formation of a tube abscess necessitated its withdrawal. It had to be replaced, however, in 2 weeks. A month later it was removed, but on this occasion the child's breathing was found to be much improved and re-insertion of the tube was not again required. The child was 10 months in hospital. This case illustrates the value of prolonged Intubation in the treatment of laryngeal stenosis.

The child was examined by me 18 months after discharge from hospital, and I found her general condition very good. The breathing, however, was noisy, and the voice extremely hoarse. The child attends school daily.

Case of E.F., aet. 3 years, admitted 27th. November, 1921. No. 3 Intubation tube was inserted on admission, but it was expelled on three successive occasions, and a larger tube was indicated. No 4 tube was, accordingly, inserted. However, auto-extubation and re-insertion of the tube occurred several times during the first week, and thus the child was considerably weakened. Ultimately, persistent ejection of

the tube occurred, which necessitated the operation of Tracheotomy. The child almost died on the table. The Intubation tube was replaced 4 days later. In cases of persistent expulsion of the tube, where Tracheotomy has been done as an urgent operation, it is necessary to remove the tracheal cannula as soon as possible, as, if this is not done, the larynx will probably close down above the tracheal wound, thus preventing further Intubation. In this case, no difficulty was experienced in inserting the Intubation tube after the removal of the tracheal cannula. The Intubation tube was allowed to remain in position for 2 weeks. It was then removed, and it did not require to be re-inserted.

I examined this child on 20th. March, 1924, fully 2 years after being discharged from hospital, and found her general condition good. The breathing, however, was noisy on exertion and during sleep, and also when a cold was contracted. It is worthy of note that during an attack of measles, about 3 months ago, the child had no sign of respiratory obstruction.

Case of A.S., aet. 2 years, admitted 9th. April, 1922. During the first 2 weeks in hospital, the child expelled the Intubation tube on several occasions. So persistent did expulsion of the tube become, than an urgent Tracheotomy had to be performed. During the operation the child almost died. Six days later, re-intubation was performed

The tube was removed in 6 weeks, and did not require to be re-inserted. The breathing, however, was very noisy. The child was discharged after residence in hospital of $4\frac{1}{2}$ months.

About 2 years afterwards on 17th. January, 1924, the child was re-admitted suffering from considerable respiratory difficulty. Re-intubation was indicated, but No. 3 tube, which was chosen, would not enter the larynx. A smaller tube was selected, but it was also found impossible to insert it, and consequently the operation of Tracheotomy had to be performed.

About one week after Tracheotomy was performed, a general anaesthetic was administered, and a director was inserted into the larynx by way of the Tracheotomy wound. Subsequently, a pair of scissors was inserted by the same route, and the blades were gently separated in order to dilate the lumen. A vertical incision of about $\frac{3}{4}$ " beginning at the upper end of the Tracheotomy wound, was then made in the anterior wall of the trachea. No. 3 Intubation tube was then placed in position in the larynx. On the following day, it was coughed up, necessitating the introduction of a larger tube. The tube was allowed to remain in the larynx for 5 weeks. It was then removed, and did not require to be re-inserted. The child is still

in hospital. The breathing is noisy at times, but otherwise the general condition of the patient is good.

This case is of considerable importance, as the failure of the tube to pass into the larynx, is sufficient evidence of the existence of a partial stenosis. On inquiry in regard to the condition of the child before she was readmitted to hospital, the mother states that the child's breathing was always noisy, especially during the night, and that it seemed to her that the child would choke. The voice was always very hoarse.

In the light of this case, I would conclude that those cases of stenosis, that have been discharged from hospital after prolonged Intubation and that still have noisy breathing or some slight respiratory embarrassment on exertion, suffer from a partial stenosis of the larynx.

Case of T.W., aet. $3\frac{1}{2}$ years, admitted on 21st. June, 1922. After Intubation, frequent expulsion of the tube occurred, and the child's condition became so serious that the trachea had to be opened and a cannula inserted. A week later, the Intubation tube was replaced. The tube was removed 10 days afterwards, and it was not again necessary. This child was discharged on 13th. October, 1922 after residence in hospital for 113 days.

On inquiry regarding the child's condition 18 months after discharge from hospital, I was informed that the child

had recently died suddenly. The father stated that the child had been in good health after his discharge from hospital, but that the breathing was laboured, especially on exertion and during sleep. It also was more laboured when a cold was contracted. One night the child was awakened, apparently by some respiratory obstruction, which however passed off in a short time. The father stated that he thought the child would choke. At this particular time, the child was suffering from a cold. Two days following this, the child was again awakened during the night on account of dyspnoea. On this occasion, the child became rapidly worse, and death occurred in a few minutes. No post-mortem examination was performed, but there is strong evidence that this child suffered from partial stenosis of the larynx.

Death was probably due to complete occlusion of the constricted lumen, produced by the congestion of the mucosa associated with the catarrhal condition.

Case of S. McN., aet. 2 years, admitted 9th. January, 1920. Intubation was performed, but as the tube was persistently coughed up, Tracheotomy was necessary. When re-intubation was attempted, the tube would not enter the larynx on account of constriction of the lumen. An anaesthetic was administered, and the surgeon cut through the cricoid cartilage and part of the thyroid. The upper end of the opening was found to be closed by scar tissue. The

Intubation tube was inserted after the removal of the scar tissue. The tube was withdrawn in one month to be cleaned. The child was comfortable, and consequently the tube was not replaced. Three days later, however, the patient again had considerable respiratory difficulty, and it was essential to re-insert the Intubation tube. On attempting to do this, however, it was found that the larynx had again closed down, and consequently the tube would not enter. The child was taken home by the parents, who refused to have any further operative treatment.

This child was examined by me on 26th. March, 1924. I found the general condition of the patient to be good, though the tracheal cannula has been constantly worn since discharge from hospital. The breathing is stertorous during the night, but the child can run about without any difficulty.

Case of R.S., aet. 3 years, admitted 15th. March, 1920. No. 3 Intubation tube was inserted. Three days later the tube was removed, but re-insertion was necessary. The tube was coughed out several times after this, but always had to be replaced. On 4th. April, the child again expelled the tube, and an urgent Tracheotomy had to be performed, on account of the rapid asphyxiation which followed its expulsion. In about a week after this, the Intubation tube was again replaced. On this occasion there was some resistance to the tube as it was being

passed into the larynx. On the following day the Intubation tube was coughed up necessitating the insertion of the cannula. Ten days after this it was found impossible to intubate on account of a constricted lumen. A second attempt to insert the Intubation tube was made a few days later, but it was unsuccessful. The child was taken home by the father, who refused further operative interference.

Shortly after going home, Dr. Walker Downie was called to see the child, and advised operation. Accordingly, the child was brought back to the County Hospital, Motherwell, where the operation was performed. On 26th. August, 1920 Walker Downie opened up the larynx, and found a constricting band above the tracheal wound. A soft rubber tube was inserted after removal of the band. A silk cord was attached to the upper end of the rubber tube, and also to the lower end. The cords projected out of the wound. By means of the cords the tube was kept in its proper position, i.e. by pulling the lower cord the rubber tube was drawn upwards, and by pulling the upper cord the tube was drawn downwards. On the 3rd. September, the rubber tube had to be removed, as the child's breathing was somewhat laboured. The tracheal cannula was inserted. Two days later the rubber tube was replaced, but it had to be removed again in 3 days, and the tracheal cannula replaced. The rubber tube was re-inserted several times after this, but the tracheal cannula had always

to be replaced, as the child could not breathe satisfactorily with the rubber tube. On 20th. October, the child was taken home with the tracheal cannula in position in the larynx.

On 17th. November, 1923, Dr. Syme was called to see the child, and he advised further operative treatment.

Accordingly, the child was removed to the Throat and Nose Wards of the Western Infirmary, Glasgow. A rubber tube was again inserted, but after 4 months' treatment, the child was removed home with the tracheal cannula in position in the larynx.

As has been previously mentioned, prolonged Intubation with the vulcanite tube is the most satisfactory treatment in laryngeal stenosis.

Case of G.L., aet. 2 years, admitted on 9th. September, 1921. The child was intubated on admission, but coughed up the tube shortly afterwards. Accordingly, it had to be replaced. During the next 10 days, the tube was expelled on several occasions, and in consequence the child was considerably weakened. The tube was coughed out one morning early, and so rapid was the onset of asphyxiation that the child died before it could be re-inserted.

A post-mortem examination revealed thickening of the mucous membrane beneath the epiglottis and inside the larynx. On the anterior wall of the trachea, there was a little area of thickened mucous membrane. At this point, the wall was ulcerated through, the opening communicating with an abscess

in front.

Case of M.R., aet. $1\frac{1}{2}$ years, admitted on 22nd. April, 1921. This was another case of persistent ejection of the tube, which resulted in the performance of Tracheotomy. Four days after Tracheotomy was performed, the Intubation tube was re-inserted. Auto-extubation, however, continued. One morning after expulsion of the tube, the child was so exhausted that Intubation was not indicated, on account of the difficulty that is experienced in hooking up the epiglottis in a moribund child. Accordingly, I re-opened the old tracheal wound, but the child died before I managed to re-insert the cannula.

A post-mortem examination revealed ulceration of the anterior wall of the trachea below tracheal opening. There was evidence of absorption of cartilage. The glottis was normal.

In this case, and in the one previously mentioned, the ulceration was situated on the anterior wall of the trachea. From our limited number of post-mortem examinations, I cannot form an estimate of the relative frequency of ulceration on the anterior wall.

According to O'Dwyer,⁵ however, there are three situations where ulceration is most likely to occur, (1) the cricoid area, (2) the base of the epiglottis, (3) the anterior wall of the trachea. Tsakiris and Hugues⁵ mention the anterior part of the trachea, the base of the epiglottis, and the arytenoid and cricoid cartilages.

Bokai, in his series of cases, found ulceration of the anterior wall 73 times, ulceration from the fourth to the tenth ring of trachea 35 times, and ulceration from the first to the fourth ring of trachea 11 times. (Sargnon, Tubage et Tracheotomie, 1900).

Case of W.R., aet. $4\frac{1}{2}$ years, admitted 2nd. February, 1917. This child was intubated on several occasions, but the operation of Tracheotomy was not necessary. The child was discharged on 28th. March, 1917.

Two months after this, the child was brought back to hospital suffering from dyspnoea. The parents refused to leave the child, however, but consented to his going to the Victoria Infirmary, Glasgow. A bronchoscopic examination revealed stenosis of the larynx. The child died suddenly in the Victoria Infirmary.

In this case, death was probably due to slow cicatricial contraction, subsequent to ulceration of the larynx. No post-mortem examination was performed.

The conclusions, that might be drawn from these cases of laryngeal stenosis which have been described, are

- (1). That stenosis of the larynx frequently occurs after the use of the Intubation tube. In our series it was approximately 10 per cent.
- (2). That prolonged Intubation by the hard vulcanite tube is the most satisfactory treatment for laryngeal stenosis.

- (3). That after successful treatment of laryngeal stenosis with the hard vulcanite Intubation tube, a certain degree of stenosis may still exist.
- (4). That a simple catarrh superimposed upon a partial stenosis of the larynx may in a few cases have a fatal termination.
- (5). That the voice is usually hoarse after the use of the Intubation tube.

I append a brief summary of all the cases of laryngeal stenosis following Intubation since 1915:--

<u>Year.</u>	<u>Case.</u>	<u>Result.</u>	<u>Remarks.</u>
1915	R.B.	Recovered.	-
	J.B.	Recovered.	Examined by me 28/3/24, very well.
1917	E.McF.	Recovered.	Child thin, breathing quite normal, attends school irregularly.
	M.McD.	Recovered.	-
1918	J.D.	Discharged wearing tracheal cannula.	Died at home.
1919	G.M.	Recovered.	-
1920	S.McN.	Discharged wearing tracheal cannula.	Examined by me 28/3/24, child very well, but still wearing cannula.
	C.B.	Recovered.	Examined by me 28/3/24, voice hoarse, general condition good.
	R.S.	Discharged wearing tracheal cannula.	Had subsequent treatment in Western Infirmary, Glasgow, still wearing tracheal cannula.

<u>Year.</u>	<u>Case.</u>	<u>Result.</u>	<u>Remarks.</u>
1921	M.R.	Died.	-
	G.L.	Died.	-
	W.H.	Died.	-
1922	M.W.	Recovered after prolonged Intubation.	Examined by me 28/3/24, general condition very good, breathing noisy, voice hoarse.
	E.F.	Recovered after prolonged Intubation.	Examined by me 26/3/24, general condition good, breathing noisy, voice hoarse.
	A.W.	Died.	-
	A.S.	Recovered after prolonged Intubation.	Re-admitted to hospital 2 years afterwards suffering dyspnoea. A case of partial stenosis.
	T.H.	Died.	-
	J.K.	Died.	-
	T.W.	Recovered after prolonged Intubation.	Died suddenly at home during the night, probably a case of partial stenosis.

Laryngeal stenosis following the use of the tracheal cannula.

Case of T.M., aet. 3 years, admitted 6th. January, 1914.

Tracheotomy was performed on admission. The cannula was frequently removed, but it had always to be replaced.

The child died on 28th. February, 1914.

Some doubt existed as to whether this was a case of cicatricial contraction, subsequent to ulceration of the

larynx, or whether it was of nervous origin entirely, as the child would be quite well for a time, then suddenly wake up through the night struggling for breath. No post-mortem examination was performed.

Case of J.K., aet. 2 years, admitted 1st. May, 1922.

This child was very ill on admission, and having failed to intubate, I performed Tracheotomy. The cannula was removed in a few days, but it had to be replaced. It was removed on several occasions after this, but the child's dyspnoea always necessitated the replacement of the cannula. On 30th. May, the child was intubated. The Intubation tube passed into the larynx without any difficulty. Six days later, the Intubation tube was removed, and it did not require to be replaced.

In this case, prolonged Intubation was not necessary. It was probably a case of partial stenosis following the use of the tracheal cannula.

This child was examined by me on 29th. March, 1924, almost two years after discharge from hospital. The child's general condition was good, but the breathing was noisy, especially after a cold or on exertion. The mother stated that the breathing was not so noisy as it was when the child was discharged from hospital.

Case of C.L., aet. 2 years, admitted 25th. July, 1922. Tracheotomy was performed on admission. The cannula was removed on several occasions, but it had always to be

re-inserted. Broncho-pneumonia supervened, and the child died.

This was probably a case of partial stenosis of the larynx, following the use of the tracheal cannula.

Case of P.D., aet. 1 year, admitted 7th. March, 1924. Tracheotomy was performed on admission. The tracheal cannula was taken out several times, but it had always to be replaced in a short time on account of dyspnoea. The Intubation tube was finally inserted, as it was considered there might be a stenosis above the tracheal wound. The tube passed into the larynx, however, without much difficulty. It was allowed to remain in position in the larynx for a few weeks. After its removal, the child was found to be fairly comfortable without it. The tube did not require to be replaced. The child is still in hospital.

These are all the cases of stenosis of the larynx, subsequent to the use of the tracheal cannula, that have been observed in this hospital during the years 1913, 1914, 1922, 1923, and 1924.

It appears, therefore, that laryngeal stenosis is less frequent after Tracheotomy, than it is after the use of the Intubation tube.

It is evident, from the literature on the subject, that other operators, who practise Intubation, have frequent experience of laryngeal stenosis, and of the difficulties met with in its treatment. In Welsh and Schamburg,

one reads "Three of our patients were taken to a general hospital, and placed under the care of a surgeon. An operation was performed with the view of overcoming the stenosis, due to contraction of the cicatricial tissue in the larynx, but in each instance the operation was unsuccessful, and the tracheal cannula had to be continued. Two of these children contracted pneumonia and died. There are other three ex-patients, of whom we have knowledge, with retained tracheal tubes, in one the retention at the time of writing has extended over a period of six months, and in the other two of about four years each"

It has been already stated that prolonged Intubation with the hard vulcanite tube is the most satisfactory treatment for laryngeal stenosis. Its only disadvantage is that the tube may be forcibly expelled. To overcome this disadvantage, Dr. Rogers treats stenosis with special Intubation tubes, into the anterior part of which a plug is screwed or a clamp placed, so that it will project vertically out through the tracheal opening, making it obviously impossible for the tube to be coughed out. (Archives of Pediatrics, March, 1916). However, in our cases, treated by prolonged Intubation for laryngeal stenosis, coughing up of the tube has been a rare occurrence, as it is our custom to use a large tube for dilatation of the stricture. Dr. Samuel Iglauer, on the other hand, uses a hard

rubber Intubation tube with a groove cut round the neck. A silk thread tied around this groove projects through the tracheal opening, and is fastened to the sides of the neck by means of adhesive plaster, thereby preventing auto-extubation. (Archives of Pediatrics, March, 1916). However, as previously mentioned, I consider that the most satisfactory results are obtained by O'Dwyer's hard vulcanite Intubation tube, and that in those cases of prolonged Intubation, to overcome stenosis of the larynx, the tube is not so frequently expelled.

The following case, that was regarded by me as laryngeal stenosis, may now be described.

Case of C.D., aet. 3 years, admitted 25th. June, 1923. This child was considered to be suffering from laryngeal diphtheria, and accordingly 8,000 units anti-diphtheritic serum were given intramuscularly with apparent benefit. After being in residence in hospital for 3 weeks, the child was suddenly seized with severe dyspnoea about 10 p.m. one evening. Two hours later, I had to perform Tracheotomy, and the child was instantly relieved. In a few days, the tracheal cannula was removed. The patient's breathing, however, continued to be noisy, and there was slight recession of the chest wall, which I regarded as being probably due to a certain degree of stenosis of the larynx, subsequent to Tracheotomy. During this time the patient's breathing was not sufficiently embarrassed to

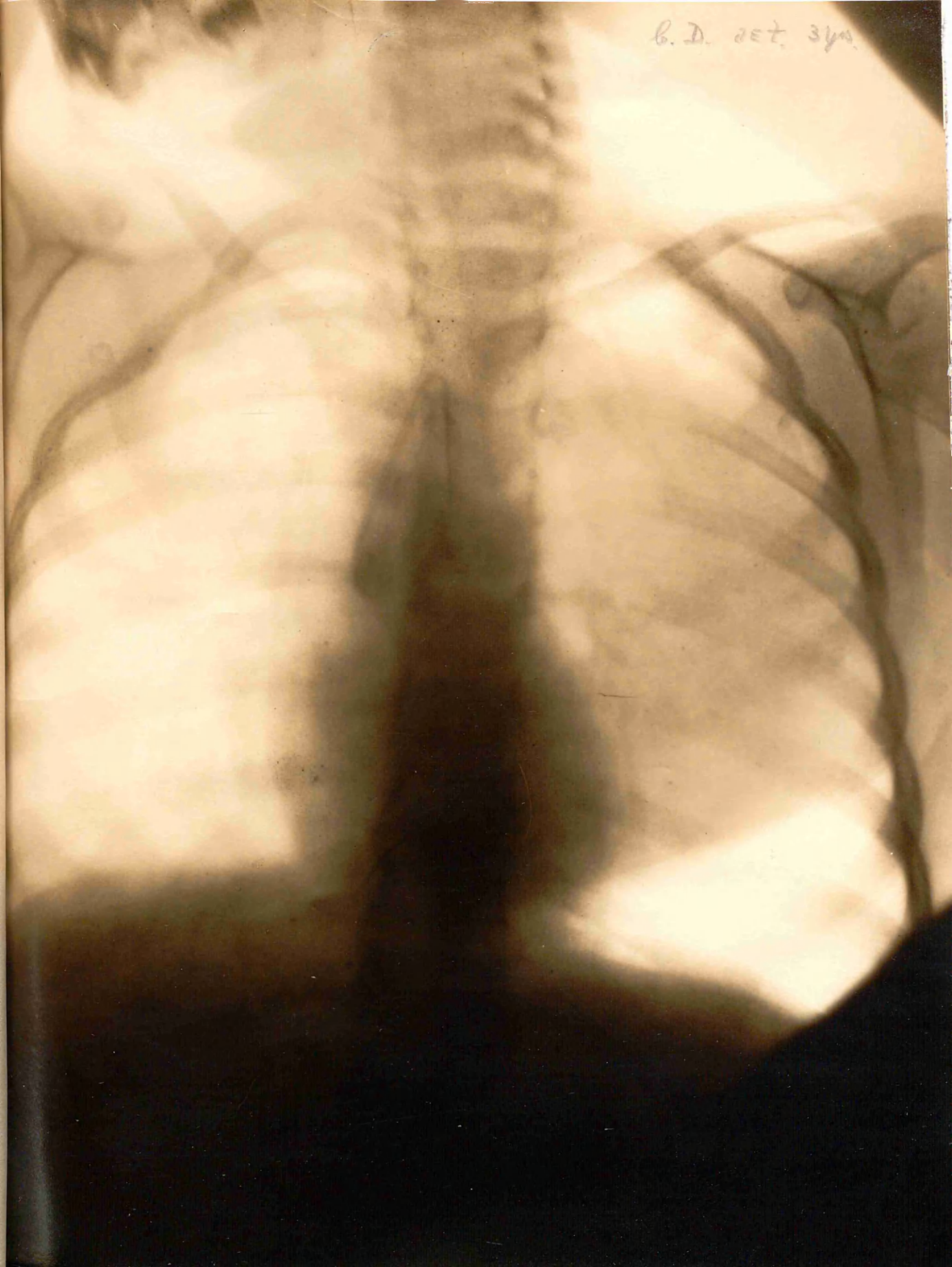
necessitate the re-introduction of the tracheal cannula. The Intubation tube was inserted to determine if there were any stenosis of the larynx. The ease with which the tube was passed, however, and its failure to relieve the dyspnoea, indicated that the slight respiratory difficulty was due to some cause other than stenosis. It was then considered that the persistent dyspnoea might be arising from the condition of the child's chest. Accordingly, an X-ray photograph of the chest was taken, which revealed an open safety pin in one of the bronchi.

Dr. Brown Kelly was called to see the child, and he advised removal to the Victoria Infirmary, Glasgow. A bronchoscopic examination was then made, and the pin was successfully removed. The child made a complete recovery. The pin may be seen in the accompanying photograph.

(e). THE INCIDENCE OF BRONCHO-PNEUMONIA IN THE RIVAL OPERATIONS.

Many surgeons, who practise Intubation in preference to Tracheotomy, contend that the incidence of broncho-pneumonia is less after the former operation. There would appear to be some justification for this view, on account of the possibility of blood being sucked into the trachea when it is opened. In fact, when I first became interested in these rival operations, I was inclined to hold the same opinion. Many surgeons hold this view at the present time. For

G. D. det. 340.



example, Scholes⁴ regards the greater incidence of broncho-pneumonia after Tracheotomy as one of the disadvantages of the operation. Ker² appears to hold the same view, as he refers to broncho-pneumonia as that dreaded complication of Tracheotomy. Bonain and Gillet⁵ likewise hold that this complication is more frequent after Tracheotomy. According to Gillet this complication arises in 60 per cent. of cases of Tracheotomy, and 54 per cent. of Intubation. Chaillon⁵ (1895) holds that this complication is more frequent after Tracheotomy. On the other hand, Hagenbach, Burckard, Roucke, and Escherich⁵ (1893), hold the converse view. Damin (1895) also holds that this complication is more frequent after Intubation. (Sargnon, Tubage et Tracheotomie, 1900).

The factors in the causation of this complication may now be considered. The cause of this complication may not be attributable to either of these rival operations, but may in some cases be due to the spread of the membrane to the bronchi and smaller bronchi. In fact, I would consider, that in many cases this complication is naturally a sequel to the primary pathological condition. But on the other hand the cause of this complication may reside wholly with the operation. For example, the blood which may be sucked into the trachea, when it is opened, may be the direct cause of a complicating broncho-pneumonia. In Intubation also, broncho-pneumonia may be the result of the ingestion of fluid while the child is being fed.

On this matter, however, there are divergent views. For example, Casselbury⁵ holds that broncho-pneumonia may be the direct result of the ingestion of fluid, and he accordingly recommends that the child should be fed with the head at a lower level than the body - Casselbury's position. O'Dwyer⁵ contends that this complication does not occur in the adult. Castaneda holds the same opinion as Casselbury. (Sargnon, Tubage et Tracheotomie, 1900).

Northrup⁵, however, does not believe that broncho-pneumonia is caused by the ingestion of fluid during feeding. In 116 autopsies, he found neither milk nor any other foreign substance in the bronchi, and by giving children with the tube in position coloured fluids to drink, he always had negative results. (Sargnon, Tubage et Tracheotomie, 1900). From my experience, however, I would consider that some fluid may enter the trachea, as I have known cases where a choking spasm during feeding necessitated the immediate withdrawal of the Intubation tube. However, this accident may be prevented by the adoption of nasal feeding, but in some cases nasal feeding may not be suitable on account of the incessant coughing that may be produced, and the consequent expulsion of the Intubation tube. It was not unusual for our cases to expel the tube during nasal feeding.

I would consider, therefore, that broncho-pneumonia may be due to the entrance of blood into the trachea, when it is opened, in the performance of Tracheotomy, and that in

Intubation broncho-pneumonia may be caused by the ingestion of fluid, and also by repeated intubation consequent on the expulsion of the tube.

Our death-rate from broncho-pneumonia has been found to be higher in intubation than in tracheotomy, but as has been previously stated, a conclusion based on epidemics of diphtheria of different years may be of no real significance as, one may be contrasting a mild type of diphtheria with one of exalted virulence. The high death-rate from broncho-pneumonia in the year 1922 was due to a very severe type of diphtheria. Many of the cases were complicated with broncho-pneumonia on admission, and I am inclined to think that if tracheotomy had been done in that year, instead of intubation, the death-rate from this cause would not have been less.

My contention, then, is that the incidence of broncho-pneumonia is as frequent after intubation as it is after tracheotomy, and therefore that it need not be considered as an important factor in the determination of the operation of election.

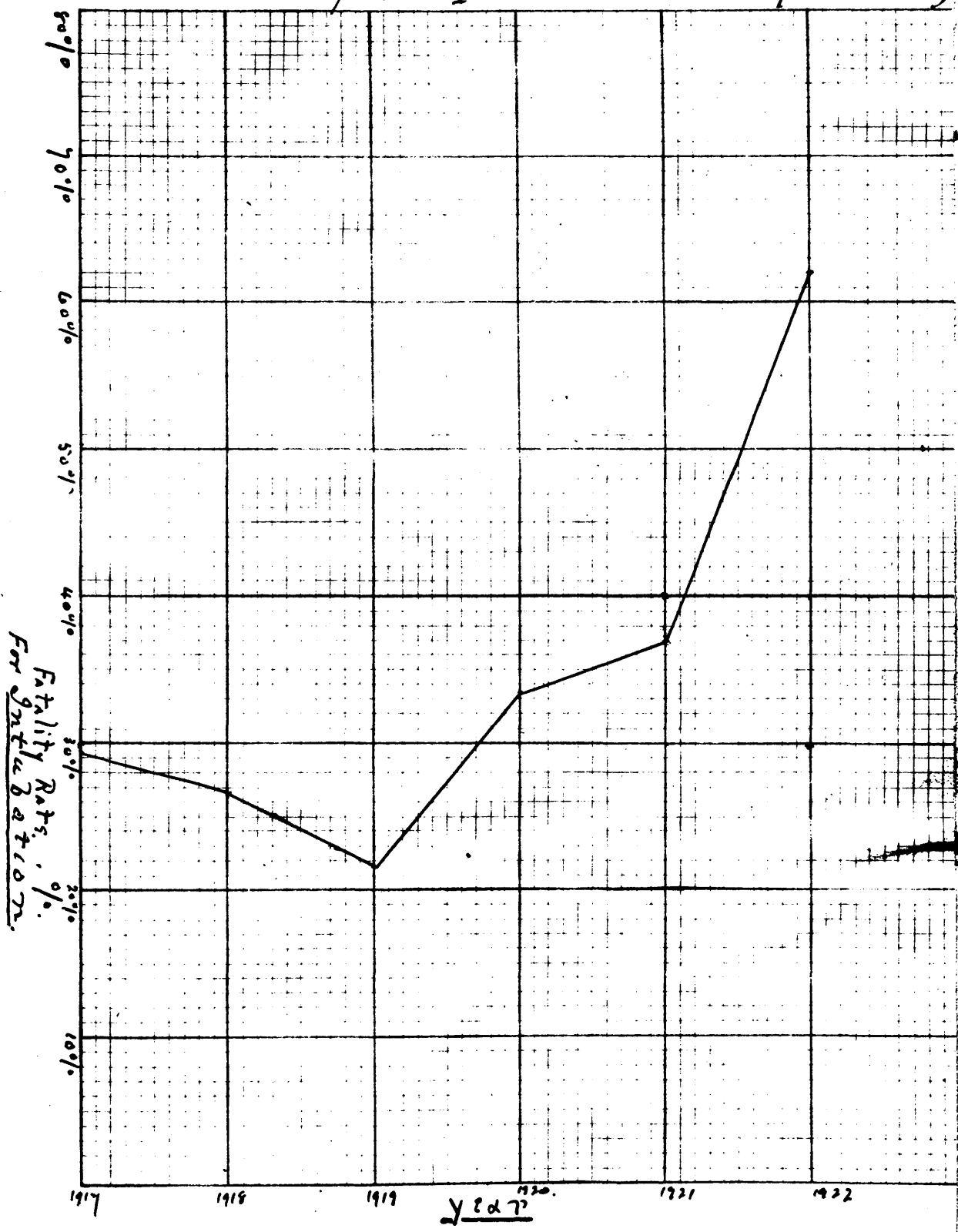
(f). A COMPARISON OF THE MORTALITY RATES.

The mortality rate in Intubation and Tracheotomy must necessarily vary with the type of laryngeal diphtheria. In the year 1922, the mortality rate in Intubation rose to the high figure of 61 per cent. Previous to this, the mortality rate in our intubated cases had been approximately 30 per cent. The severe type of diphtheria during the year 1922 was entirely responsible for the increased mortality rate. Many of the cases were complicated with broncho-pneumonia on admission.

Another factor upon which the mortality rate largely depends is the condition of the patient at the time of operative interference. It would appear that some surgeons operate on cases that would get well if left alone; at least judging from the results obtained by some one can come to no other conclusion. There is no triumph in operating on cases that would get well if left alone. The lowest mortality rate in our intubated cases was 21.7 per cent. in the year 1919. The average mortality rate was 37.9 per cent. for the years 1915 - 1922. The variation in the mortality rate for each year is shown in the graph.

Scholes⁴ states that the mortality in Intubation is much lower than in Tracheotomy. Out of 735 intubated cases, he had 103 deaths, a mortality rate of 14 per cent. Basan, writing in the Lancet, July, 1901, had four deaths in 32 cases of Intubation, a mortality rate of 12.5 per cent.

Percentage Fatality rates
for Intubation. {1917-22}



Graph showing marked increase of mortality - rate in the year 1922.

Cartin, in private practice, reports 440 cases with no Tracheotomies, no chronic tube cases, and a mortality rate of 14 per cent. (American Medical Association Journal, October, 1923). Sheffield had 64 cases with but 1 death. (American Medical Association Journal, October, 1923). Hoyle states that he has reduced the mortality rate considerably during the years 1918 - 1920. In the year 1918, out of 121 cases he had 61 deaths, i.e. a mortality rate of 50.4 per cent. In 1919, he reduced it to 32.3 per cent., and in 1920 he reduced it further to 15.6 per cent. (American Medical Association Journal, May, 1923). In Nothnagel's Encyclopaedia of Practical Medicine, 1902, Waxham has lately reported 40 Intubations with a mortality rate of 5 per cent., and other operators have given a similar number with no deaths.

To any one, who has any knowledge of Intubation, these must appear as extraordinary results, and I cannot conceive how they can be obtained in any other way than by operating on cases that would get well if left alone.

Cartin reports a mortality rate of 14 per cent. in private practice, but, as I have previously stated, Intubation is contra-indicated in private practice on account of the probability of the tube being coughed up with consequent asphyxiation of the child.

Some of the big American hospitals, however, record mortality rates that are more in keeping with what has been found in this country. The Willard Parker Hospital in New York has had an average mortality rate of 57.8 per cent. for Intubation during the years 1901 - 1903 for 588 cases. At the Philadelphia Municipal Contagious Diseases Hospital, the average yearly mortality rate for 1897 - 1903 was 59.2 per cent., and at the Boston City Hospital from 1895 - 1903 it averaged 59.5 per cent. (Hoynes, American Medical Association Journal, May 7th. 1921. From the report of the Providence City Hospital, the mortality rate for Intubation is 26.3 per cent. for 1910, 19.1 per cent. for 1911, 30.7 per cent. for 1912, and 26.06 per cent. for 1913.

It would appear that the mortality rate for Intubation in hospital practice is much greater than it is in private. I hold, however, that Intubation is quite unsuitable for private practice, and that the low mortality rates that are reported for Intubation are obtained by operating on cases that would get well without operative interference.

As previously mentioned, our average percentage mortality rate for Intubation was 37.9, whereas for Tracheotomy during the years 1911 - 1914 and 1923, the average percentage mortality rate was 29.4. The higher mortality rate for Intubation is chiefly due to the very severe type of diphtheria during the year 1922. If Tracheotomy had been the operation of election in 1922 instead of Intubation, I have not the least doubt but that the mortality rate for

Tracheotomy would have been as high as that for Intubation. The mortality rate, then, is largely dependent on the type of diphtheria.

From my experience of cases, I would conclude that the mortality rate in these two rival operations is about the same, and therefore that it is not an important factor in the choice of operation.

(g). CONCLUSION.

What is the operation of election in laryngeal diphtheria? The literature on the subject provides us with antagonistic opinions. Sargnon, in *Tubage et Tracheotomie*, 1900, states that Intubation constitutes the operation of election in cases of laryngeal obstruction, especially of infants, and also in cases of measles laryngitis. Scholes states "In hospital intubate always; in private practice, if patient is over four years old" (Lectures to Students, 1920). Jacobi adds "I can only say that for years I have not seen a case, in which Intubation would not take the place of Tracheotomy, and have therefore not performed the latter" (Twentieth Century Medicine, Volume 17, 1899). Ker³ states that Intubation, supplemented if necessary by secondary Tracheotomy, may be depended upon to give excellent results in hospital practice, and that in general practice, if had recourse to early, would save many a patient from a needless Tracheotomy.

(The Scottish Medical and Surgical Journal, June, 1907).

On the contrary, Walker Downie states, "Intubation has never been a success in this country!" (Clinical Manual of Diseases of the Throat, 1894). Dr. Urban of Leipzig, thinks, that the disadvantages of Intubation outweigh the advantages, and that Intubation can never take the place of Tracheotomy. Intubation violates one of the most important of surgical requirements, that is, rest for a diseased structure. Dr. Urban says that in Leipzig Intubation is entirely given up. (Parker, Diphtheria, 1891). Dr. J. MacCombie, Superintendent of the ^{South} Smith Eastern Fever Hospital, states, "I have thus far got more help from Tracheotomy than from Intubation. For the present, I shall continue to advocate and practise Tracheotomy, as the more rational and safer method of treating laryngeal diphtheria during the acute stage" (Parker, Diphtheria, 1891). It is apparent, then, that each of these rival operations has its enthusiastic advocates.

Ker states, "While in America, in France, and in most European countries, Intubation has been enthusiastically adopted as the operation of election in laryngeal diphtheria, it has not had many votaries in Great Britain. It is only recently that it has met with any serious consideration, and even now those who prefer it to Tracheotomy are few in number" (The Scottish Medical and Surgical Journal, June, 1907). Is it a natural

conservatism that has blinded us to the advantages of this operation over Tracheotomy, or is the cause to be found in our failure to perform the operation with the same dexterity as other nations? According to some writers, failure to obtain good results is due to "faults of the operator, or inborn, or sometimes unavoidable clumsiness, apparently at times, national in its extent" (Nothnagel's Encyclopaedia of Practical Medicine, 1902). However, dexterity in the art of Intubation is not the prerogative of any country, and one's own results and not another's must be the final arbiter in the determination of the operation of election.

Do our results for Intubation in this country really differ to any great extent from those obtained in other countries? It would appear from statistics on the subject that the results of other nations are better than ours, but on careful investigation of some of their results, I find that there is practically no difference between our own and theirs. From an examination of the report of the Providence City Hospital, 1913, I find that they operate on about 75 per cent. of their laryngeal cases, while we operate on about 50 per cent. The following table, from the Providence City Hospital Report, 1913, shows the number of cases operated on during the years 1910 - 1913.

<u>Year.</u>	<u>No. of cases.</u>	<u>No. of cases intubated.</u>	<u>Percentage.</u>
1910	38	30	79.
1911	68	58	85.
1912	52	40	76.
1913	46	39	84.

It is evident that by operating on a larger percentage of laryngeal cases, the death rate appears to be less.

The total death rate, however in the Providence City Hospital is not less than ours, as is shown in the following table:-

<u>Year.</u>	<u>Fatality rate per cent.</u>
1910 - 11	12.7
1912	13.7
1913	10.5

Our total mortality rate for diphtheria is approximately 10 per cent. As it is not likely that their mortality rate for faucial diphtheria will differ from our own, it follows that their mortality rate for Intubation is not less than ours, but that it only appears so in consequence of operating on a greater percentage of laryngeal cases.

My contention then is that the results obtained for Intubation in this country are as good as those obtained in any other country. I have also shown that Intubation does not give better results than Tracheotomy. In very severe cases of laryngeal diphtheria, however,

Tracheotomy may be regarded as giving better results than Intubation. Ker,² who is an enthusiastic supporter of Intubation, supports this view in the latest edition of his book on Infectious Diseases. He states, "since 1912 my results have not been so good, the type of diphtheria in the City being much more severe. At the present time, my mortality rate is over 40 per cent., and to judge from the returns of some of the great American hospitals such a figure is after all not very unusual. It does not, however, compare very favourably with the Tracheotomy results of some hospitals in this country, and I am at present considering whether in diphtheria of the severe type the latter operation may not give more success".

In the severe type of laryngeal diphtheria of 1922, when Intubation was the operation of election, our cases were frequently complicated with laryngeal stenosis. I consider, that if Tracheotomy had been the operation of election, the incidence of stenosis would have been less.

The frequent incidence of stenosis after Intubation is, in my opinion, one of the strongest arguments against the operation.

It is held by Sargnon, in *Tubage et Tracheotomie*, 1900, that the future of the child after Tracheotomy is more gloomy than after Intubation. From an examination of over 40 old cases of Intubation and Tracheotomy, I cannot

agree with this statement. I found the general condition of the child, on whom Tracheotomy had been performed, was quite as good as the one who had been intubated. I have inserted below a list of all these cases, that were examined by me, and a short note on the condition of each

List of Intubations.

<u>Year when in hospital.</u>	<u>Case.</u>	<u>Present condition.</u>
1919	S.C.	Voice hoarse after dismissal - now quite well.
"	J.B.	Very well.
"	H.D.	Voice hoarse for some time, now much improved.
1918	J.S.	Very well.
1920	O.M.	Hoarse at first, very well now.
"	M.F.	Voice still hoarse.
"	M.K.	Noisy breathing after dismissal, died of appendicitis.
"	T.W.	Child thin, but quite well, hoarse after discharge.
1921	M.C.	Hoarse after discharge, breathing noisy.
"	D.F.	Mother says child has never been so well since. Voice hoarse for 3 months after discharge.
1920	D.O.	Very well.
"	A.D.	Voice still hoarse, breathless after running.

List of Intubations (continued).

<u>Year when in hospital.</u>	<u>Case.</u>	<u>Present condition.</u>
1921	A.N.	Noisy breathing at first, quite well now.
"	J.S.	Very noisy breathing after discharge, but now much improved.
1920	A.B.	Very well.
1921	J.B.	Still very noisy breathing.
"	J.A.	Very well.
"	J.M.	Very hoarse after discharge, much improved of late.
"	J.W.	Very well.
"	J.R.	Voice still hoarse.

List of cases on whom Tracheotomy was performed.

<u>Year when in hospital.</u>	<u>Case.</u>	<u>Present condition.</u>
1913	A.W.	Mother states he is easily fatigued, since discharge.
"	N.E.	Very well.
"	A.P.	Very well.
"	J.McG.	Very well.
"	C.G.	Died 5 years ago, heart disease.
1914	M.B.	Three months after going home, child sat up in bed, and died suddenly.

List of cases on whom Tracheotomy was performed (continued).

<u>Year when in hospital.</u>	<u>Case.</u>	<u>Present condition.</u>
1914	H.S.	Child thin, voice slightly hoarse.
"	W.S.	Very well.
"	H.R.	Very well.
"	M.K.	Five days after going home, the wound was re-opened and the cannula inserted, on account of dyspnoea. Six weeks later it was removed. The child has been very well since.
1923	L.B.	Very well.
"	H.S.	Breathless after going home, now very well.
"	A.R.	Very well.
"	V.M.	Very well.
"	E.Y.	Very well.
1922	C.M.	Very well.
1923	W.M.	Very well.
"	J.McM.	Very well.
"	J.W.	Very well.
"	E.K.	Very well.
"	P.McG.	Voice hoarse.
1913	W.P.	Very well.

I would conclude from the above cases -

(1). That the general condition of the child is as good after Tracheotomy as after Intubation.

(2). That noisy breathing ^{indicative of a certain degree of stenosis} is more frequent after

Intubation than Tracheotomy.

- (3). That the vocal cords are frequently affected after Intubation.

From this inquiry into the comparative value of Intubation and Tracheotomy, the conclusions I would draw are:-

- (1). That the operation of Intubation is easier than Tracheotomy, when the necessary skill is acquired.
- (2). That the disadvantages of Intubation are much greater than the disadvantages of Tracheotomy.
- (3). That the disadvantages of Intubation outweigh the advantages.

My contention then is, that Tracheotomy is the operation of election in laryngeal diphtheria.

.....

My thanks are due to Dr. J. Reid, Medical Superintendent, County Hospital, Motherwell for information regarding cases before October, 1920.

References omitted in the text are
inserted below.

REFERENCES.

1. Pye's Surgical Handicraft, 1919.
2. Ker, Infectious Diseases Text Book, 1920.
3. Ker, The Scottish Medical and Surgical
Journal, June, 1907.
4. Scholes, Diphtheria, Lectures to Students, 1920.
5. Sargnon, Tubage et Trachéotomie, 1900.
6. Welsh and Schamberg, 1905.