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On Tracheotomy in Croup.



David Galloway.

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The employment of Tracheotomy in Croup is a question of great importance and about which there has been much discussion :

In cases where Foreign bodies have found their way into the Trachea or Bronchi, and when other means for their removal have been tried in vain, Tracheotomy is universally admitted to be of the greatest value ; —

In Acute Laryngitis, unaccompanied by membranous exudation, when other remedies have failed, and death by asphyxia is imminent, the operation is generally advised, and is often successful ; —

— In Chronic laryngitis, likewise, of whatever kind, it is often resorted to, and is usually the means of prolonging the patient's life, and of palliating the disease by which it was endangered; —

Even in the extreme spasmodic dyspnoea caused by compression or tension of the Recurrent Laryngeal nerve, this operation has been frequently performed, with the result of greatly relieving the patient's sufferings, and of prolonging for a time his wretched existence:

In all these cases, as well as some others, Tracheostomy is generally practised, and is justly valued, but the propriety of its performance in Croup, or true Membranous laryngitis has not been so universally conceded, nor, when its propriety has been admitted, have the rules for its performance been very distinctly stated: I have

chosen this question as the subject of my thesis, and when we consider the suddenness with which the patient's life is brought into extreme peril, and the necessity for promptly deciding as to the performance of the operation in actual practice, the great importance of the subject is very obvious.

When Croup has resisted all the remedies which the skill of the physician can suggest, when the symptoms are becoming rapidly worse in spite of treatment, and when the fatal termination seems certain, and not far distant, — if any attempt is to be made for the patient's salvation, there is but one resource — the performance of Tracheotomy.

Unhappily the resource is far from being a certain one; the Operation is not without danger even under favorable circumstances, and it may fail in relieving the disease; even if successful at the time, it exposes to serious danger from subsequent pulmonary inflammation, so that the chance of ultimately saving the patient's life is small; besides, even if the patient is saved, the laryngeal obstruction may never be fully removed, and his life may thus be rendered unhappy and precarious by the necessity of constantly wearing the tube.

For these reasons many condemn the use of Tracheotomy in Croup, or at least, consider it very unadvisable; Let us examine these objections seriatim, and see whether there are not grounds for somewhat modifying this opinion.

Objection 1. The danger of the operation.

The danger of Tracheotomy in ordinary circumstances — as when performed for the removal of foreign bodies from the air-passages, is very slight indeed, and such operations are almost uniformly successful; but it is true that there are special dangers attending the performance of the operation in Croup, which demand separate notice; they are chiefly these three — Asphyxia, Hemorrhage, and Syncope.

a/. Asphyxia during the operation

This may arise from other causes than the entrance of blood into the trachea.

In the case of very young children — when the disease is advanced, the dyspnoea excessive, and the strength almost exhausted, the patient may die during the operation, even before the trachea has been opened, from Asphyxia induced by the horizontal position and by the prevention, even for a few minutes of the violent respiratory efforts which the obstruction in the air-passages renders necessary.

I am satisfied that such was the

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"Traité des maladies des enfants" par M.M. Barthez et Rilliet
tome 1, 1^{re} édition. Paris. 1843.

Article sur la Trachéotomie par M. Droupeau

cause of death in a case of Tracheotomy for this disease at which I was present last summer :

The patient was not more than two years of age, the disease was far advanced, the difficulty of breathing was extreme and accompanied with throwing backwards of the head, so as to elongate the trachea, and with violent efforts at full dilatation of the chest ; the operation was undertaken with reluctance by a surgeon of much experience, it was quickly performed, the hemorrhage was trifling, but on opening the trachea there was not the slightest attempt at respiration, and all efforts to induce it were vain.

Although such a case may well deter from the performance of Tracheotomy under similar circumstances, when the disease is already so near its fatal termination, it does not prove that in better selected cases, and at an earlier period of the disease, the operation would not be free from this danger.

The occurrence of Asphyxia during the operation and its proper treatment, are thus spoken of by M. Froussseau of Paris, whose large experience of this operation entitles his opinions to the greatest respect : *

" J'ai vu plusieurs fois l'asphyxie arriver, et la respiration cesser pendant

l'opération : le malade était dans un état de mort apparent. Je terminais le plus vite possible la trachéotomie, j'introduisais la canule; puis, faisant placer le malade sur le côté s'il s'écoulait du sang dans la trachée, et sur le dos dans le cas contraire, je faisais sur le ventre et sur la poitrine des pressions alternatives, qui chassaient l'air de la poitrine et l'y appelaient de nouveau, et tous mes malades sont revenus à la vie".

b/. Hemorrhage

Hemorrhage is a danger which always attends tracheotomy when it is performed for obstructed respiration, and its special danger in Croup arises from the readiness with which the entrance of even a small quantity of blood into the trachea would cause death by asphyxia, and from the inability of the patient to bear any considerable loss of blood.

It is rarely necessary in this operation to check arterial hemorrhage by ligature, and as the venous bleeding ceases almost entirely as soon as the trachea is opened and free respiration established, the quantity of blood lost is seldom great. The danger of its entrance into the trachea is in great

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loc. cit.

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Archives générales. 1848. Tome 2~~2~~ 17.

measure abated, by raising the patient to the sitting posture as soon as the opening is made; and in cases fitted for the operation the patient will always be able to expel by forcible expiration the few drops of blood that inevitably enter during the first inspirations by the new opening.

It is objected also that in children the neck is so short, and the parts so small, that the danger of wounding the large vessels at the root of the neck is much greater than in the adult; and this is certainly true, but a danger so obvious can surely be easily avoided by care and caution in the use of the knife.

c/. Syncope

Syncope immediately after the operation is said by Trousseau* to occur not unfrequently;

he ascribes it to the sudden removal of cerebral congestion by the establishment of free respiration; although it continued for almost an hour in one of his cases, he has never seen it prove fatal. M. Vanthier* however reports two cases in which this was the cause of death.

The treatment is that of Syncope in other cases, to which M. Trousseau adds irritation of the trachea through the artificial opening.

Objection 2. The Nature of the Disease, and the small chance of averting its fatal termination by Tracheotomy.

The chance of averting death, say those who object to the operation, is exceedingly small, - even if the patient escape the immediate dangers of the operation - because coughing is now rendered impossible, and the exhausted patient is quite unable by forcible expiration to effect the detachment of the false membrane, and its expulsion through the small orifice of the Canula.

— Because the opening is made and the tube introduced at the point which is often the very centre of the disease, so that, even if the dyspnoea be relieved for a time, you have only added fresh fuel to the existing inflammation which will thus be exaggerated and speedily prove fatal.

— Because in some cases the Trachea may be so obstructed and the inflammation may so involve the whole bronchial tree, that, so far from saving the patient's life, the operation may scarcely afford even temporary relief.

— And, lastly, because the state of

* *Lectures on the diseases of Infancy & Childhood*
Lect. 22. 3rd. Ed. London. 1854.

the blood is altered - perhaps fatally - by the diminished supply of oxygen, and the interference with its necessary respiratory changes.

These objections bring at once under consideration a point of the greatest importance in reference to this whole question - viz. the primary and most frequent seat of the membranous exudation.

The nomenclature of Croup is of itself sufficient to prove that different opinions have been held on this subject; - "Laryngitis fibrinosa", "Laryngite pseudo-membraneuse", "Membranous Laryngitis", "Infantile Laryngitis" all seem to indicate the larynx as the seat of the disease; while "Tracheitis" and "Cynanche trachealis" seem to point to the Trachea as the affected part.

This variety of nomenclature, and of opinion as expressed by it, seems to depend on the fact that the chief seat of Croup is not invariable; and that while in the large proportion of cases, it is the Larynx, in others it is the Trachea, and in a third & very small class of cases, the larger Bronchial Tubes.

According to Dr West, *the false membrane "is found in the larynx more frequently than in the Trachea, and in both more frequently than in the Bronchi"

He adds, "In cases of Croup that have come under my own observation,

* "Traité des maladies des Enfants".

2^{me} édition : Paris 1853 art. "Laryngite pseudo-membraneuse"

* Guide des médecins praticiens. Paris 1853.

3^{me} éd. tome 1, Art "Croup"

the formation of false membrane in the larynx has seemed almost invariably to precede its deposit in the trachea; and not infrequently it has been found constituting a tough tenacious continuous membrane in the former situation, but growing less tenacious in the upper part of the trachea, and passing gradually into a thick puriform mucus, interspersed with shreds of lymph. I have usually observed the false membrane lining the whole of the larynx, and reaching down to the lower edge of the thyroid cartilage, while the trachea contained nothing else than a puriform matter, or glairy mucus sometimes of a reddish color.

In some instances the false membrane has been confined to the upper part of the larynx, lining the lower surface of the epiglottis, blocking up the opening of the sacculus laryngis, and covering the Chordæ vocales, but not extending any further.

According to Barthez & Rilliet, ^{*} the inflammatory process, and consequently the exudation, may affect primarily the larynx; — may extend secondarily to the larynx from the Tonsils, palate and pharynx, as in Diphtheritis; — and, lastly, may attack primarily the Bronchial tubes.

The opinion of Vallin ^{*} exactly agrees with that just quoted from Dr. West;

* loc. citat. let 23.

He describes as the primary anatomical lesion in Croup, false membrane lining more or less completely the cavity of the larynx, and says that when this is found in the trachea also it is by extension of the inflammation from the larynx.

The result of these opinions and experiences seems to be that the chief and primary seat of the disease is the Larynx, that it frequently extends to the trachea, and occasionally also involves the larger Bronchi;

if this be true, the tracheal opening is not in what is usually the centre of the inflammation, and, instead of increasing it by its irritation, it is more likely (even theoretically) to relieve it by giving rest to the inflamed parts and by rendering unnecessary the painful & violent efforts at respiration. Besides, as is well remarked by Dr West*, tracheotomy is of great value not only because it procures the free entrance of air to the lungs, but also because it "obviates the danger of that spasm of the glottis which the inflammation occasions, and which will not cease until either the inflammation is subdued, or the spasm relaxes with the approach of death."

As to the other objections under this head: — It is true that Coughing, strictly

speaking, is now impossible, but surely the chance of the expulsion of the false membrane by forcible expiration is much greater, now that there is a free passage, than when coughing was painful and difficult, and the passages much obstructed.

Further, temporary relief, at least, seems always to have followed successful tracheotomy in the cases of Croup where it has been practised hitherto, whether this result should, theoretically, have followed the operation, or not. And, as it can never be ascertained how far the state of the blood has been changed by the deprivation of oxygen, and the accumulation of Carbonic acid, this has little weight as a practical objection to the operation.

For these reasons it seems just to conclude that the objections founded on the nature of the disease are by no means sufficient to condemn the use of tracheotomy in Croup, and this conclusion will be amply corroborated when considering the results of the operation in cases where it has been had recourse to.

Objection 3. The danger of
Subsequent pulmonary inflammation.

This is an objection that can be brought against tracheotomy in any circumstances, and which would contraindicate it, were its performance not imperatively demanded by some other existing disease, the treatment of which must overrule everything else.

It is undoubtedly true that some of the patients operated on for croup, subsequently die of Pneumonia but the possibility of its occurrence should not deter us from relieving a disease otherwise certainly and speedily fatal.

The occurrence of Pneumonia can generally be avoided by proper attention to the temperature of the room, and by keeping the orifice of the tube loosely covered with some light woolen material, which, by retaining part of the heat and moisture given out in expiration, will both warm and humify the inspired air.

When it does occur it must be treated like Pneumonia under ordinary circumstances, — with due regard to the extent of the disease, & strength of the patient.

It is too often fatal, in spite of treatment, but not invariably so.

This objection also is fully answered by the ultimate results (about to be considered) of the cases where this operation has been performed.

Objection 4. It may be impossible ever to remove the tube, or a tracheal fistula may be left after its removal.

This is a trivial objection, for these inconveniences may follow the operation whatever cause may have demanded its performance:

It is certainly true that in some cases the air passages never regain their healthy condition, and the constant wearing of the tube becomes indispensable; probably too this is more frequent after croup, than in some other cases which may require the operation.

In cases where this result follows the operation, bronchitic attacks are very frequent, and often threaten to cause the death of the patient by asphyxia.

I had a case of this kind under my care some time ago; the operation had been performed more than a year before in the Royal Infirmary, but every attempt at the removal of the tube gave rise to such dyspnoea as to demand its replacement: The boy was

about five years of age; his general health was better than might have been expected: by covering the orifice of the tube with his chin, he could speak, but not distinctly; he had slight bronchitis, or rather bronchorrhoea, almost constantly, and occasional acute attacks which caused alarming dyspnoea.

A Tracheal fistula would probably give rise to results less marked, but somewhat similar.

These objections may be urged against tracheotomy in all circumstances, but are never held to contra-indicate it; indeed the operation is often performed in cases where the subsequent removal of the tube is never contemplated.

Being, in truth, inconveniences rather than dangers, they are as nothing compared with saving the life of the patient, and deserve no consideration in deciding as to the propriety of the operation in Croup.

Objection 5. The probability of ultimately saving the life of the patient is exceedingly small.

This compound objection is the one most generally urged; — that from the danger of the operation, the nature of the disease, and the likelihood of subsequent inflammation, the chance of ultimately saving the patient is exceedingly small; it has been to a certain extent

* loc. citat.

answered by the consideration of these dangers individually, but in order to answer it fully, it is necessary to examine the results of tracheotomy in the cases of croup where it has been practised; and as the operation has been had recourse to in France much more frequently than in Britain, it is the results of French experience that must be examined.

Against all such general results the objection is invariably brought, and often with reason, that the diagnosis was not certain.

It is unquestionable that cases of Simple Laryngitis, and, still oftener, cases of Pseudo-Croup or Laryngismus Stridulus, have been mistaken for True Croup, and that, for this reason, many of the statistics on this subject are valueless:

Instead, therefore, of reckoning up the results of a multitude of cases recorded as Croup — by which means it is possible to prove almost anything — it is infinitely better to ascertain the results of a more limited number of cases, in which the diagnosis was certain.

This has been so admirably and carefully done by M. Halleix, that his own words must be quoted: — *

"Quant à moi, pour éclairer cette question, j'ai rassemblé d'abord 54 observations, dans lesquelles le diagnostic n'était nullement douteux, car la maladie

" était caractérisée par l'aphonie, la respiration
" sifflante, et l'expulsion de lambeaux membraneux,
" ou leur présence dans le larynx après la mort,
" et j'ai trouvé 17 guérisons bien constatées, sans
" opération. Puis, examinant ce qui se
" passe dans les cas de Trachéotomie, j'ai vu,
" avec M. Bricheaux, que la trachéotomie réussit
" presque une fois sur trois, proportion tout-a-
" fait semblable à celle que je viens d'indiquer."

In a note referring to this passage, M. Val-
-leix adds — " ceci a été écrit en 1842; depuis
" lors des faits en grand nombre sont venus
" confirmer cette proportion; Rien
" n'est donc mieux établi maintenant que l'utilité
" de la Trachéotomie dans le Croup "

The result of these statistics is the
startling but indisputable one that almost
as many cases are saved by Tracheotomy, as
by other means: and when we remember
that it is not performed till other remedies
have failed and it is the only resource left,
its great value is apparent, and we must
agree with Valleix in regarding its application
to croup as a true medical victory.

The opinion of M. M.
Barthez & Rilliet is also best given by quoting
their remarks in reference to these statistics
of M. Valleix, and on the nearly equal proportion
of cures, with Tracheotomy and without it. —

* loc. citat 2^{me} edit. Paris 155

Art. "Laryngite pseudo-membraneuse"

" Cette proportion, comme il fait d'ailleurs
 " remarquer avec justesse, est tout entière en
 " faveur de la tracheotomie. En effet la
 " plupart des guérisons ainsi obtenus l'ont
 " été lorsque la mort était imminente, et
 " lorsque tous les autres moyens avaient échoué.
 " En outre, il faut tenir compte de cette cir-
 " -constance, qu'on a publié à peu près tous
 " les cas dans lesquels l'opération a été
 " pratiquée, qu'ils aient été ou non suivis
 " de guérison; tandis qu'on a toujours
 " fait connaître de préférence les succès obten-
 " -us par les moyens médicaux.
 " Ajoutons, enfin, que d'après les derniers
 " rélèves de M. Frousseau, et en suivant la
 " traitement que nous avons préféré, on doit
 " espérer une réussite plus fréquente "

No one has a better right to
 speak on this subject than M. Frousseau, for
 he has probably had greater experience of trach-
 -eotomy in Croup than any other man; but,
 in judging of his results, the great alteration
 which has taken place in his treatment must
 be noted, and the consequent alteration in
 the proportion of unsuccessful cases:

Until the year 1850, it was his constant
 practice after the completion of the operation,
 repeatedly to sponge the inner surface of the

* Union médicale 23 août. 1857. (Paris)
"Nouvelles expériences sur la trachéotomie"

trachea with a very strong solution of nitrate of Silver, with a view to loosen the false membrane, and to prevent its re-formation: this practice he entirely abandoned seven years ago, and certainly with reason.

I give his experience in his own words:—

* "J'ai fait jusqu'aujourd'hui 23 Aout 1851, 169 tracheotomies, 11 pour des maladies chroniques du larynx, 158 pour des cas du Croup.

"J'ai en tout 43 guérisons, un peu plus du quart; mais, en ne comptant que les 18 derniers, que je viens de rapporter, dans lesquelles le traitement a subi de si grandes modifications, j'obtiens une proportion de guérisons infiniment plus considérable, 8 guérisons sur 18 opérations, près de la moitié."

Along with his own experience,

M. Trousseau, gives the results of the operation at the large Children's hospitals of Paris:—

"Les resultats obtenus dans notre hôpital des Enfants, où la même médication est adoptée ne sont pas moins heureux; 19 tracheotomies ont été fait depuis le 1^{er} Janvier 1851 jusqu'aujourd'hui 23 Aout 1851: Il ya 8 enfans guéris: le 19^{me}, encore en traitement, est tellement bien que tout fait espérer une prochaine guérison — soit 9 sur 19.

L'an dernier, à l'hospice des Enfants

* "Bulletin general de Therapeutique" Octobre, 1852.
Art. "Reflexions sur la trachetomie dans le cas de

Trouvés, M. Guillot père 3 enfans, 2 guérissent"

Lastly, M. Guersant, surgeon to the Hôpital des Enfans at Paris reports the cases which occurred there during the two years 1850 & 51, as follows; — "Dans le cours de l'année 1850
 " sur 20 opérations faites à l'hôpital, nous avons
 " eu 7 guérisons, et à la fin de cette année 1851
 " sur 31 opérations le nombre des succès s'élève
 " à 13."

These results, giving successful cases in the proportion of 2 out of every 5 cases, only confirm the experience of Trousseau, and the conclusions of Valleix.

It will no doubt be objected in reference to these arguments in favour of tracheotomy in Croup this disease, that the "Croup" of France is not the "Croup" of Great Britain, and that many of the cases reported under this name by French writers are merely cases of extension of Diphtherite into the air passages.

That this variety of Croup is frequent in France, and that it has been reckoned along with pure (or British) Croup in forming these statistics, is undoubted; and it is certainly true that "Inflammation of the larynx with membranous exudation" following "diphtherite" differs pathologically from "Inflammation of the larynx with membranous exudation" arising from cold and damp,

or from any other cause, but practically in reference at least to Tracheotomy, there is little or no difference.

The advantage on the side of diphtheritic Croup which seems to follow from the pretty certain limitation of the disease (unless in its most advanced stages) to the larynx, is fully counterbalanced by the co-existence of the diphtherite in the pharynx & palate, and by the state of general health which its existence implies. Therefore it seems quite just to argue from accurate French statistics (although they do include a proportion of cases of diphtheritic Croup) as to the propriety of the operation in the Croup of Britain.

Let us then unite the results of the experiences just quoted; and we find, as a general result, that in cases of Croup where Tracheotomy has been demanded, the proportion of Cures is rather more favorable than 1 out of every 3 cases.

Notwithstanding the eminence of these reporters, and their assertions to the contrary, let us suppose that in some of these cases a cure might have been obtained without Tracheotomy, and that in some others the disease was not True membranous Croup, and, reducing the number of cures by the

operation, let 1 in 4, instead of 1 in 3, be taken as the proportion of successful cases.

Even after such concessions surely but one opinion can be drawn from these facts;—

an operation which saves one patient in every four from certain death needs no further argument to prove its utility, and we are compelled to believe that Tracheotomy is often of the greatest value in Croup.

The objections to the operation which have been mentioned are certainly not trivial, and the proportion of cases ultimately unsuccessful is undoubtedly great, but without it, every case would have been fatal.

It seems, therefore, reasonable to conclude, both from the testimony of experience, and from a consideration of the individual dangers which may attend or follow the operation, that in a large proportion of the cases of Croup, when other means have failed, Tracheotomy is not only justifiable, but highly advisable as affording the patient a very considerable chance in a case otherwise hopeless.

We come next to inquire how far these objections, which are not sufficient to condemn the operation, should be admitted in every case as modifying the propriety of its performance, and the probability of its success; and to consider the different circumstances which should more or less affect in all cases the decision as to the operation. —

Circumstances which modify the propriety of the operation, and affect its success.

1. The age of the patient

The Influence of the age of the patient as a modifying circumstance is of the greatest importance, so much so that, other things being equal, the younger the patient, the less probable is ultimate success. This is what might be expected, the powers of endurance being so feeble, and life so easily destroyed in an infant, and it is also the testimony of experience as shewn by the statistics of M. Frouseau.

The younger the patient, the strength is the sooner exhausted by the disease, asphyxia is the more easily produced, subsequent inflammation would be the more dangerous,

and the mere irritation of the tube would with greater difficulty be endured.

To fix any period under which tracheotomy should not be performed is impossible, for the mere youth of the patient should never be taken as an absolute contraindication when other circumstances are favorable, but, as a general rule, it may be said that in patients under 2 years of age the probability of ultimate success is very small, and that the operation should not be performed under this age, unless all the circumstances are favorable, and the friends of the patient desirous that the chance, small as it is, should be afforded.

I have twice seen the operation performed on patients about this age; in one of these cases, which has been already alluded to, the patient died of asphyxia before the trachea could be opened; in the other patient, who was a little older, the exhaustion immediately after the operation was so great that death seemed at hand & recovery impossible;

although this case was ultimately successful it proves that in similar cases, at this early age, the prognosis must be ^{very} doubtful.

Since the operation is so frequently unsuccessful at this age, it is fortunate that Croup is so much more frequent after ^{this period} ~~two years~~ of age than before it.

* as quoted by *Valley*. loc. citat.

2. Any other disease coexisting with Croup.

The existence of any other disease along with croup must always have a very important influence on the decision as to the operation, and on the subsequent prognosis — especially if the complication be an acute thoracic inflammation.

According to M. Guersant, *coexisting inflammation of one lung does not forbid the operation, while double Pneumonia is an absolute contraindication: The same physician believes the coexistence of slight Bronchitis to be favorable rather than otherwise, because the increased expectoration facilitates the detachment and expulsion of the shreds of false membrane. The correctness of both these opinions seems more than questionable.

It is exceedingly difficult to be quite certain of the existence of these affections unless they have been diagnosed before the development of the croup, for while their symptoms are masked by, or confounded with, those of the Laryngitis, their physical signs are rendered very obscure by the extension of the laryngeal wheezing sounds to every part of the chest.

Too much weight therefore, should not be given to their supposed ^{or possible} existence as contra-indicating the operation in a case otherwise

favorable, but where the presence of either Pneumonia or Bronchitis can be ascertained, the operation should not be performed.

The existence of other diseases, — themselves surely proceeding to a fatal termination, — are also usually held to forbid the operation.

In Diphtheritis, where the pharynx and palate are affected by an inflammation somewhat similar to that which exists in the larynx and often preexisting, the operation is not contraindicated, but the treatment of the diphtheritis is carried on simultaneously with the treatment of the laryngeal affection by Tracheotomy.

In the Croup which occurs secondarily to the exanthemata the extent of the exudation is usually limited, but the state of the patient is too often such as to render the operation a very hopeless resource.

In reference to all these complications, it is important to remark that it is only when considered in reference to the other circumstances of the case, and the general condition of the patient, that their true value as modifying the prognosis and treatment can be rightly estimated.

3. The effect of previous remedies

It is certainly true that Tracheotomy has often been performed when a cure might have been effected by the assiduous use of medical treatment; but probably this has not happened so frequently as the opponents of the operation have alleged; for the friends of the patient are sure to object so long as there is any hope of recovery without it, and its fatality even in the most favorable circumstances is sufficiently great to deter the medical man from urging the operation before it has become absolutely necessary.

While such haste in resorting to the operation is certainly unjustifiable, the other extreme is equally, or rather, still more to be avoided: for while the premature performance of the operation only exposes the patient needlessly to its dangers (and these we have seen not to be great), too great delay in its performance greatly diminishes the chance of its success, and very often renders it vain.

Therefore as a general rule, it may be said, that whenever other remedies after a fair trial, fail to arrest the disease, or to produce any decided effect on its symptoms, they should be no longer trusted to, but recourse

be had to Tracheotomy.

The length of time during which medical treatment may be relied upon, must be determined by the skill of the physician, and must vary with the nature of each individual case — according as the disease has been sudden and acute in its onset, and rapid in its progress, or has had a more gradual onset and slower progress. In the former case, the operation may be demanded before it has been possible to afford a fair trial to other remedies; while in the latter, medical treatment may be persisted in for some time — until indeed it becomes pretty obvious that it will not prevent the fatal termination of the disease, but as soon as this seems certain, the operation should be performed at once.

Tracheotomy should not be left out of consideration till all other means have been exhausted, as seems to be the rule too frequently followed at present, whatever be the nature of the case, but the true indications for its performance should be found in the urgency of the case symptoms, irrespective of whether other remedies have ^{not} been tried at all, or have been fully tried in vain.

4. The period of the disease

This circumstance as affecting the decision as to the operation has been included to a certain extent under the remarks of the effect of previous remedies. It is impossible to lay down any fixed rule on this point, or to limit the operation to any particular period of the disease: It is performed because of great dyspnoea, and danger of speedy death by asphyxia, and is demanded when these conditions exist whatever has been the duration of the malady.

The fatality of the operation in Britain, can only be explained by too great delay in its performance - from the practitioner waiting till he has exhausted all other remedies by which time the disease has reached a very advanced stage, and death is at hand; the much greater success which has attended the operation in France is chiefly due to the earlier period at which it is performed there;

It may be that sometimes it is performed unnecessarily, but after deducting this small number of cases, the French practice still remains greatly more successful than ours; and it cannot be doubted that by avoiding both these extremes, especially the fatal ^{one} of too great

delay, we might obtain in Britain at least equal success.

The performance of the operation in the very last stage of the disease, when the patient is "in articulo mortis" should always be avoided, if possible; first, because the operation requires care and caution in its performance, but especially because the blood has become so altered by a long continued deficiency of oxygen, and the strength of the patient is so completely exhausted, that a successful result can scarcely be hoped for.

It cannot be too strongly insisted upon that the indications for Tracheotomy in Croup should be drawn neither from the effects of remedies nor the duration of the disease, but from the urgency of the symptoms and the danger of a fatal termination if the operation is not employed.

Having now spoken of the different circumstances which should more or less influence our decision as ^{to} the operation, we come next to speak of the operation itself — If resolved on, how is it to be performed?

If it is true that the larynx is the chief and primary seat of the disease, Tracheotomy

must be infinitely preferable to any of the other operations, which open the air-passages higher up in the neck; the greater ease and rapidity with which the other operations may be performed, do not counterbalance the objection that the place of their performance is usually the centre of the disease.

Before speaking of the operation itself, there are several special points connected with it which should be noticed; —

Chloroform. Chloroform has been given for this operation in cases of Croup by Dr. Snow in London, and by M. Chappaigne in Paris, but its use is very inadvisable: the operation is soon over and is not very painful, and chloroform cannot be given without danger since the respiration is already so much embarrassed.

Dilators. The introduction of the blunt extremity of the canula into the longitudinal ^{linear} opening in the trachea is not always easy, and as it should be done without delay various instruments have been devised to dilate the opening and facilitate its introduction.

In adults, an instrument of this kind is unnecessary, but in the case of children it may sometimes be useful, for the walls of the trachea are so flexible and the opening so small, that the canula is often introduced with difficulty, and is apt to pass by the side of the trachea,

instead of within it.

Dilators are generally used in pench practice, and are made after different patterns; probably a pair of common dissecting forceps, introduced closed into the tracheal wound, and the blades then separated by a finger between them, would be sufficient; they are always at hand, and seem to render a special instrument unnecessary.

By many operators this help will be rejected, but unexpected difficulty may be experienced, and the operation will be safer and surer and perhaps not less rapid by its use.

Canula. A tube through which respiration shall take place for a time is essential, and its form and construction are very important.

It should be double, to admit of being easily cleaned & freed from obstructing mucus by the removal of the inner tube only, without incurring the inconvenience and danger of removing the entire Canula;

It should be made of silver, and its diameter should correspond to the age of the patient; it should neither be too curved nor too straight, to avoid the pressure of its inner extremity on either the anterior or posterior wall of the trachea;

about their middle third, both tubes should be pierced by an aperture in their upper walls,

so placed that when the tube is introduced, it may be free and uncovered within the trachea, so as to admit of air reaching the lungs through the natural passages, by which means the return of normal respiration is induced and the early removal of the tube facilitated;

the position of this aperture is important; if too near the outer end of the tube, the swelling of the parts after the operation, by withdrawing the tube slightly from the trachea; brings it so far forward that it is covered by the wound, and may give rise to much needless and injurious irritation by allowing blood to ooze into the trachea; On the other hand, if placed too far back (a less frequent error), it is covered by the posterior wall of the trachea and therefore rendered useless. In either case, the certain result is necessity for prolonged use of the canula, and the probable one, impossibility of ever dispensing with it. ^{The}

outer tube should have a shield about $\frac{1}{4}$ of an inch in breadth, around its extremity, which should rest upon the skin of the neck when the tube is introduced: at each side of the shield there should be an aperture or projection for the attachment of tapes, which, being tied behind the patient's neck on the completion of the operation, shall prevent the expulsion of the tube by the violent respiratory efforts; there should also be an

* Chirurgie Aperatoire. par M. Guérin. Paris 1853.
Art " Trachéotomie "

arrangement for connecting the inner tube to the shield, but so as to admit of its easy removal when necessary; further, there should be attached to the shield a small moveable plate which may be made to cover more or less completely the opening of the tubes, and so by diminishing the supply of ^{through the canula,} air, may induce the speedy return of free respiration by the natural passages.

Several methods have been devised for the performance of Tracheotomy, and deserve notice:

M. Chassaignac, surgeon to the Hôpital Lariboisière at Paris, has proposed an easy and rapid method which has been frequently followed in operating for croup: * his instrument is a grooved director with a curved sharp hook at its extremity - coming off from the side opposite to the groove: the operation is begun by introducing the hook through the skin and soft parts, without any preliminary incision, into the trachea, and by fixing it behind the cricoid cartilage in order to pull forward the trachea, and steady it; a bistoury is then run along the groove of the director, and is conducted by it into the trachea; the skin, trachea and intervening textures are then divided to a sufficient extent by one single incision,

* *Lancet*. May. 1853.

* *Lancet*. March. 1853.

* *Cruikshank's Surgery*. 7th edition. London 1856 p. 463

a dilator is used to separate the edges of the wound, and the introduction of the tube completes the operation.

D^r Charles Edwards* has described a method precisely similar and has given a figure of a director with a tenaculum at its extremity exactly resembling the punch instrument.

The supposed advantages of this mode of operating are rapidity and certainty, and the great objection to it is that the operator does not see what he is cutting; in some cases it must be inapplicable as in cases of erysipelas of the neck, or from swelling of the parts covering the trachea, such as frequently happens after the application of blisters.

Although inferior to the safer & slower, but purer & safer way in which the operation is usually performed it is certainly valuable in cases where the immediate opening of the trachea is demanded; In cases of Croup such haste is not often necessary, and the necessity for it should always be avoided by operating at an earlier period.

Another mode of performing Tracheotomy has been proposed by Mr Henry Thompson* of University College Hospital, London, which cannot be so favorably spoken of; he also has devised a special instrument which serves both as a bistoury and a dilator: it consists

* "of two blades, united at one end by a hinge; at the other, bent downwards at an angle, & furnished with cutting

Druitt's Surgery, 7th Edition. London. 1836. p. 146

"edges, nicely adapted together, so as when pressed together
 "to make as it were but one edge." There is a
 screw by which the blades can be separated or approx-
 -imated. In performing the operation, the cutting
 point is introduced "transversely, in the middle line,
 "about a quarter of an inch below the Cricoid cartilage
 "so as to slip the point into the trachea, between the first
 " & second rings. Then the blades are separated by the
 "screw, sufficiently to admit a tube; the screw is then
 "reversed and the instrument withdrawn" *

This instrument is supposed to enable the surgeon to perform tracheotomy with ease, rapidity and safety.

If the trachea is exactly hit upon, the operation may be easy & rapid enough, but the danger of cutting im-
 -portant parts when digging transversely in search of it, seems very serious. Besides, a transverse

wound in the trachea without dividing a single ring gives much less space for the introduction of the tube;

in a patient of 2 or 3 years of age, division of the trachea in half its circumference would scarcely afford an opening wide enough to admit it, and when introduced, it would cause much greater irritation by pressure than when the incision is longitudinal.

When the instrument is used as a dilator much time is lost in introducing the tube and its easy introduction is hindered by the shape and transverse position of the instrument. This

method of performing the operation in children, seems to be in all respects objectionable.

The best method of performing Tracheotomy ^{is,} indeed, the usual one; —

The patient should be laid on his back before a good light with a pillow under the neck and shoulders;

if the pillow is placed under the neck merely, the shoulders sink down and the operation is rendered much more difficult. (Trousseau)

The incision in the skin should be exactly in the middle line, and should extend downwards for about an inch and a half from the level of the cricoid cartilage; it may be made either by a vertical incision, or by raising a fold of integument and dividing by transfixion, the knife being guided by a vertical line previously drawn on the skin;

the fat and fascia being next divided in a line parallel to the first incision, the sternohyoid muscles are exposed, and slightly separated;

a very little dissection suffices to expose the thyroid isthmus, and the plexus of veins which usually lie in front of the trachea below it; the isthmus is to be avoided if possible, or if necessary it is to be cut across, — the arterial hæmorrhage which follows its division being usually very trifling.

the veins which cannot ^{be} drawn aside, are also to be divided; if they are very large it might be prudent to apply first a double ligature, but cases requiring this are extremely rare; Compression by the finger of an assistant until the operation

is finished, is generally quite sufficient to prevent any considerable hemorrhage.

At each expiration the veins become distended and may jet like arteries; it is impossible to arrest this except by relieving the embarrassed respiration which causes it, when it usually ceases at once; the rule to wait till the hemorrhage ceases before opening the trachea is therefore absurd, for the completion of the operation is the only effectual way to arrest it.

The rings of the trachea are next laid bare by the division of the small quantity of areolar tissue that immediately covers them: Before opening the trachea, the surgeon sees that the Canula, and the Dilator (if he uses it) are at hand, and then, entering the point of the bistoury about the 5th or 6th ring of the trachea, cuts upwards, because of the large vessels so near the bottom of the wound, and divides three or four rings according to the size of the tube to be introduced; then holding open the wound with ^{his} finger or a pair of forceps, or a special instrument, he introduces the canula and retains it in the trachea until the breathing by the tube has become fairly established.

The patient should be raised to the sitting posture as soon as the operation is completed, and the tube carefully ^{secured} held in the trachea, notwithstanding his struggles.

The opening of the Trachea is immediately followed by a rush of air which expels the blood that enters by the opening, sometimes along with shreds of the false membrane, which has already invaded the trachea. For a minute or two the respiration is embarrassed and difficult, a few drops of blood entering with the air and being violently expelled again by each expiration, but generally in a very short time it becomes calm and easy, and the aspect of the patient undergoes a very hopeful change. The tube being secured by tapes behind the neck, the wound is dressed by a strip of lint placed round the orifice of the tube, and some loose woollen covering is placed over its opening; an intelligent assistant should be left near the patient for a few hours after the operation to remove by means of a feather any obstruction in the Canula, and also occasionally to remove & clean the inner tube; this constant attention soon becomes unnecessary, and the removal of the tube is less frequently required.

The appearance of the patient is greatly improved, and all the symptoms are remarkably alleviated, almost immediately after the operation; as a proof of this, and as a result of previous exhaustion, the child usually falls asleep soon after being put to bed, and,

although frequently disturbed by mucus collecting in the tube, the sleep is often long and refreshing.

The patient being thus saved from imminent death, and having escaped the dangers of the operation, the proper ^{subsequent} treatment comes now to be considered: the indications are —

To avoid or subdue subsequent inflammation
 To support the patient's strength
 and To effect the removal of the tube as soon as possible.

1. Subsequent inflammation is to be avoided by carefully protecting the patient from cold, by the use of the loose woollen covering for the tube, already mentioned, and by maintaining around the patient a warm and humid atmosphere: this last object is best accomplished, it is said, by occasionally dipping a heated brick in water, and allowing the clouds of steam thus generated to rise into the room. When inflammation does occur, it must be combatted like inflammation in any other circumstances, and by means proportioned to the strength of the patient.

In Diphtheritis, that form of inflammation is apt to attack the wound also: it is best treated by free and repeated cauterization ^{with} by nitrate of silver.

* loc. citat.

2. The food of the patient should be nourishing, given slowly and in small quantity at a time.

A kind of dysphagia is apt to occur after the operation, caused by the entrance of food into the air passages, and it may be so great as to endanger the patient's life from inanition, if the food be not artificially introduced into the stomach.

Guersant has frequently been obliged to use an œsophageal tube for this purpose and he says* that its introduction is often much better borne by the less disagreeable to the patient when ^{it is} passed by the nose (if possible), than by the mouth.

It is rarely that the dysphagia requires such measures, and it usually passes off in a few days: it is best avoided by giving the food very slowly, and in ^a tolerably consistent uniform pulp.

3. The speedy removal of the tube is an object of the greatest importance; of course it cannot be accomplished, nor even safely attempted, till the patient can respire somewhat by the natural passages; to promote this, the arrangement before alluded to for the gradual diminution of the orifice of the tube is very useful.

The period when this can be commenced, the rate at which it may be carried on, and the time within which normal respiration may be established, are very variable.

After the process of diminution of the artificial opening is somewhat advanced, both tubes should be withdrawn daily for a longer or shorter time according to the effect on the respiration: the amount of air admitted by the normal passages gradually increases, as the products of the inflammation are removed by absorption, and the length of time during which the tube can be dispensed with gradually increases also, until at length it can be altogether removed.

This is usually accomplished according to M. Trausseau's Experience in about 14 days, but the period varies considerably, and is often much longer.

I have now spoken of the objections to Tracheotomy, and tried to answer them: of the circumstances which more or less affect the propriety of the operation, and tried to give to each its proper weight: and lastly of the operation itself, and of the treatment to be followed after its performance.

If I have succeeded in showing that in very many cases of Croup, Tracheotomy might be of the greatest value, and is deserving of far more attention than it has yet received in reference to this disease, my principal object in writing on this subject shall have been gained.

David Yellowlees.