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THE SAFEGUARDING OF THE TONSIL AND ADENOID OPERATION:

THE PREVENTION AND TREATMENT OF SOME OF THE POST- OPERATIVE COMPLICATIONS OF THIS OPERATION.*

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THE sequelæ of the tonsil and adenoid operation which will be discussed in this communication are the following:

1. Temperature elevation.
2. Increase of arthritic symptoms.
3. Edema of the palate and uvula.
4. Hemorrhage.
5. Middle-ear inflammation.
6. Acidosis.
7. Pulmonary abscess.

1. **Temperature Elevation.** This condition, frequently associated with a degree of tachycardia which is out of proportion to the pyrexia, is very often found. The height ranges from 99° to 101°, rarely going higher unless there is some definite focal lesion, such as an infected middle ear. It may last one day, rarely more than two, and is so common that it usually is unnecessary to attach any importance to it, with the exception that no patient with a mouth temperature of over 99.5° should be allowed to leave the hospital.

In order to get definite figures, I took the charts of 25 private patients consecutively operated upon at the University Hospital and averaged the temperature figures. I selected the highest recorded temperature the day of the operation, the day after the operation and the day following that. The following is the result:

On the day of operation the average high temperature was 98.6°.

* Read before the Section of Otology and Laryngology of the College of Physicians of Philadelphia as part of a Symposium on "Safeguarding Tonsillectomy," December 21, 1921.

On the day following operation the average high temperature was 99.3°.

On the second day following operation the average high temperature was 98.9°.

What the elements are which cause this elevation naturally are difficult to analyze. The local pain and discomfort, the general physical distress, the bronchial irritation from the ether may and probably do enter into it. It is likely that an important factor is the extra dose of tonsil-derived toxins which necessarily is squeezed into the circulation during manipulations essential to a tonsillectomy. With this probability in mind it follows that good elimination should be maintained during the early postoperative days, the bowels being kept open and plenty of water being imbibed. This last procedure is not a difficult one to follow, with exceptions, of course, if the water is taken in large, rapid gulps, instead of in widely separated sips or through a tube.

There is one type of temperature elevation which always is gratifying to the operator, and that is the one which follows severe hemorrhage, as it indicates the absence of or recovery from shock and also tells us that the blood-making apparatus is at work replacing the lost vital fluid.

Should the fever rise above 101° and remain there for two or more days it should be the signal for a thorough examination of the sinuses and ears and of the system in general, particularly the lungs, heart and kidneys. A blood count at such a time may afford a suggestion as to what is going wrong.

2. Increase of Arthritic or Neuritic Symptoms. When a patient has been operated upon for the purpose of removing a focus which has been causing an arthritis, a neuritis or some other such condition, a temporary exacerbation occasionally is seen postoperatively. Instead of this being regarded as a complication it is not unreasonable to view it as a confirmation, a confirmation of the diagnosis that the focus was in the tonsils. Such a viewpoint is consoling both to patient and operator. If the patient can be told that the operation itself naturally would cause an inordinate dose of tonsil poison to be forced into the system and that the increase of symptoms means that the diagnosis of tonsil responsibility is confirmed, then all fears are allayed.

A case which is apropos is mentioned by Keiper,¹ who states that he "had one case wherein after tonsillectomy a severe infection of the right knee-joint developed." The case is reported thus briefly, but it indeed would have been interesting to know whether or not the organisms in tonsil and knee were the same. This case is of interest also in connection with the question of the method of transmission of the infection in cases of pulmonary abscess.

¹ The Tonsil Question Up to Date, *Laryngoscope*, St. Louis, 1921, 31, 777.

3. **Edema of the Palate and Uvula.** This occurs in varying degrees, and while it sometimes is found in children it is far more frequent in adults. In my experience it is more likely to occur when the patient has had a similar condition during antecedent attacks of tonsillitis or quinsy, when there is a large upper tonsil pole, when the tonsil is adherent to its fossa wall or when some of the mucosa of the soft palate overlying the palatoglossus has been lifted from the underlying tissue during the freeing of the upper half of the tonsil from its bed. A curious feature of this edema is that the posterior portion of the uvula is usually more swollen than is the anterior. Unless the anterior mucosa and submucosa have become toughened by food friction, and therefore swell less readily, only a detailed study of the venous and lymphatic systems will give us a true explanation of this phenomenon.

The condition always is a distressing one and not infrequently it causes alarm to the patient by creating fears of strangulation. It also prolongs convalescence, since it adds tremendously to the ordinary difficulty in swallowing, not only by narrowing the pharynx, but in addition the lengthened uvula extends so far down that it becomes part of the food bolus and the patient tries to swallow his own uvula. This is a powerful discourager to eating and is altogether very annoying. When it is extreme the nutrition of the uvula may be slightly interfered with, and I fancy that all of us have seen a spot of necrotic epithelium at the tip of the uvula in some of these cases.

There is nothing which will give to this condition any relief worthy of the name. As it really is a hypostatic condition (with possibly at times an element of infection added) it is irrational to expect that any local application will afford relief. Punctures are recommended, but the effect of these is slight or nil, and such incisions never reach the most swollen part, viz., the posterior part. As they always close in a brief time it is difficult to believe, on either theoretical or practical grounds, that they avail anything. And, on the basis that the condition is due to a severing or constriction of the efferent venous and lymphatic pathways, it is best to realize that the gradual disappearance of pressure or the establishing of collateral paths must be awaited with as much philosophic anticipation as patient and physician can command.

In the early days of my practice I had a case in which the edema was extreme and caused intense discomfort to the patient. Feeling that I had to do something I slipped a lingual tonsillotomy over the enormously lengthened uvula and cut off the lower half. This gave no relief whatsoever, and to add insult to injury, when the palate healed it did so in the form of an inverted A, there being a distinct notch where the uvula had been. No unpleasant consequences resulted, but this taught me two things: Never to do

it again and that the edematous uvula is not all uvula. Approximately half of it is uvula, viz., the lower half, and the other half, viz., the upper half, soft palate.

An aggravation of this condition is found when the uvula is bifid, as under these conditions the lower end becomes club-shaped and may swell enormously.

Various applications have been recommended for local use, tannic acid, tincture of benzoin, silver nitrate solution, adrenalin chloride solution, etc. Sometimes comfort can be given the patient by having him lie on his side, and this frequently will check gagging. Ice may be used externally and in the mouth, but altogether its a painful condition and a trying one, and only Nature's methods will give ultimate relief.

4. **Hemorrhage.** This is the most important phase of tonsil operative work. There are two phases to the situation, the preventive and the curative, and of these two the preventive is the more important.

It is not putting the case too strongly to say that no patient should be submitted to a tonsil and adenoid operation whose bleeding habits have not been gone into thoroughly and whose coagulation and bleeding time have not been taken preoperatively whenever this is practicable. In addition, it should be axiomatic that no patient should leave the operating table until all bleeding has ceased, this to be proved by careful inspection.

In the present stage of our tonsil technic the phrase "bloodless tonsil operation" should be abolished from usage unless we are using the words in a Piekwiekian sense. "Bloodless" means without blood, and this word will be applicable only when someone is able to develop a method of operating which invariably sheds no blood at the operation and which invariably is followed by no postoperative hemorrhage. At the hands of all of us some cases are operated on with but a few drops of blood being lost, and in others the amount of bleeding, even if but brief, is at times terrifying. Again in some cases the bleeding is negligible at operation but alarming secondarily.

The question of hemorrhage at operation ordinarily need not cut any great figure if the operation is performed with deliberate care, attended by thoroughness and assured technic. A complete removal of the tonsil, followed by gauze pressure in the tonsil fossa, using any astringent the operator finds most serviceable (my own preference is for 10 per cent solution of silver nitrate) and the picking up and ligating of all bleeding-points, affords the least chance for prolonged bleeding on the table and the greatest insurance against postoperative trouble. For many years I have tied off every bleeding-point, since experience (and I fancy that all will agree with this) has shown that the tiny bleeding-point of two o'clock in the afternoon may become the gusher of midnigh.

I use the ordinary Kelly hemostat, for the reasons that it has a broad point, thus making the closing of the knot easy, and the curve is of value in depressing the tongue or retracting the anterior pillar. I use no needle, simply a surface tie, employing No. 2 chromic catgut, softened in water, for the purpose. I never have found any knot-tying device necessary, the fingers being all sufficient for the purpose. In this connection it should be stated that we may be compelled to modify the freedom with which suture ligatures are used in the tonsil fossa. It is at least conceivable that septic material may thus be introduced into the tissues of the pharynx and that septic thrombi may be formed later to cause trouble elsewhere in the body.

The bleeding may come from anywhere in the fossa, and the greater one's experience the more certain does one become of this. The three most difficult places in which to find and clamp a bleeding vessel are high up in tonsil fossa, low down in the fossa and on the posterior surface of the anterior pillar. A few points about these: three times have I had great difficulty in securing vessels in the upper part of the fossa. In the first case of this kind, after twice securing the vessel with a hemostat and then having the ligature cut completely through the tissues, I passed a large, strong, curved needle through the palate, entering mesially to the fossa and emerging laterally to the anterior pillar. This secured the vessel, but the patient six weeks later died of pulmonary abscess, this being the one tonsillectomy case I have lost.

In all of them with one blade of a pair of scissors in the tonsil fossa and one anterior to the palate I cut through the anterior palatine arch to the upper pole of the fossa and then had no difficulty in getting the offending vessel. An interesting feature of these cases is that the arch on the cut side healed symmetrically with the other.

In a number of cases a very annoying feature has been the slow and repeated filling of the tonsil fossa with blood, apparently from below, and with no bleeding vessel discernible. Up to six years ago I habitually sewed a gauze pad into the fossa in such cases. At the time mentioned the thought occurred to me that one hitherto unexamined region was the posterior surface of the anterior pillar. With this idea in mind, at the next case presenting this feature I clamped with a hemostat and everted the anterior pillar, and on its posterior surface the offending vessel was found. In only 1 case since then has it been necessary to sew in a plug and in 6 others have I found a bleeding vessel situated at this place, where it easily was secured and tied.

It seems hardly reasonable to condemn the suction apparatus as a cause of immoderate bleeding. Its value as a cleanser of the throat is unquestioned and no one who uses it intelligently puts the end on the raw surface and sucks away. Its proper places

of use are in the cheek, in the pharynx and in the tonsil fossa, too, but in the last-mentioned place very gently and but momentarily. For the minor cleansing and in looking for bleeding-points gauze sponges sometimes are more efficacious. The complaint of the anesthetist that the suction motor sucks away his cherished ether is probably well founded, but in spite of this I question whether, weighing every actual advantage against every suppositious or proved disadvantage, any operator who has become accustomed to the apparatus ever feels quite at home, quite as efficient and quite as safe without it.

Secondary bleeding should be handled precisely on the same principles as in bleeding at operation. Two very important precautions are these: On returning the patient to bed to place him in a ventrolateral position with the face down and to have constant watching by a skilled nurse until the patient is out of ether. Should hemorrhage start the operator should be notified at once and should visit the case immediately. The handling of such a hemorrhage is no job for an intern and patients have died because the chief had been notified too late. A full dose of morphin should be given at once to an adult. Pressure with the operator's favorite styptic should be tried, and if this fails, every effort should be made to secure the vessel or vessels. If the patient, child or adult, is so unruly or the reflexes are so active that accurate work is impossible, there should be no hesitation in promptly (with the accent on the *promptly*) taking the patient to the operating room, reëthérizing and handling the situation in a truly surgical way. Great exsanguination is no contraindication to giving ether, as it is astonishing how the general condition improves under the anesthetic and how the pulse improves when the leak in the circulatory system is plugged. Refilling of the partly emptied vessels should be done with cautious deliberation, Murphy drip or small repeated enemas of physiologic salt solution being used to an amount which will not too suddenly increase the blood-pressure.

5. *Middle-ear Inflammation.* That an acute otitis media sometimes, although rarely, follows a tonsil and adenoid operation is not remarkable, but that it does not follow more frequently *is* remarkable. There are many factors which could predispose to this accident. Among these are the normally germ-laden condition of the upper respiratory tract, the trauma that is exerted upon the walls of the nasopharynx, the irritation of the nose and nasopharynx by the ether vapor and the presence in the nose and nasopharynx of clotted blood which quite easily could obstruct the tube or could be blown or coughed into it. It is impossible to decide which is the more dangerous, to leave the clotted blood in the nose and nasopharynx or to wash it out before the patient leaves the table. Many good and ultra-careful operators use the latter procedure, have used it for years and favor it highly. I

confess to a slight feeling of trepidation when I see it done, as to me it carries with it the well-known dangers attending the use of the nasal douche. My own practice is to use postoperatively no spray or douche in the nose, and no case of middle-ear abscess has ever resulted from operation. Probably I have been fortunate but this experience has caused adherence to the let-alone principle.

As already remarked in substance, we always are operating in a septic field. In addition we always are operating upon septic tissue, and this probably is as true of the adenoid tissue as of the tonsils. The former growth hangs down in the nasopharynx usually in three, four or five leaflets, and it is quite astonishing to note how frequently in the rhinoscopic mirror we can see pus exuding from the fissures between these folds. I recall one curious case in which the growth was removed with the largest-sized La Force adenotome, and on opening the box to shake out the adenoid nearly a dram of yellow, creamy pus was found in the instrument with the severed adenoid. As no pain in the pharyngeal vault had been complained of, we evidently had here a chronic abscess of the adenoid.

Since the above was written there has appeared in the *Journal of the American Medical Association*, of December 17, 1921, a "Current Comment"² referring to some recent work along this line. The following is an extract and is of great practical interest:

"Heretofore the tonsils and the pharynx in general have received most of the consideration devoted to the bacteriology of the upper respiratory passages. Recently, however, a group of investigators at the University of Illinois College of Medicine devoted their attention to the adenoids. Cultures were taken from the excised adenoids to determine more definitely the flora of the nasopharynx. *Pathogenic bacteria were found in every specimen.* Of the more important organisms, hemolytic streptococci occurred in 61 per cent, pneumococci in 65 per cent, *Bacillus influenzae* in 40.9 per cent and *Bacillus diphtheriae* in 12 per cent. Other streptococci, diphtheroids, staphylococci, Gram-negative cocci, *Bacillus mucosus capsulatus* and *Bacillus fusiformis* were encountered. The depths between the folds and bottoms of the crypt like structures of the adenoids harbored hemolytic streptococci, pneumococci, and *Bacillus influenzae* in larger numbers than the epithelial surface or the nasopharyngeal swabs. The adenoids then, like the tonsils, are to be regarded as common foci harboring dangerous microorganisms."

Rarely though tubotympanic complications occur, when they do they may extend in any one of their favorite directions, and it behooves us to exercise every care to prevent and to recognize early such a complication. In the line of prevention as much

² Bacteriology of the Adenoids, *Jour. Am. Med. Assn.*, December 17, 1921, 77, 1975.

care in asepsis should be taken as in any other major operation, this including gloves, face mask and all other essential details. If there is to be a series of tonsil operations the operator, the assistants and the whole operating room paraphernalia should be just as aseptic for the second and subsequent operations as for the first. Even at this day one can see a series of operations performed without any of the staff changing gowns, with a perfunctory resterilization of instruments and with no change of the instrument table layout. This is all wrong. The punctilious attention to the details of surgical cleanliness at each individual operation takes time, but that much is due the patient. Only by following such a plan could an operator's conscience be clear if any serious complications should follow an operation. In case a patient should develop postoperative sepsis when the operator had failed to exercise all the niceties of aseptic technic, no matter at what cost of time or effort, the surgeon could not hold himself blameless, nor, in case the patient's people should become antagonistic and institute legal proceedings, could any brother surgeon testify wholeheartedly in his favor.

Another point is this: We all are familiar with the reflex otalgia which so frequently is complained of during the first few post-operative days. The glossopharyngeal nerve, with its pharyngeal and tympanic branches, as well as the vagus with its pharyngeal and auricular branches, afford a ready explanation of this phenomenon. So common is this that we can almost expect it. Yet not only is it the safest of practice always to examine the ears when such complaint is made, but it is advisable to go still further and practice examination of the ears as a routine procedure. Should a surgeon, for example, have one middle-ear abscess in 500 cases, it is only one-fifth of 1 per cent for him, and that may not be a high percentage for the operator, but to the patient and to that patient's family it is 100 per cent and a very serious matter.

6. *Acidosis.* The theory of this condition was first promulgated in 1850 and the present name applied in 1906. Medical literature is teeming with articles on this subject. The first one which directed the attention of laryngologists to the subject was presented by George B. Wood³ in 1917. Two recent articles of interest are by Donnelly⁴ on the "History of Acidosis," and by Farrar⁵ on "Acidosis in Surgery: Its Occurrence during Operation and its Treatment by Glucose and Gum Acacia Given Intravenously." Farrar's article will be freely quoted in this communication.

The bicarbonates of the blood are carriers of the acid by-products

³ Bicarbonate of Soda in Ether Anesthesia, Transactions of the American Laryngological Association, 1917, 39, 239.

⁴ History of Acidosis, New York Med. Jour., August 21, 1920, 112, 246.

⁵ Acidosis in Surgery: Its Occurrence during Operation and its Treatment by Glucose and Gum Acacia Given Intravenously, Surg., Gynec. and Obst., April, 1921, 32, 328.

of metabolism to the alveoli of the lungs and constitute the alkali reserve of the body. If the bicarbonates are present in the blood in large amount their ability to unite with the CO_2 is quantitatively high, but if there is a diminution of the bicarbonates the CO_2 will accumulate in the tissues. The resulting increased CO_2 tension in the blood will stimulate the respiratory center to increased respiration. If alveolar ventilation is not then obtained a condition of intracellular acidosis results, with serious disturbance to internal (tissue) respiration.

Two things should be remembered as being of great importance: One is that carbohydrates and fats are base-forming foods and the other has just been mentioned, viz., that the bicarbonates of the blood are carriers of the acid by-products of metabolism to the lungs. Hence the necessity of avoiding proteid food and of administering bicarbonates before operation as well as afterward if vomiting appears.

The percentage of blood bicarbonates is an important factor in surgery for the reason that during operation, owing to increase in acid metabolism and to the fact that ether affects the liver, which is the regulator of acid by-products, there is considerable drop in the alkali reserve. As long as there are fixed bases in the blood the elimination of CO_2 will continue. If the alkali reserve is high to begin with the drop may not be great enough to cause a severe acidosis.

"The more marked the existing acidosis to begin with the more sensitive is the patient to operative procedures, and the more likely is he to be let down by them into a region of danger.

"The essential feature in one's conception of acidosis is a general impoverishment of the blood in bases or in substitutes which generally give rise to bases, so that the body as a whole shows some systemic abnormality. If metabolism is faulty then there may be an accumulation of acid by-products in the body due either to excessive production or to defective elimination, or both together, and the condition of acidosis results."

Among Farrar's⁶ conclusions are the following:

"The alkali reserve (bicarbonates of the blood) is the criterion of the acid-base balance of the body.

"Acidosis is a term used to signify an impoverishment of the blood in bases.

"The range of the carbon dioxide combining power of the blood in women (150 cases) . . . is about eight points lower than Van Slyke found for men.

"As the range is shorter in women the danger line is sooner reached, which accounts for the greater frequency of acidosis following operations in women than in men.

⁶ Loc. cit.

"The fall in alkali reserve during operation depends not only upon the anesthetic and the duration of the operation but upon the nature of the operation and the occurrence of hemorrhage and shock.

"The fall in the alkali reserve bears a close relation to the fall in blood-pressure and pulse-pressure. If the fall in blood-pressure is prevented there is a saving in alkali reserve.

"Carbohydrate feeding before and after the operation together with the use of bicarbonate of soda will do much to prevent or lessen acidosis."

Prevention of this condition is most important, and since I routinely have fed sodium bicarbonate to all patients before operation under general anesthesia I have had no marked cases. Vomiting has been absent or at a minimum and operative convalescence much more comfortable. As Wood⁷ said in the paper mentioned above, "As a rule patients who have been given sodium bicarbonate before the operation, after having emptied their stomachs of the blood and fluid swallowed during the operation, do not vomit again and seldom complain of nausea, unless there is continued bleeding."

Should persistent vomiting occur after operation in the absence of any such obvious cause as continued hemorrhage, and should examination of the urine reveal acetone, treatment should be instituted at once. If food can be retained at all it should consist of carbohydrates and fat and not of proteids. Alkalies, bicarbonate of soda or, as suggested by Lynch,⁸ citrate of soda as of more agreeable taste, should be given by mouth. Sodium bicarbonate (2 per cent) or glucose (5 to 20 per cent) should be given in small, repeated enemas or by Murphy drip. Lynch, who practices in New Orleans, states that the condition is much more frequent in hot weather and also that the postoperative use of codein and morphin tends to increase the quantity of acetone and consequently the incidence of vomiting. Before hearing this statement I had made no such observations, nor since using sodium bicarbonate routinely before operation, and morphin, heroin or codein in adults and paregoric in children after operation, when pain requires it, acidosis has occurred.

Van Slyke⁹ in a recent communication stresses the importance of hemoglobin in this condition. He states that "the carriers of carbon dioxide may be most simply described as substances which hold in combination alkali, of which they supply CO_2 , as it enters the blood, sufficient to bind nearly all of it as alkali bicarbonate. . . The chief carbon dioxide carrier of the blood

⁷ Loc. cit.

⁸ Discussion of Paper by George B. Wood, see ante.

⁹ The Carbon Dioxide Carriers of the Blood, *Physiol. Rev.*, January, 1921, 1, 141.

is the hemoglobin," it furnishing 80 per cent to 95 per cent of the alkali which neutralizes the CO_2 .

7. Pulmonary Abscess. 80 per cent of postoperative cases of abscess of the lung are secondary to tonsil removal. In every 781 cases of tonsillectomy there is one which develops lung abscess. Rather startling statistics! The first figure is given by Wessler¹⁰ who studied 100 cases of suppurative lung disease. Of the 100, 26 were postoperative, and of these 26, 21 were posttonsillectomy. The other figure is given by Keiper,¹¹ but he does not mention the sources from which his statistics are derived.

None of us know how many of our tonsil cases have been followed by this complication, particularly in our ward cases. They may not associate their pulmonary trouble with the antecedent operation and are likely to consult some other physician or clinic. An illustration of this is found in the report of Fisher and Cohen¹² of 5 cases, all of which had had tonsil operations in a hospital other than that in which they finally landed.

Richardson¹³ first brought this matter to our attention in 1912. In this report he details the histories of two cases, both of which recovered, one after incision and drainage of the abscess and the other without any active interference. He described them as cases of "septic infarct of the lung."

Following this pioneer report a large number of observers have placed their cases on record. The *Quarterly Cumulative Index* for the first nine months of 1921 lists 13 articles on lung abscess, 5 of which relate to this condition as secondary to tonsillectomy. For 1920 there were 19 lung abscess papers, 4 of which were confined to the posttonsillectomy feature. In 1919 the figures were 15 and 1, and in 1918, 11 and 3. These numbers show the increasing attention which is being given to this subject.

Of all the sequelæ of tonsillectomy this is one presenting the highest percentage of fatalities; the death-rate varies, according to treatment, from 25 per cent to 50 per cent. It is therefore a condition toward which all possible prevention should be exerted, whose appearance should be constantly watched for and against which treatment promptly and intelligently should be directed.

The etiology of lung abscess has caused much discussion. Some favor inhalation as the main cause, while others believe that the process usually is an embolic one. Hedblom¹⁴ states that the abscess is a sequel of inflammation, or results from infection reaching the lung tissue by way of the bronchus, the blood stream or

¹⁰ Am. Jour. Roentgenol., April, 1910, 6, 161.

¹¹ Loc. cit.

¹² Pulmonary Abscess in Adults Following Tonsillectomy under General Anesthesia, Jour. Am. Med. Assn., 1921, 77, 1313.

¹³ Tonsillectomy, with Consideration of its Complications, Washington Medical Annals, May, 1912, 11, 85.

¹⁴ Pulmonary Suppuration, Med. Rec., September 13, 1919, 96, 441.

by direct extension. This, of course, covers the possibilities, and probably is as far as we can go.

Opinions vary greatly as to the effect of posture on the incidence of this disease. Wessler and Schwartz¹⁵ state that "in those cases following operation the disease is usually seated in the upper lobes, while, on the other hand, abscesses resulting from the aspiration of foreign bodies and the chronic bronchopneumonia type of bronchiectasis usually localize in the lower lobes. The authors suggest that it is not improbable that the recumbent position during operation has some bearing on the upper lobe localization of these abscesses."

As opposed to this view, Richardson¹⁶ believes that the head should be kept low and well extended. On the other hand it is largely the custom in New England for tonsil operations to be performed with the patient in the sitting position. This naturally would cast doubt upon the efficacy or necessity of the lowered head position, and leaves the question of operation posture a rather open one.

It has been stated¹⁷ that the question of which pathway, circulatory or respiratory, transmits the infection to the lung is largely an academic one. While this may be true to some extent it does not alter the fact that every endeavor should be made to prevent, as far as possible, the ingress of blood, etc., into the trachea and bronchi during operations. To aid in keeping the lungs safe from abscess and other postoperative complications various suggestions have been made. These include posture (the head low and well extended), having the patient not too deeply under the anesthetic, warm ether, keeping the pharynx as clean as we can with suction apparatus, the abolition of motor-driven anesthetic apparatus and seeing that the patient is in proper condition for the operation. Some of these are and all of them may be of value and they suggest a few thoughts for brief elaboration.

Posture has just been mentioned.

That the motor-driven ether can force the pharyngeal contents into the trachea and bronchi would at least seem to be open to question. But to prevent too deep anesthesia always has seemed to me to be a tremendous desideratum. The coughing reflex is one of great value, and particularly when the patient has been returned to bed is it of importance that the pharyngeal reflexes return as soon as possible. Cases of deep narcosis have occurred in which the patients have bled into the stomach almost to the point of exsanguination without any swallowing movements being visible, the blood having trickled down the relaxed esophagus.

¹⁵ Quoted by O. H. P. Pepper, *Prog. Med.*, September, 1921, p. 89.

¹⁶ Discussion of paper by Fisher and Cohen, *Jour. Am. Med. Assn.*, October 22, 1921, 77, 1313.

¹⁷ *Loc. cit.*

The same thing might easily happen to the trachea. The almost universal use nowadays of the prone position of the patient post-operatively is a great safeguard against such untoward and sometimes fatal happenings.

It would seem that the ideal degree of anesthesia would be to keep the patient just over the edge of absent reflexes, with the idea of thus helping to keep the tracheobronchial passages as clear as possible. In a series of cases in which there was used a motor-driven ether pump there occurred in a short time so many cases of deep cyanosis and real ether poisoning, several requiring oxygen and artificial respiration, that I soon gave it up. A trying feature was that the patients went to the bad so quickly that no warning was given. I might add that physicians experienced in anesthesia were presiding over the ether. Ether vapor pumped by a hand bulb with constant watching of the patient is quite safe, and in quantity and effect can be gauged with great accuracy, thus preventing too profound anesthesia and the entrance of blood, etc., into the trachea and bronchi.

Probably all believe that the suction apparatus is of value in preventing inhalation troubles. That blood and septic tonsil crypt contents do sometimes get into the trachea cannot be questioned. We frequently, in evidence of this, hear large tracheal rales, and often during operation we can see accumulations of blood, etc., appear in the pharynx during expiration and disappear downward during inspiration. It is here that suction is of great value, for such collections promptly can be drawn out. Richards¹⁸ has suggested that the suction nozzle be used to pick up the masses squeezed out from the tonsil at operation, an idea which would seem to be worthy of adoption.

Voorhees¹⁹ also favors this scheme. He believes that the possible inspiratory causes are blood-clots, pieces of adenoid, cheesy masses from the tonsil, a broken tooth or rarely pieces of tonsil which have broken off from the main mass in the removal. He states what is undoubtedly true, that "in using the Sluder method cheesy masses are forced out of the crypts during the engaging of the tonsil in the ring of the instrument." This would apply to any method of operating, but probably with greater force to one of the guillotine type than to the dissection method. Voorhees suggests that all cheesy masses and detritus should be removed from the tonsil crypts before the operation is begun.

It should not be forgotten that an actual foreign body, such as a loose tooth, an especially common condition in children during the years of their second dentition, may be the cause of the trouble. A corollary of this is that teeth which readily could be

¹⁸ Discussion of paper by Fisher and Cohen, *vide ante*.

¹⁹ Lung Abscess Following Tonsillectomy, Report of a Case with Bronchoscopic and X-ray Findings, *Laryngoscope*, August, 1921, 31, 609.

uprooted by a mouth-gag should be looked for before operation. I never will forget, at one operation, on picking out a white mass from the hollow of the cheek to find that it was a deciduous molar tooth which had come loose during the operation.

At present we are at sea as regards knowing the frequency with which lung abscess follows tonsillectomy under local anesthesia. Search of the literature has resulted in finding but two articles on this question. Porter reports 2 cases, as also do Simpson and Noah.

Porter²⁰ takes a very reasonable position. He says: "There exists a complicated network of veins, the plexus tonsillaris and the plexus pharyngeus, which cover the outer walls of the pharynx and the tonsillar cavities, receiving blood from the tonsils, tonsillar pillars and pharyngeal walls. These vessels are exposed and always injured even in the gentlest operative work. This too, is a field impossible to protect from germ-laden saliva and pus. It is therefore not difficult to believe that infected emboli could be dislodged from veins thrombotic from trauma and infection located in an area active in every attempt at speech and swallowing. I feel that there can be no doubt that infected emboli travel direct to the lungs and cause certain cases of pulmonary abscesses. 'Aspiration' could not account for a brain abscess secondary to operation on the faucial tonsils, yet undoubted cases have been reported by careful observers." Such an embolic process naturally could occur under any form of anesthesia.

Simpson and Noah²¹ state: "The writers believe that aspiration does not account for the production of lung abscess in the 2 cases reported. On the other hand they believe the following points favor hematogenous infection as the cause: (1) Both cases were operated on under local anesthesia in the upright position. (2) The mouths and throats were in a septic condition before and for some time after operation. In Case 1 considerable sloughing of the right tonsillar fossa and posterior pillar occurred. (3) Late occurrence of symptoms point to a blood-stream infection. (4) The occurrence of the abscess at the site of the tuberculous lesion, which was in both cases in the upper and middle lobes.

"Conclusions. 1. During or following operation septic material enters the veins, passes through the right heart to the lungs and there finds, in the presence of a tuberculous lesion, suitable soil for the production of an abscess.

2. "The possibility of aspiration of infected material as a cause of pulmonary abscess is not to be denied, yet we believe that more cases occur as a result of hematogenous infection than is generally supposed."

²⁰ Pulmonary Abscess Following Tonsillectomy under Local Anesthesia, *Virginia Medical Monthly*, March, 1921, 47, 12, 696.

²¹ Report of Two Cases of Lung Abscess Following Tonsillectomy under Local Anesthesia in Tubercular Subjects, *Penn. Med. Jour.*, March, 1920, 49, 322.

It should be added that both the cases reported by Porter "presented physical and roentgen-ray findings of definite lesions indicative of coexisting tuberculous pathology." While a local anesthetic is the one of choice for tonsillectomy in a tuberculous patient, these cases should help us to realize that the procedure is not without danger.

The onset of pulmonary abscess is usually quite characteristic, and when the following symptoms appear the chest should be carefully examined, preferably by a skilled internist: Persistence of an irregular temperature of 100° or more for several days; breath more foul than that usually found after tonsillectomy; chills, sweats, a feeling (frequently localized) of fulness or pain (the latter especially if the pleura is involved) in the chest; hemoptysis, which sometimes may be traced to the lungs by laryngeal examination, and an increase of leucocytes. Along with this there may be a feeling of anxiety and a septic appearance on the part of the patient. Later will come the purulent sputum, possibly blood-streaked, the diagnosis finally being confirmed by the physical signs and roentgen-ray and fluoroscopic examination. Norris and Landis²² state that the diagnosis is rarely made prior to or in the absence of the sudden expectoration of a large quantity of purulent sputum. This should not be the case in posttonsillectomy abscess, for we should be on the lookout for the condition.

Occasionally the symptoms are atypical and misleading, as in the case reported by Hare and related later in this paper.

The symptomatology of this condition in children is described as follows by Wessler and Schwartz:²³ "Immediately or several days after the operation a distressing, persistent cough develops. This is especially harassing at night, but it may also be present during the day. With the cough there is usually a rise of temperature. This temperature is fairly constant during the first weeks, with minor fluctuations. Later it may become intermittent and there may be entire absence of temperature elevation for days. The physical signs of lung involvement are usually slight or absent during the early stages. Later, they may become definite and the evidences of a cavity may be made out. This is in contradistinction to the adult cases in which the physical signs, even of an extensive process and a large cavity, are usually indefinite.

"On the thirteenth or fourteenth day signs of gangrene are noted; including fetid breath, putrid sputum and hemoptysis. The sputum is then profuse. Club-fingers appear very early and disappear after the abscess has healed, sometimes earlier.

"During the course of the disease, complications such as perforation into the pleura with a resulting empyema or pyopneu-

²² *Diseases of the Chest and the Principles of Physical Diagnosis*, 1917, p. 458.

²³ *Am. Jour. Dis. of Children*, 1920, 19, 137.

mothorax, severe hemoptysis or cerebral abscess, may make their appearance."

Norris and Landis²⁴ describe the sputum as follows: "It is negative for tubercle bacilli. The presence of elastic tissue points very strongly toward the presence of a pulmonary abscess. Its absence, however, does not rule out the presence of an abscess. By pouring the sputum on a piece of glass with a black background pieces of lung tissue may be picked out. The elastic tissue appears as grayish-yellow spots which are selected for examination under the microscope. If there is no microscopic evidence of broken-down lung tissue the sputum should be stained with one of the elastic-tissue stains, such as Weigert's."

The death-rate in lung abscess is very high. Fisher and Cohen²⁵ report 5 cases with death in 3 and chronic invalidism in the other 2. Walker²⁶ collected 132 cases, with a death-rate under medical treatment of 54 per cent and with a surgical mortality of approximately 25 per cent. Obviously the disease is largely a surgical one, a conclusion reached by Norris and Landis,²⁷ who as the result of a study of 30 such cases state that the mortality statistics of lung abscess "make imperative the constant coöperation of a surgeon in all such cases."

Hare²⁸ relates an interesting case in which the symptoms were such as to suggest an exploratory abdominal section for the purpose of studying the condition of the gall-bladder, the appendix and the right kidney. This was not done, however, and eventually pulmonary signs, including the usual foul expectoration, cleared the diagnosis. The patient did so well under no treatment whatsoever directed toward the abscess that she was discharged from the hospital. Later the condition recurred and the patient became so ill that operation was performed, consisting of incision, drainage and the use of Dakin's solution. Gradual but complete recovery ensued.

Another interesting case is described by Lilienthal.²⁹ The first symptoms suggesting abscess appeared about a week after operation. Six weeks after operation there was a pulmonary hemorrhage and during the next few weeks there were fifteen hemorrhages, some of which were quite copious. Lilienthal removed the right lower and middle lobes and part of the upper lobe. "Over a year later the patient was in excellent general condition and stated that he was able to dance through seventeen dances without undue effort and without shortness of breath."

²⁴ Loc. cit.

²⁵ Loc. cit.

²⁶ Acute Abscess and Gangrene of the Lung, Boston Med. and Surg. Jour., 171, 49.

²⁷ Loc. cit.

²⁸ A Clinic at the Jefferson Medical College, Therap. Gaz., 1921, 45, 474.

²⁹ Resection of Lung for Posttonsillectomy Abscess, Surg., Gynec. and Obst., November, 1919, 29, 443.

The report of Goldberg and Biesenthal³⁰ is the most encouraging of all. They detail 3 cases treated by artificial pneumothorax, all of whom recovered. They find that of the 16 cases so treated reported in the literature, 12, or 75 per cent, have made a complete recovery; 2, or 12 per cent, were reported as improved early in the course of treatment; while 2, or 12 per cent, were reported as dead. One of the latter developed a pyopneumothorax following rupture of the abscess; the other having been complicated by pregnancy, epilepsy and asthma.

This is truly a splendid showing, and it has the great advantage that the specially skilled technic required of bronchoscopic or external surgical methods is not required and that the procedure itself is so comparatively free from discomfort and danger.

A larger series of cases is necessary before final conclusions are drawn, but surely no one will quarrel with the conclusion of Goldberg and Biesenthal that "From a comparison of the results obtained in the treatment of acute lung abscess, in addition to the simplicity of the procedure involved, artificial pneumothorax apparently should be the operation of choice."

Treatment of this condition is beyond the sphere of the otolaryngologist, with the exception of the bronchoscopic phase. Lynch's³¹ experience in this class of cases has been relatively great, and he concludes that "By the use of the bronchoscope in the treatment of bronchiectasis and pulmonary abscess many patients suffering from these conditions may not only be relieved but even cured by the establishing of proper drainage of the lung. . . . Pulmonary drainage is difficult in cases of circumscribed abscess, but I think the conservative bronchoscopic measures of treatment should be given a thorough trial first before radical major surgery is attempted."

It is possible that by observing certain precautions we can help to minimize the frequency of this condition:

1. We can avoid operating on patients whose throats or general systemic condition causes them to be poor risks.
2. We can set and maintain the highest possible standard of aseptic operative technic.
3. We can adopt whatever position of the patient's head that seems most reasonable to us.
4. We can avoid too deep anesthesia.
5. We can prevent as far as possible the entrance into the bronchi of substances foreign thereto.
6. We can reduce to a minimum the trauma of the throat.
7. We can use surface ties instead of needle-carried ligatures.

³⁰ The Treatment of Acute Lung Abscess by Artificial Pneumothorax, *Am. Rev. Tuberc.*, 1919, 3, 169.

³¹ Bronchoscopic Treatment of Bronchiectasis and Pulmonary Abscess, *New York Med. Jour.*, February 7, 1921, 215.