

DIAGNOSIS AND TREATMENT OF DIPHTHERIA.*

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The fact that diphtheria has received such scant consideration from the laryngologists of the country is my reason for bringing this subject to the attention of this society. One cause of this apparent neglect is the fact that in many of our large cities patients with this disease are promptly transferred to contagious hospitals. This procedure develops a certain number of physicians in the hospital highly skilled in diagnosing and treating diphtheria, and who are especially skilled in performing intubation and tracheotomy, which measures are at times so necessary for the saving of life. In consequence of this prompt transfer of patients, laryngologists of the cities see fewer cases, and are, as a result, called upon less frequently than formerly to perform intubation or tracheotomy. The early use of antitoxin has likewise materially reduced the number of cases requiring operation.

In our smaller communities the general practitioner still, to a large extent, attends his diphtheria cases alone, though I know of no disease where the internist and laryngologist can, to a better advantage to the patient, work hand in hand. The throat man can often be of service in determining the extent of the lesion, particularly as to the nose and larynx, and likewise diagnosing early complications, as a beginning otitis media. The laryngologist, on account of his being accustomed to examine and treat the larynx, is better prepared to perform intubation when needed.

The diphtheria organism may attack any mucous membrane, and likewise the abraded skin, as in eczema and wounds. Diphtheria of the pharynx is the most common form, and the

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one to which I shall first direct your attention. Unfortunately, there is no method of diagnosing, with positiveness, diphtheria from "ordinary sore throat" so-called, except by finding the characteristic organism, Klebs-Loeffler bacillus. Even when a culture is taken, one negative finding does not exclude diphtheria, if the clinical symptoms are suggestive, and in the absence of a positive finding, the patient should not be denied the benefit of antitoxin. The case which is reported later illustrates this point. The cause of a negative finding in cases of true diphtheria is not always the fault of the laboratory. It may be due to a failure to touch accurately the edge of the membrane, perhaps due to an imperfect view of the throat. One has often to contend against a struggling child, and frequently, too, in a poorly lighted room. It is also necessary to bring the inoculated part of the swab in contact with the surface of the blood serum. The use of antiseptics within an hour or so of the time of taking the culture destroys all chance of a growth on the serum tube.

The diagnosis of diphtheria has been relatively easy since Klebs, in 1883, discovered the organism in the diphtheritic membrane, and Loeffler in 1884, one year later, isolated the organism—hence Klebs-Loeffler bacillus. It is a small rod of irregular size and shape. It stains unevenly with Loeffler's alkaline methylene blue, giving at times a beaded appearance. This staining peculiarity is of great diagnostic importance, and is more marked in a culture twelve or more hours old than in a young culture, or from a swab of the throat. There is a tendency for the organism to assume a parallel arrangement, which has served me well in doubtful cases. This is more noticeable from a culture than from a swab. The organism is stained by Gram's method. As a differential stain, there is probably none better than Neisser's. Here the peculiar granules are stained dark blue, while the body of the organism assumes a light brown color. The most suitable culture medium is blood serum. On this it grows rapidly at body temperature, distancing the common pus organism, so, at the end of six or eight hours, a diagnosis can usually be made with the microscope. In some cases a staining of the swab will give valuable aid in the diagnosis, though a culture will be found more reliable.

Although the bacteriologic findings are of first importance

in making a correct diagnosis, as before stated, when in doubt give antitoxin, if the case is at all severe. In primary laryngeal cases a negative finding is of little value if the swab is only taken from the pharynx. A laryngeal applicator could in these cases be used to advantage.

Cultures should be taken of all sore throats, particularly in infants and children. It is impossible to state otherwise, with accuracy, whether the case be one of simple tonsillitis or diphtheria. A correct diagnosis is important, not only for the safety of the child, but also from a public health standpoint. The following case will serve to illustrate two points—in the first place, the importance of not waiting for a positive finding before giving antitoxin, and secondly, the necessity of administering large doses of antitoxin.

Patient, L. C., age seven years. First seen by me at Asheville, N. C., in consultation with Dr. Powell, on Sunday night, July 2nd, the fifth day of her illness. The attack began with all the clinical appearances of simple tonsillitis. The culture negative. On Saturday, the day prior to my visit, the temperature was normal till 6:30 p. m., when it registered 99.5°. When I first saw her on Sunday night the picture had changed, for the membrane had spread from the right tonsil to the anterior pillar of the same side. A patch was also seen on the left tonsil. Temperature 103.5°. Neck very much swollen, and head extended to facilitate breathing. Patient showed signs of severe toxemia. Administered at once 10,000 units of antitoxin. The following morning patient no better; given 20,000 units of antitoxin. That afternoon, Monday, patient still dangerously ill. Culture positive for the first time. Seen with Dr. Dunn, and 40,000 units given. The next morning, Tuesday, seen with Dr. Briggs, patient slightly better, but still dangerously ill. Repeated 40,000 units. That afternoon patient much better, and only 20,000 units given. Small doses of antitoxin were continued for a few days, till all signs of membrane had disappeared. She was given, during her illness, 170,000 units of antitoxin. Her recovery was complete and uneventful, except for some paralysis of her palate and eye muscles. These had all disappeared at the end of nine weeks. Her pulse continued rapid for some time, which required absolute quiet. Stimulants were given as indicated.

Hoffman's bacillus closely resembles the diphtheria bacillus,

though it is somewhat shorter and thicker. It does not show the polar bodies by Neisser, nor is it pathogenic to guinea pigs.

Bacillus xerosis,¹ as recently described, cannot be distinguished from Klebs-Loeffler bacillus. It is further said that bacillus xerosis forms acid from saccharose, not from dextrin; while bacillus diphtheria forms acid from dextrin, and not from saccharose. However, the final test in differentiating bacillus diphtheria from all so-called "pseudodiphtheria" bacilli is by animal inoculation. This slow method of differentiation can only be of use from a public health standpoint.

The clinical diagnosis of diphtheria is often difficult. It is particularly so in mild cases affecting the tonsils alone, and also where the larynx is primarily affected. Temperature is of little value in making a diagnosis of diphtheria. It is frequently not high, ranging from 99 to 100° F. Strange as it may seem, the temperature may be normal in cases of severe toxemia. A sudden rise in temperature suggests a beginning otitis media or pneumonia. The pulse, like the temperature, is a poor guide in the diagnosis, for it may vary from a slow pulse to a very rapid one. The extremes, as a rule, are of serious prognostic significance. The volume of the pulse soon becomes small, owing to a myocarditis. The depression is great in cases of severe toxemia, though in mild cases this need not be the case. It is too often said by the attending physician: "The patient is not sick enough for diphtheria." Follicular tonsillitis usually makes one seem sicker than true diphtheria. The temperature is usually higher. Before the appearance of the membrane there may be observed a peculiar plum color of the mucous membrane of the pharynx, particularly evident on the soft palate. There may be considerable edema present. Valuable time in the treatment may be saved by this early diagnosis. The membrane is at first of a grayish white color, though not unlike the membrane due to the pus organism. The cases of septic sore throat which occurred in Boston² from the milk epidemic of 1911 had some clinical resemblance to diphtheria. The bacteriology was different. The situation of the membrane is of great diagnostic importance. If found on the pillars, or any part of the pharynx other than the faucial tonsils, our suspicions should at once be aroused that we are not dealing with a case of simple sore throat. The odor in septic diphtheria may be foul. There

is usually seen a peculiar red margin at the edge of the membrane, which has served me well for diagnosis in certain cases. The use of violence in removing the membrane to see if bleeding takes place is of little value, and is unjustifiable. Mucus in the throat may be gently swabbed away without harm to the patient. Albumin in the urine is suggestive of diphtheria. Early glandular involvement is a suspicious symptom of diphtheria, though the Boston milk epidemic of 1911 showed this symptom very frequently. There may be edema of the neck, which may extend down over the chest. This is strong evidence of diphtheria, and indicates a severe type of the disease. These are cases requiring large dosage of anti-toxin.

Nasal diphtheria is the most contagious form, and from a public health standpoint is of the first importance. The membrane may be in the nose proper, or the nasopharynx. In the latter situation, that is, in the nasopharynx, the symptoms are more severe, owing to a rapid absorption through a bountiful lymph drainage. On account of the difficulty of inspecting the nasopharynx of very young children, the diagnosis of this type of diphtheria must usually be made from the symptoms and finding the characteristic organism. There is noted a serous or serosanguinous discharge from the nose, which may excoriate the upper lip. When the membrane is in the nose one can usually see it upon rhinoscopic examination. Frequently the membrane may be confined to one side of the nose, and then you get a one-sided discharge which simulates a foreign body in the nose. There may be nasal hemorrhage of some severity. The patient, if old enough, complains of a stopped-up feeling of the nose. The symptoms may persist for a long time, and may be so mild as not to be suspected as being diphtheria. As before stated, these cases are very contagious and become a menace to public health.

From autopsies performed by Councilman and Mallory at the South Department, Boston, it is probable that the sinuses of the nose, particularly the antrum and sphenoid, harbor the diphtheria organism for a long time. There may be an extension of the membrane from the nose to the ear, pharynx, larynx, or eye.

Diphtheria of the eye is a serious condition, particularly as to sight, and frequently results from an extension through

the tear duct, though it may be due to accidental inoculation from other regions.

When the larynx is primarily involved it is difficult of diagnosis, especially in very young children. On account of the difficulty of inspecting the larynx in children by means of the indirect method, the laryngeal specula, as devised by Mosher and Jackson, are useful for direct laryngoscopy. The symptoms of laryngeal obstruction from a diphtheritic process come on slowly, and in this respect differ from a foreign body, and also spasmodic croup. At first there is hoarseness, followed by aphonia, evidenced in infants on attempting to cry. In a few hours this obstruction becomes greater, and we get signs of the patient breathing through a stenosed larynx, such as stridor, both inspiratory and expiratory in character, rigidity of the sternocleidomastoid muscle, and retraction of the abdominal muscles and supraclavicular spaces. There may be pallor instead of cyanosis, a fact which is easily overlooked when the question of giving relief by operative interference is considered. When the obstruction is lower down, as a foreign body in the bronchus or bronchial glands, there is more expiratory stridor. The auscultatory signs of the chest in cases of foreign body are the absence of normal respiratory sounds over the area where the entrance of air is obstructed. When the obstruction is high up, as in retropharyngeal abscess, the stridor is more inspiratory in character. The diagnosis of retropharyngeal abscess can best be made by palpation with the index finger.

Catarrhal spasm of the larynx, or spasmodic croup, as it is sometimes called, may be mistaken for laryngeal diphtheria, but the former usually comes on suddenly at night, and there may be a history of previous attacks. The temperature is usually lower in spasmodic croup, though too much reliance must not be placed on this point in the diagnosis. Improvement usually follows in a few hours after appropriate treatment, not the case in laryngeal diphtheria unless relieved by operation.

Acute laryngitis in infants simulates diphtheria very closely. The constitutional symptoms are usually milder, except the temperature, which may be higher than in laryngeal diphtheria. Aphonia is not so marked. If there be a patch on the pharynx, glandular enlargement of the neck, or albumin in the urine,

think of diphtheria. Direct laryngoscopy should be practiced in all doubtful cases.

Pneumonia resembles laryngeal diphtheria in the marked dyspnea, but there is usually no stridor. There can be elicited the physical signs of pneumonia, and probably a leucocytosis.

Jackson³ has described a laryngotracheitis due to the influenza bacillus, which can be differentiated from diphtheria only by direct inspection. There is no membrane or Klebs-Loeffler bacilli present.

In distinguishing the laryngeal symptoms of measles, we should look for Koplik's spots, which appear before the skin rash. The eye and nose symptoms appear early in measles. A culture from the throat should, of course, be taken.

Diphtheria may be a complication of measles. In fact, it complicates this disease more frequently than any other.⁴ Early laryngeal symptoms point to measles alone, while a later stenosis of the larynx in measles suggests diphtheria as a complication.

The diagnosis of diphtheria from scarlet fever, when a membrane is present, can only be made by the microscope. The general redness of the fauces, the appearance of the tongue, and perhaps the skin rash in scarlet fever may assist in the clinical diagnosis. One should be on the lookout for a complication of scarlet fever with diphtheria.

Vincent's angina has been very clearly and fully described by Place.⁵ It may be mistaken for diphtheria. It is more chronic in nature, and usually shows a dirty patch on the tonsil or elsewhere in the mouth. Place says: "It differs from diphtheria in being always an ulceromembranous process, which diphtheria never is primarily." The finding of the bacillus fusiformis and the spirillum gracillis confirms the clinical diagnosis. Syphilis of the nose and pharynx may simulate diphtheria, but with the finding of the specific spirochete and the Wassermann reaction the diagnostic difficulties should be less.

Inherited syphilis of the nose in a young child may be mistaken for diphtheria, but there are usually other evidences of syphilis. It is less acute in character and there is the absence of Klebs-Loeffler bacilli.

Secondary syphilis of the throat is characterized by a thin layer of necrotic epithelia with a well defined border. There is

usually less constitutional involvement, though there may be fever with syphilis.

Later forms of syphilis of the throat are characterized by a deep ulcer with a very much inflamed border. The appearance is out of all proportion to the symptoms, for there is usually little pain on swallowing. With the Wassermann reaction in syphilis and the finding of Klebs-Loeffler bacilli in diphtheria, there should not long exist doubt in the diagnosis of syphilis and diphtheria.

Traumatic exudates from operative procedures, as tonsillectomy, simulate diphtheria. A close inspection and a history of the case should remove all doubt. It should be remembered, however, that Klebs-Loeffler bacilli may be a complication of an operative procedure, so if there exist constitutional symptoms out of proportion to the appearance of the wound, a culture should be taken.

Leptothrix mycosis may be distinguished from diphtheria by its chronic course, often without symptoms. The projections on the tonsil are conical and show a growth of the leptothrix fungus.

In all lesions simulating diphtheria the microscope should be promptly used in clearing the diagnosis.

PREVENTIVE TREATMENT.

Patients should, if possible, be sent to an infectious hospital. In lieu of this, isolation and quarantine should be rigidly enforced at home. Immunizing doses of antitoxin, 500 to 2,000 units, depending somewhat on the age, should be administered to all exposed children. Adults should be carefully watched, as to their noses and throats.

There is hardly a question but that epidemics of diphtheria are kept up by "carriers," so, as a preventive measure, these cases should be sought for and isolated. Seligmann⁶ lays stress on this point, and also speaks of nasal diphtheria being liable to convey the infection for a long period of time. Diseased tonsils and adenoids are especially liable to harbor the organism. The writer,⁷ in 1908, removed diseased tonsils and adenoids for the purpose of getting rid of the diphtheria organism in a "carrier," and soon the patient was rid of the infection. Since that time this method has been frequently practiced in certain localities with marked success. It would

not be advisable to practice this method as a routine procedure, but is suitable for certain selected cases. An immunizing dose of antitoxin should be given at the time of the tonsil operation, to prevent infection of the wound with Klebs-Loeffler bacilli. Scheetz, a Danish physician, some years ago, recommended spraying the throat with a living culture of staphylococcus pyogenese aureus, to rid the throat of diphtheria infection. Page,⁸ Lorenz and Ravenel⁹ have practiced the overriding of diphtheria throats with staphylococcus pyogenes aureus, and report good results. As the two organisms are found growing side by side in throats, and can likewise be grown together in culture tubes, it is not easy to understand the reason for the disappearance of the diphtheria organism by this method of treatment. It would seem as if there is an element of danger in a spray of living staphylococci. Inasmuch as "carriers" have, as a rule, abnormal throats or noses, it would seem more rational to treat these abnormalities with a hope of ridding the patient of diphtheria bacilli. Place tells of a "carrier" who got rid of his infection when a foreign body was removed from the nose. At least two negative cultures, and probably three, should be required before release from isolation. The writer saw last year, while working at the South Department, Boston, a child who had been in the institution more than a year, awaiting the required negative cultures. Diphtheria vaccines¹⁰ have been used with some success in ridding "carriers" of diphtheria bacilli.

SERUM THERAPY.

Under treatment, I shall consider first, antitoxin, for it is by far the most important. It is an absolute specific when given in time and in sufficient dosage. Of the 241 physicians, nurses, and attendants contracting diphtheria at the South Department, Boston, not one succumbed. It is not necessary to consume your time in offering proof of the efficacy of antitoxin in this formerly much dreaded disease. I assume that every member of this society is a believer in the life-saving value of antitoxin. It should be given early, and in sufficient dosage to produce the desired effect. The size of the initial dose should vary from 5,000 to 50,000 antitoxin units, and more in the malignant cases which have existed for some time. As McCollom rightly says, the age, over two years, has noth-

ing to do with the size of the dosage. It is a chemical reaction, and not a physiologic one, so there is no reason to doubt but that a young child may have as many toxin units as a fully grown man. They certainly have a lessened resistance on account of their tender years. The antitoxin is, in no sense, an antiseptic, but in neutralizing the toxin it gives the leucocytes and other protective forces a chance to get in their work.

Textbooks have been very inadequate in the size of the dosage recommended. Tyson, in his "Practice of Medicine" recommends 1,000 to 2,000 units, depending upon the severity of the attack. Ballenger recommends 2,000 to 3,000 units in what he terms ordinary diphtheria; 3,000 to 5,000 units in laryngeal cases. McCollom, in his classical paper on diphtheria in Osler's *Modern Medicine*, says: "If there is a very extensive membrane when the patient is seen for the first time, 8,000 to 10,000 units should be given, repeated every four or six hours, until the characteristic effect of the serum is produced, namely, the shriveling of the membrane, diminution of the nasal discharge, a correction of the fetid odor, and general improvement."

Since the above was written, the dosage at the South Department, Boston, has been increased, and the mortality likewise reduced. It may be of interest to state that the mortality at this large infectious hospital, from 1888 to 1894, the year of the introduction of antitoxin, was 43.2 per cent. From 1895 to 1904 inclusive, it was 11.48 per cent. For the year 1912 it was 7.6 per cent, including laryngeal and moribund cases. The greatest reduction was in the very severe cases where massive doses of antitoxin were administered.

Both nasal and laryngeal diphtheria require large doses of antitoxin. Abraham Levinson¹¹ says that the curative dose in nasal and laryngeal cases should not be less than 25,000 units. Diphtheria of the eye, on account of the danger to sight, requires large doses of antitoxin. It is far safer to give larger doses than is required to neutralize the toxin, which is so destructive to the vital cells, than to leave a portion free to exert its deadly effect on the tissues of the body. There is no way of estimating, with accuracy, the amount of toxin requiring neutralization, but the amount depends somewhat upon the duration of the illness, the extent of the surface involved, and, lastly, the virulence of the organism. A mild case of

pharyngeal diphtheria should receive, as a single dose, from 5,000 to 10,000 antitoxin units; a moderately severe case of several days' standing should receive 20,000 to 25,000 units, and a severe case, 50,000, and more if the case seems desperate. The size of the dose can soon be reduced and smaller doses continued until the membrane has completely disappeared. Place strongly advises getting all the required antitoxin in during the first three days of the treatment, even if 500,000 units are required. This dosage, of course, refers only to the desperately ill cases.

Ehrlich says two poisons are produced by the growth and multiplication of the diphtheria bacillus. To one he gives the name of toxin, and to the other toxon. To the former he attributes the early acute symptoms, and to the latter, the toxon element, he attributes the late paralyses. The affinity is stronger between the toxin and antitoxin than between the toxon and the antitoxin, hence the importance of having a surplus of antitoxin to neutralize the toxon element after the toxin has been chemically disposed of.

There is what is termed a precocious form of palatal palsy, occurring about the fifth day of the disease. This is not so serious as the late forms, occurring usually within the first three weeks of the illness, but the early form is somewhat an index to the severity of the illness.

Rosenau and Anderson¹² have shown by animal experimentation the uselessness of giving antitoxin with a hope of influencing the paralyses occurring late in the disease.

My favorite situation for injection of the antitoxin is in the loose areolar tissue of the back, near the angle of the scapula. This region is relatively free from the sensory nerves, is protected from vital parts, and lastly, the operation is not witnessed by the patient. This last point is quite important from a psychic standpoint. The site selected should be sterilized, and the situation should be changed from time to time, as there is usually a local reaction.

Fritz Meyer¹³ strongly recommends intravenous injection of antitoxin in serious cases—says much time is saved in the absorption. Eckert¹⁴ and Hoesch¹⁵ and others advise intramuscular injection as being more rapid of absorption than the subcutaneous method.

DANGER OF ANTITOXIN.

The danger of antitoxin has been grossly exaggerated. That a few deaths have taken place following its administration cannot be denied, but they are too infrequent to be seriously considered in view of the dangers of diphtheria when left untreated by antitoxin.

Park¹⁶ says that "In over 100,000 patients immunized (New York) since the introduction of antitoxin, there has been but one known fatality due to the serum injected. This child suffered from status lymphaticus and died shortly after an injection of 1000 units." Place says that more than 100,000 doses of antitoxin have been administered to over 40,000 patients at the South Department, without a dangerous symptom attributable to antitoxin.

The work of Theobald Smith, followed by the work of Otto, Rosenau and Anderson,¹⁷ proved that horse serum administered to guinea pigs sensitized them, after an elapse of about ten days, to the same kind of serum. A small second dose was often sufficient to cause death with symptoms of distressed respiration, cyanosis, convulsion and finally death. This phenomenon has been termed anaphylaxis. While this reaction is common in laboratory experiments with guinea pigs, it is very rare clinically. It would be a great pity if these interesting laboratory experiments should curtail the use of antitoxin in diphtheria. It has been thought that the rare appearance of severe symptoms following the use of the first antitoxin dose is due to a natural "sensitization," or anaphylactic condition. The symptoms are marked respiratory distress, and may be due to the contraction of the smaller bronchi. Asthmatics, hay fever patients, and those sensitive to the emanations from the horse are more liable to have symptoms of anaphylaxis on administration of antitoxin. Adults seem to be more subject to this condition than young children. It would seem, if such patients require antitoxin, that they should be given a preliminary dose of atropin, followed by a tentative dose of antitoxin. The writer resorted to this procedure on one occasion where the patient had experienced severe respiratory disturbance following a dose of antitoxin in a previous attack of diphtheria. The patient was given a full dose of atropin, hypodermatically, just fifteen minutes prior to the antitoxin.

Concentrated antitoxin was then administered in small doses every fifteen minutes until the required amount was given. In patients in whom there is a suggestion of a sensitized state, this method is worthy of a trial. It may be of interest to analyze the sixteen deaths reported in the literature following the use of antitoxin. The size of the dose in each case was small, varying from 500 to 4,000 units. Only six of the sixteen cases were suffering from diphtheria, and six others, owing to exposure to diphtheria, were given small immunizing doses. The remaining four did not have diphtheria at all, but were given antitoxin for asthma. Nine of the sixteen gave a history of asthma in some form.

There is another condition known as "serum sickness" following at a variable interval the administration of antitoxin, usually about the tenth day, characterized by rashes of various kinds, with intense itching, joint pains and fever. There may be some edema. The pulse is quickened, but of good strength. This condition may at times be mistaken for measles or scarlatina, though there are not the usual symptoms of these diseases. Park says that about 20 per cent develop the rash. The reaction is certainly less in the concentrated serum where the irritating proteids have been removed by the Gibson process than in the more bulky product. Calcium chlorid¹⁸ has been strongly recommended in gram doses, beginning on the day of the injection of antitoxin.

The treatment of serum sickness is largely symptomatic. Sponge with cold water for the fever, menthol solution for the itching, and heat to the swollen joints.

The general treatment of a patient with diphtheria should be the same as other acute infectious diseases. The room should have abundance of fresh air. The food should be light and nourishing. The urine should be examined occasionally. On account of the heart bearing the brunt of the attack, it should be guarded as much as possible.

The patient must be kept quiet in bed, not only during the attack, but for a considerable period of time after the illness, depending somewhat upon the severity of the attack. The time should also be longer in cases where antitoxin was given late.

Cardiac stimulants should be given as the heart shows signs of weakness. This can best be determined by listening to the

heart sounds, particularly the second pulmonic. Jacobi¹⁹ has always been a great advocate of alcohol in some form. At the South Department, Boston, reliance is placed on camphor, caffeine, atropin and strychnin.

Cracked ice held in the mouth is grateful, and ice packs to the neck are useful, particularly where edema is present.

The use of local antiseptics is of secondary importance, and if strong may be actually harmful. In my judgment, anything stronger in the nose than normal salt solution or liquid vaselin is not to be recommended. To the pharynx in young children antiseptics are of doubtful value, as the physical resistance offered may be more harmful than the local treatment is useful. In older children and adults, my favorite application is a solution of one part of peroxid of hydrogen to three or four of water. Some advise Loeffler's solution, while others prefer irrigation with a hot normal saline solution. The ear should be watched for a beginning otitis media.

Paracentesis should be performed early. Borden²⁰ lays stress on the number of mastoid involvements discovered at autopsy in patients dying with diphtheria whose drum membranes were apparently negative.

Pneumonia is a serious complication, and is especially frequent in laryngeal cases. Stimulants should be given as the case requires.

Gallop rhythm is a serious complication or sequela, and is best treated by absolute rest, rectal feeding, and appropriate stimulation.

Diphtheritic paralysis is a frequent sequela of diphtheria. It may attack any nerve, but particularly those of the palate and larynx. It is more serious when the pneumogastric is involved.

In laryngeal diphtheria, particularly in intubation and tracheotomy cases, it is advisable to use steam inhalations under an improvised tent. Ipecac may be used in slight stenosis pending the action of antitoxin. This should be relied upon but for a brief period of time, for we must remember that the laryngeal stenosis not only taxes the respiratory system, but gives an added burden to a heart already weakened by the diphtheritic toxin. As before mentioned, these are cases requiring large doses of antitoxin.

In intubation cases the question of feeding comes up. As

a rule semisolid food is best, and should, if possible, be given in the upright position. Rarely is it necessary to use a stomach tube or the Casselberry position.

Whether intubation or tracheotomy is preferable in laryngeal stenosis of diphtheria has long been a mooted question. Since the introduction of the intubation tubes by O'Dwyer, of New York, which marks one of the brightest spots in American medicine, physicians on this side of the waters have shown a decided preference for intubation. France has for a long time been an advocate of intubation, while Germany is using more and more the O'Dwyer tubes. England, in her conservatism, clings to tracheotomy. It is not to be understood that intubation is to entirely supplant tracheotomy, for there are certain conditions where tracheotomy is preferable.

The advantages of intubation are:

1. Relief of the stenosis without the shock of a cutting operation, and without an anesthetic.
2. Consent of the family for operative relief is more readily obtained. This is a great advantage, as early relief of the stenosis is a great factor in reducing the mortality.
3. There is no danger of local infection, and less danger of pneumonia in intubation than in tracheotomy.
4. There is no resulting scar.

Tracheotomy instruments should always be at hand where intubation is performed, in case of stoppage of respiration from pushing the membrane in front of the tube. This is not a frequent occurrence. Rarely the patient persists in coughing up the tube, which, if continued, requires tracheotomy. There are also cases where there is marked pharyngeal swelling, together with edema of the aryepiglottic folds, where tracheotomy is indicated. Lastly, if the surgeon cannot remain within easy reach of the patient, in case of stoppage of the intubation tube, or its coughing up, it might be safer to perform tracheotomy. It does not seem necessary to give the technic of intubation or tracheotomy, for excellent descriptions of these operations are given in our textbooks. However, the ingenious method of Mosher's²¹ intubation deserves mention, and in the hands of some should prove simpler than the indirect method. The same O'Dwyer tubes are used, only it is performed with a straight introducer, through a laryngeal speculum. If the direct method is used for diagnosis, it might

be best to continue the operation and insert the tube with Mosher's introducer.

The writer wishes to emphasize the following points:

1. The diagnosis of diphtheria depends primarily on finding the organism. Cultures should be taken of every sore throat in children, and likewise suspicious nasal discharges. But in the absence of a positive finding, if the symptoms point to diphtheria, antitoxin should be given. This is particularly important if the symptoms are severe.

2. Much larger doses of antitoxin should be given in diphtheria. Textbooks have been misleading in this respect.

3. Laryngeal cases are serious partly from mechanical obstruction, requiring prompt relief of the stenosis, and large doses of antitoxin. Intubation in the main is preferable to tracheotomy. Laryngologists should perfect their technic in this operation until it becomes a fairly simple one.

4. Epidemics of diphtheria are kept up largely by "carriers." They should be sought out, isolated, and the abnormality treated. Diseased tonsils and adenoids may require removal.

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