EYE, EAR, NOSE AND THROAT

ABSCESS OF THE LUNG: ETIOLOGY*

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Diagnosed cases of pulmonary abscess have increased very greatly in the last few years. The fact that the bronchoscopic treatment of this condition is assuming added importance, and that quite a number of these cases have occurred following operations upon the nose and throat make the study of this condition of prime importance to us as oto-laryngologists.

The terms, "abscess of the lung," "gangrene of the lung," and "bronchiectasis," are rather loosely used to describe various conditions resulting in destruction of lung tissue. This fact, which is not of great practical importance, is probably due to the anatomical peculiarity of lung tissue and to the clinical difficulty in exactly differentiating borderline cases. For the purpose of this paper, the term "abscess of the lung" will be limited to circumscribed suppuration of lung tissue.

Dr. Charles W. Richardson, of Washington, D. C., first called attention to this condition as a complication of operations in the upper air passages by reporting in 1910 a case of septic infarct of the lung following tonsillectomy, and in 1912, three cases of abscess of the lung following the same operation. Since then there have been many such cases reported by Bassim, Manges, Tewksbury, Frank and others, following sinus operations, septum resections, extraction of teeth, and especially tonsillectomies. One of the latest reviews of this subject is that of Drs. Fisher and Cohen, of Philadelphia, presented at the meeting of the American

Medical Association, at Boston, in June, 1921, showing reports of seventy-six cases of abscess of the lung following tonsillectomy.

Lung abscesses are practically never primary, but are secondary to infections of such severity that the lung tissue involved is unable to withstand the invading organism, and undergoes the succeeding inflammatory changes of hyperemia, extravasation, coagulation, consolidation, and necrosis.

BACTERIOLOGY

Many varieties of organisms are found in these abscesses: the different pyogenic cocci, various forms of streptococci, pneumococci, *B. proteus vulgaris*, *B. coli*, *B. pyocyaneus*, etc. Several cases have been observed in which anaerobic bacilli were found and also an acid fast bacillus allied to the *B. tuberculosis*. Our bacteriological knowledge of this condition, however, may be summed up in the statement that no special class of organism can be held accountable for it.

The causes of this condition may be divided into intra-pulmonary and extra-pulmonary.

Intra-Pulmonary Causes are: (1) Inflammation of lung tissue occurring in such diseases as broncho-pneumonia, lobar pneumonia, influenza, pleurisy, asthma, colds, typhoid, measles, scarlet fever, etc. In tuberculosis there is occasionally seen the so-called caseous abscess.

(2) Inflammation of lung tissue resulting from the inspiration or penetration of foreign bodies.

Extra-Pulmonary Causes are: (1) Direct extension from abscesses of adjacent structures, such as empyema, suppurating bronchial glands, mediastinal abscesses, echinococcus cysts, abscesses of the liver, and from malignant growths of adjacent organs.

(2) Infective emboli from distant parts.

An idea of the relative frequency of these various causes may be given by

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quoting from W. S. Lemon's analysis of eighty-one cases seen at the Mayo Clinic. The causes of abscess in the eighty-one cases are summarized as follows:

Pneumonia	31
Colds, grippe, pleurisy, asthma, typhoid, measles and scarlet fever	19
Tooth extractions (general anesthesia)	7
Tonsillectomy (general anesthesia)	5
Appendectomy	2
Gastro-enterostomy	1
Gall-bladder	1
Excision of gastric ulcer	1
Trauma	2
Unknown	12

The channels through which infection may invade the lung in these cases are lymphatic, venous and tracheal. Although infection of lung tissue by way of the lymphatics is quite possible, I have not found in the reported cases any in which venous and tracheal infection are excluded and this pathway definitely proven as the mode of entrance of the infective material.

A familiar example of infection through venous channels is the formation of a lung abscess as the result of an embolus from a thrombosed lateral sinus. The cases of lung abscess resulting from the inspiration of foreign bodies such as tacks, seeds, etc., furnish good examples of the tracheal method of infection.

The cases which invite special study, from an etiological point of view, are those resulting from the inspiration of foreign bodies, and those following operations in the upper air passages. Our bronchoscopic friends have deeply impressed upon us the dangers arising from the presence of foreign bodies in the bronchi, and I shall not dwell upon this phase of the question.

The presentation of the numerous papers upon the subject of lung abscess following operations in the upper air passages has resulted in much discussion as to the causes of this complication. These may be classified under the following heads: (1) General condition of the patient, (2) anesthesia, (3) technic, and (4) special infective agents.

GENERAL CONDITION OF THE PATIENT

It is generally accepted that tuberculosis, diabetes and chronic alcoholism increase the liability to this complication. Other conditions mentioned by various writers are syphilitic processes, acute infections, advanced cardio-vascular changes, delayed coagulation time, high blood pressure, chronic bronchitis, bronchiectasis and virulent infections near the operative field.

ANESTHESIA

Fisher and Cohen's paper, mentioned above, shows that of the seventy-six cases of abscess of the lung following tonsillectomy, which they collected, seventy-four were done under ether and two under local anesthesia. These two cases originally reported by W. B. Porter, Richmond, Va. (*Virginia Medical Monthly*, March, 1921), together with two cases reported by John R. Simpson and Harry G. Noah, Pittsburgh, (*Pennsylvania Medical Journal*, March, 1920), and one case reported in the New York Academy of Medicine (*Laryngoscope*, February, 1921), from the service of Dr. C. G. Coakley, at Bellevue Hospital, are all the cases following tonsillectomy under local anesthesia I have been able to find. All of these patients, with the possible exception of the last, were tuberculous subjects.

By the kindness of Dr. E. R. Van Meter, St. Louis, I am enabled to cite the following case as the only pulmonary complication of any kind that I have been able to discover following tonsillectomy under nitrous oxid anesthesia:

Miss C., aged 18, was admitted September 13 with acute streptococcus tonsillitis and pharyngitis of two weeks' duration. Temperature, 104 degrees. Temperature dropped to normal in three days. Tonsillectomy was done under nitrous oxid anesthesia September 20 at 3:30 p. m. after a preliminary hypodermic injection of one-quarter grain of morphin. During the operation, owing to extreme depression of the lower jaw, the patient stopped breathing. As soon as the pressure upon the jaw was relaxed she gave a gasping inspiration which probably carried blood into the trachea, as the morphin had abolished the cough reflex. On the morning of the twenty-first there was bleeding from the left supratonsillar fossa, which was controlled by pressure. At that time the patient had a non-expulsive cough which she seemed to make an effort to suppress. She was given a quarter grain of

morphia hypodermically because of the cough and bleeding. That night her temperature rose and she complained of severe pains in the left side of her chest. The next morning her temperature was 104 degrees with signs of bronchopneumonia in the left lower lobe. She gradually recovered and was discharged convalescent October 13.

The question of whether lung abscess following throat operations under general anesthesia are due to inspiration of infective material, or to the lodging in the lung of infective venous emboli, is always a subject for spirited discussion. Dr. Charles W. Richardson believes that very few of these cases are of embolic origin, but are almost entirely due to the inspiration of septic material squeezed out of the tonsil at the time of the operation. He does not believe that general anesthesia plays an important role, and that these post-operative abscesses of the lung can be prevented by placing the head of the patient well down and using suction apparatus to keep the throat free from blood.

Henry L. Lynah, New York, believes most of these cases are due to inspiration of infective material. He also calls attention to the importance of considering the condition of the patient prior to the time of the operation, and states that in nine cases of lung abscess following tonsillectomy at the Lennox Hall Hospital, a careful review of the history showed that many of these patients suffered from post-influenzal bronchiectasis and coughed up pus for some time before their tonsils were removed. There were at least three cases of post-influenzal bronchiectasis that had been attributed to tonsillectomy. Again in general surgical operations he believes many of the abscesses may be due to inspiration of vomitus when the patient is coming out of ether. He mentions as an example a patient seen recently on whom Dr. Willy Meyer had operated for gall-stones, who inspired vomitus containing food, as he had eaten breakfast shortly before admission to the hospital. This patient developed acute lung abscess three days following the operation. He thinks that embolic abscesses most frequently follow long-standing pyemic conditions, such as sinus thrombosis and the like, and that in these

cases the symptoms are violent and the patient succumbs in a very short time. He is convinced that inspiration of infected secretions or vomitus is responsible for the great majority of cases whether the operation is done under local or general anesthesia.

Dr. W. W. Carter, New York, regards these abscesses as due either to infected blood or detritus drawn into the lung during inspiration. He attributes the accident to a deficiency either in the construction or application of the apparatus used for suction during the operation. He condemns pressure ether narcosis, and, in adenoid and tonsil cases, considers it dangerous. He describes a suction apparatus used in Gouverneur Hospital, which has a soft rubber mouthpiece with a scalloped end, which he states keeps the field perfectly clean. He believes this to be the essential precaution which, if observed, will prevent lung abscesses following nose and throat operations.

Dr. Howard Lillenthal claims that if a lung abscess develops ten or twelve days after a tonsillar operation, it is proof positive that the abscess is due to inspiration of tonsillar detritus. He also calls attention to the fact that embolic abscesses of the lung are usually multiple and almost always fatal.

Dr. P. Samuel Stout, Philadelphia, believes that septic emboli are usually associated with severe pyemia and multiple abscesses, and are fatal.

Dr. W. B. Porter believes the two cases which he reported of lung abscess in adults following tonsillectomy under local anesthesia, both of which showed evidence of a co-existing tuberculous pathology, were more probably due to venous emboli than to inspiration of infective material.

Drs. Simpson and Noah believe the following points favor hematogenous infection in the two cases reported by them:.

(1) Both were operated upon under local anesthesia in the upright position.

(2) The mouths and throats were in a septic condition before, and for some time after the operation. In Case 1 con-

siderable sloughing of the right tonsillar fossa and posterior pillar occurred.

(3) The late occurrence of symptoms points to a blood stream infection.

(4) The occurrence of the abscess at the site of the tuberculous lesion.

Dr. J. S. Unger, New York, believes that a thrombus is more apt to occur in cases where the blood vessel walls are kept from collapsing by the dense connective tissue existing around fibrous tonsils; and that the breaking up of this thrombus is more liable to occur during operations under ether than under local anesthesia, because, in the former case, the pharyngeal reflexes are abolished and the pharyngeal muscles relaxed so that they exert no constricting action about the cut and thrombosed vessels.

Dr. Coakley's case was done under local anesthesia with the patient's pharyngeal reflexes all present, and hardly enough bleeding occurred to stain a sponge, yet three days later the patient developed a lung abscess. The explanation offered was that this case might be due to an infected embolus in the lung.

Fisher and Cohen believe the majority of cases are due to infective emboli carried to the lung from the site of the operation, rather than to the inspiration of infective material through the bronchi, and cite in support of this opinion a series of thirty-one cases of lung abscess in the Pennsylvania Hospital, compiled by Norris and Landis, nineteen of which were due to emboli brought to the lung through the circulation, as follows:

Vegetative endocarditis infarct	6
Otitis media	2
Otitis media and thrombosis of the lateral sinus	2
Mastoiditis	1
Thrombosis of the portal vein	2
Thrombosis of the iliac vein	1
Abscess of the kidney	1
Abscess of the lip	1
Abscess of the pharynx	1
Abscess of the seminal vesicle	1
Abscess of the skin	1

They state that brain abscesses have followed tonsillectomy, and that they

were of metastatic origin. They report a case of lung abscess which developed from a rather mild attack of Vincent's angina. They also mention the occurrence of cases of septic arthritis and osteomyelitis ushered in with an attack of acute tonsillitis, the infection being of hematogenous origin.

Despite the many arguments pro and con the seventy-six cases reported by Fisher and Cohen indicate that ether does play an important role in the causation of this complication. While the evidence so far amassed points to the fact that both embolic and inspiratory infections are possible, most of the arguments advanced in favor of venous emboli from the site of the operation suggest the possibility of this method of infection, but do not exclude infection by way of the trachea.

That so vast a majority of these cases occur under ether anesthesia points to the fact that there is an added danger of this complication in the use of ether as an anesthetic in operations about the nose and throat, and that this added danger is not in the increased probability of dislodging infective thrombi, but in the liability of inspiration of infective material while under the influence of the anesthetic. Whether this is due to the depth of the anesthesia, the position of the patient, or to neither of these factors, we cannot ignore the proportions of seventy-four to two.

At least four of the five cases occurring under local anesthesia were in known tuberculous subjects, and the anesthetic could scarcely have been a causative factor.

The solitary case of broncho-pneumonia following tonsillectomy under nitrous oxid anesthesia directs attention to the relative safeness of this anesthetic, and even in this one case we must remember that the operation was performed only a few days after an acute streptococcus tonsillitis and pharyngitis, and that the cough reflex was abolished by a preliminary hypodermic of morphine.

TECHNIC

The errors in technic which may be causative factors are

- (1) Excessive manipulation of the tonsils;
- (2) Undue laceration of the fauces;
- (3) Prolonged operations;
- (4) Deep anesthesia;
- (5) Failure to have the head lower than the body during the operation, if done under general anesthesia;
- (6) Failure to guard against inspiration of blood between the conclusion of the operation and the complete recovery of consciousness if a general anesthetic has been used;
- (7) Failure to use an efficient suction apparatus;
- (8) The manipulations sometimes necessary in controlling hemorrhage; and
- (9) The use of motor-driven ether apparatus.

SPECIAL INFECTIVE AGENTS

Manges, Stout and Simpson, in calling attention to the fact that several of these cases followed each other in quick succession in the same hospitals, suggest the possibility of some special infective agent present at that time in those institutions.

PREVENTIVE MEASURES

In foreign body cases, preventive measures consist in the discovery and prompt removal of the offending substance, through the bronchoscope, and in the exclusion of an unsuspected foreign body in obscure pulmonary conditions.

To prevent cases occurring after operations in the upper air passages, precautions should begin with a careful physical examination, and, except for very urgent reasons, the patient should not be operated upon unless he is in good condition. Tuberculosis, alcoholism and diabetes add materially to the danger of this complication. Tonsillectomy in an adult must not be regarded as a minor operation. The use of ether

should be avoided in these operations if possible, but, if used, the anesthesia should be light, an efficient suction apparatus employed to keep the throat as clear of blood and detritus as possible, the patient placed in some position in which the blood cannot flow down the trachea, and, after the operation, be kept on the side or prone until consciousness is thoroughly regained. The writer believes that if a general anesthetic is necessary nitrous oxid is safer than any other in operations upon the nose and throat. The question of giving hypodermic injections of morphin, or drugs of similar character, before the operation, must be carefully considered because of the fact that they abolish the cough reflex and thus add to the possibility of inspiring infective material. Patients should not be operated upon too soon after an attack of acute tonsillitis. At least two weeks ought to elapse before any operative interference is undertaken.

The bleeding following tonsillectomy will nearly always cease if left undisturbed for a few minutes. Consequently, any swabbing or manipulation of the tonsillar fossae should be avoided, if possible, to prevent the dislodging of any thrombi which have formed in the cut veins.

In brief, the operative technic should be so planned as to minimize the possibility of the inspiration of infective material into the bronchi and the dislodging of venous thrombi from the site of the operation.

The forcing of fluids should be a routine measure for the rapid elimination of any toxemia which may ensue.

In conclusion, the writer desires to emphasize the fact that despite the numerous papers upon this subject in the last few years, abscess of the lung is a rare complication of nose and throat operations; but its seriousness, when it does occur, is so great that every precaution should be taken to prevent its occurrence.