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Con Fenning

University of Nebraska Medical Center

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The Etiology of Post Operative Lung Abscess

A

Senior Thesis

Con Fenning

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The ETIOLOGY of POST-OPERATIVE LUNG ABSCESS

There has been considerable speculation and very much work done in regard to the causative factors of non-tuberculous post-operative abscesses of the lung. At present the consensus of opinion is that the etiology is not fully known. Up to this time there are many questions unanswered. The most important of these questions are: How does the infection reach the lungs? Have there been any specific bacteria isolated? Why does one person develop an abscess of the lung following a specific operative procedure while another individual subjected to a similar procedure does not develop a lung abscess.

As early as 1898 Murphy (1) made a study of lung abscess. The result of this study was a classification of the etiology of lung abscess. He listed the various causes under nine separate headings. They are as follows: 1. Acute circumscribed inflammation as pneumonia followed by necrosis and softening. 2. Peri bronchitis. 3. Septic embolism of the pulmonary artery. 4. Rapid tuberculous caseation and necrosis with secondary infection. 5. Perforation of lung by infection from malignant disease of the esophagus and mediastinum. 6. Subphrenic perforations into lung with retention. 7. Foreign bodies in the bronchi. 8. Infections following injuries. 9. Suppurative inflammation around calcareous deposits. It is significant to note that no mention is made of post oper-

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ative lung abscess in this classification.

A study of the anatomy and physiology of the lungs indicate that there are three possible routes of entry by which infection may reach the lungs, localize there with the result of lung abscess formation. One mode apparent is that by means of the respiratory passages. Another portal of entry is by means of the blood stream. The other mode of possible entry is by means of the lymphatics.

The probability of infection reaching the lungs by way of the lymphatics is a remote possibility. Especially in post operative abscesses following upper respiratory operations. Especially so if the work of Most (2) and Miller (3) is considered. Most states that it is impossible for material to be transported from the tonsillar region to the lung by way of the lymphatics. He found that the cervical lymphatics follow along the course of the internal Juglar vein and empties at the junction between the juglar and subclavian veins. And that there is no communication between these and those draining the lungs and mediastinum. Miller states that there is no direct connection between the cervical lymphatics and the lung.

It was observed early after the advent of tonsillectomy procedures that lung abscess was at times met with as a complication. The first such case repor-

ted in American literature was that by Richardson (4) in 1912. Since that time the number of cases reported has increased greatly. Fisher and Cohen (5), Chipman (6), Moore (7) and Hedblom (8) have reported on new and unreported cases. Up to the present time the total number of reported cases is well over four hundred.

At the present time one of the most frequent operations upon the upper respiratory tract is that of tonsillectomy. During the last two decades or more, pulmonary abscesses have occurred as a post operative complication more frequently than from any other cause. It is a significant fact that of 2,458 cases of lung abscess reported by Hedblom (9) twenty seven percent of these followed some type of operation. Fifty five percent of these followed tonsillectomy. A large proportion of the remaining cases followed other upper respiratory tract operations or inhalation of foreign bodies.

It is of considerable importance to know the exact mode of entry in such cases. It is evident that the operating surgeon could then take proper steps to eliminate in so far as possible those factors concerned in the mode of entry of the infection.

At present two theories are in vogue in regard to the mode of entry of the infection following an upper respiratory operation. That is the Embolic theory and the Aspiration theory. Each theory has its many supporters who base their opinion upon clinical facts

and experimental evidence. The experimental work done by the opposing groups is in many instances contradictory

Embolic Theory

Experimental work done by Cutler and Schleuter (11) and others presents an array of very convincing facts. These observers state that they have been unsuccessful in producing a lung abscess following the introduction of pathogenic bacteria into the trachea of dogs. On the other hand they were able in a high percentage of cases in which virulent bacteria were injected into the internal Juglar vein to produce lung abscesses experimentally in dogs.

Fetterolf and Fox (11) have shown that in tonsillectomized dogs, thrombus occurred in the peritonsillar vessels following the introduction of virulent organisms into the tonsillar wound. Their contention is that the infected thrombi become dislodged and are deposited in the lung with the result of lung abscess.

Cutler (12) Brought forth a theory that most post operative pulmonary abscesses are probably due to a common factor to all operations, that is, namely the transportation of septic emboli by means of the blood stream.

Jackson (13) expresses his views in that there is some unknown factor present that provides a protective barrier to the development of lung abscess in the presence of foreign bodies in the bronchi.

Holman (14) firmly believes that septic thrombi are the cause of many lung abscesses. This he believes is especially true in regard to operations upon the upper respiratory tract. He puts forth the idea that constant movement of the neck muscles tend to loosen and dislodge thrombi present in the vessels following an operation. Furthermore the potential possibility present in the suction action, the result of respiratory movements should be kept in mind.

Cutler (15) states that operations done under local anaesthesia have the same incidence of post operative lung abscesses as do operations done under general anaesthesia. This he believe lends strength to the embolic theory in that it disproves some of the contentions of the supporters of the aspiration theory.

Schleuter and ^{Wardle}~~Wardle~~ (16) were unable to produce lung abscess in dogs by intra-bronchial injection of bacteria or tonsil tissue. However these experimenters were able to produce lung abscess experimentally by introducing a artificial embolus into the juglar vein.

Aspiration Theory

This theory like the embolic theory has its many authorities who have furnished experimental and clinical evidence that substantiates their views. In main the theory deals with the assumption that as a result of the anaesthetic and operation, some infected

substance is aspirated and deposited in the lung, the final result of which is abscess formation.

Hoelscher as quoted by Iglauer (17) made a study of the lungs of etherized animals and found buccal secretions present in the bronchi and alveolai. He states that the ether used has no effect but that the other material produced pneumonitis.

Lemon (18) was successful when making an experimental study of bronchoscoped patients following general anaesthesia to see that barium was aspirated and discernible in the trachea and bronchi even if the patient had been in a prone position.

Smith (19) was successful in inducing lung abscess by the intra-tracheal route in mice, guinea pigs and rabbits. He also mentions that gangrene and bronchiectasis were secured with the same organisms and the same identical methods.

Myerson (20) bronchoscoped two hundred children following tonsillectomy and frequently found blood in the trachea and bronchiol tree. He frequently found blood present in the stomach of the same individuals.

Iglauer (17) expresses the opinion that both clinical and experimental evidence indicates that aspiration of infective material is responsible for the majority of post-operative lung abscess.

Hedblom (9) summarizing the evidence as to the

mechanism of post operative infection in regard to lung abscess. Believes that aspiration is by far the most ~~imp~~ important factor. The aspiration of infective material probably being due to three fundamental factors listed as 1. Inhibited cough reflex. 2. Inability to expell aspirated material once having lodged in the lung. 3. High degree of virulence of organisms in aspirated material.

Chow and Scarff (21) were able to produce experimental lung abscesses in dogs by introducing into a bronchus plets of cotton soaked with infection from a frontal sinus infection. They believe that the obstruction of the bronchus with the cotton played an important role in the developement of the abscesses.

Joannides (22) firmly believes in the aspiration theory and gives the following factors as of great importance 1. Abolition of the pharyngeal and cough reflex in general anaesthesia. 2. The presence of mucus and blood in the mouth during anaesthesia. 3. The presence of certain micro-organisms in the mouth, namely Fusiform bacilli and Spirochaetes. 4. The presence of chronic infection in the nose, mouth and paranasal sinuses. 5. Dimension and physical states of the aspirated material. 6. The action of the cilia which clear the trachea and bronchi. 7. Specific immunity in the lung against certain organisms.

Allen (23) states that multiple abscesses of dogs may be produced by injecting warm pus from a patient with chronic abscess into the bronchi of dogs. Warm pus is stressed in this report.

Harkavy (24) expresses his opinion in that he believes the results of experiments on animals as well as clinical experience point to the fact that while embolic abscesses may occur, they are exceptional. The greater amount of evidence is in favour of aspiration as the mode of production of suppuration of the lung following operations on the upper respiratory passages.

Are There Specific Bacteria?

Bacteriological study made by many investigators resulted in reports which for the most part did not agree between any two investigators. From the jumble of facts obtained it is necessary to state that all more or less agree that no specific bacteria are known. Also that the organisms found are normally present in the mouth of a high percentage of people.

Ermatinger (25) made a bacterial examination of thirty three cases. She listed the following bacteria present in one or more of the cases. Hemolytic streptococcus, Bacillus xerosis, Micrococcus catarrhalis, pneumococcus, Staphylococcus aureus, Yeast, Bacillus mucosus, Bacillus capsulatus, Bacillus fusiform, Bacillus proteus, Staphylococcus albus, Streptococcus viridans. A further

analysis showed that Staphylococcus aureus was present in seventy five percent of the total number of cases. Hemolytic streptococcus was present in fifty five percent of the cases. Pneumococcus was present in nineteen percent of the cases.

Heuer (26) states that clinically the sputum in seventy five percent of the cases of pulmonary abscess contains predominately the anaerobic organisms found in the mouth of eighty percent of all individuals. In the remaining twenty five percent the sputum contains predominately varieties of pyogenic cocci.

Bucher 27 also made a bacteriologic study of one hundred eighteen cases of abscess of the lungs. Pus was secured from each case and an attempt was made to ~~isolate~~ isolate the organisms present. Streptococci were organisms most commonly found. Staphylococci, pneumococci, Bacillus influenza, Bacilli fusiform, Spirochaetes and various anaerobes besides other unidentified organisms were found. Bucher concluded that the organisms found in the abscesses were similiar for the most part to those found normally in the mouth and upper respiratory tract. It was not possible to pick out any one organism as the etiological factor.

Lambert and Weeks (28) from studies of experimental production of lung abscess conclude that many abscesses occur in human beings which contain only An-

aerobes. They believe that the anaerobes can and do give rise to suppuration in the human lung.

Lambert and Miller (29) were able to experimentally produce abscess of the lungs in rabbits by injecting mixed cultures of pure anaerobes into the veins.

Miller (30) makes the observation that it is significant to know that the anaerobes found in the abscesses correspond to a group frequently found in persons with bad oral hygiene, particularly diseased tonsils and pyorrhea alveolaris. He believes that they may play a more important part than just secondary invaders.

Varney (31) reports that in an analysis of bacteria of twenty one untreated cases of lung abscess that Streptococci, Bacillus fusiform, Bacillus melanogenicum and Spirochaetes were the organism most commonly encountered in the material from the lesions of the patients. Streptococcus viridans was found more frequently than Streptococcus hemolyticus. In summarizing the analysis he states that the bacterial flora from chronic lung abscess showed a remarkable similarity to that from infected tonsils, cervical abscesses and diseased teeth and mucus membranes.

Kline (32) succeeded in producing lung suppuration by intra-bronchial injection of material from carious teeth in rabbits. The material on analysis contained Spirochaetes and Bacillus fusiform.

Smith (19) isolated from cases of lung abscess pure cultures of the various Anaerobes, Spirochaetes microdentum and Spirochaetes macrodentum, two types of Bacilli fusiform four types of Vibrios and three Anaerobic cocci. All of which are found more or less normally in the mouth under certain conditions. He was also able by using washed sputum from cases of lung abscess and from scrapings from the teeth to produce lung abscess in mice, guinea pigs and rabbits by intra-tracheal injection.

Allen (23) using warm sputum containing cocci, Bacilli fusiform and Spirochaetes and instilling this by means of a catheter had success in producing lung abscess experimentally. The incidence was considerable higher if at the same time a bronchus was occluded by ligation.

Discussion

Giving due credit to the worthy investigations and clinical study carried out by the many capable men, it never the less remains a fact that the clinical arguments cited by the adherents of the two theories are often unsatisfactory. Oftimes an important argument in favour of one may be interpreted in favour of the other.

For many years pathologists have recognized that post operative abscess of the lung may on occasion pro-

duced either by septic embolism or by aspiration. It has been recognized that embolism of sufficient proportions occasionally occur following surgical operations. The embolism is usually a piece of blood clot loosened and deposited in the venous blood stream from a thrombus near or in the operative field. Moreover it is recognized that thrombosis occurs most readily in the presence of infection. It is altogether probable then that abscess of the lung does arise from embolism after operations. Especially after operations upon the upper respiratory tract. To state that this method of infection accounts for the majority of the lesions is a little far fetched. Again the strongest argument for aspiration as the mode of infection lies in the fact that there is a close similiarity between the types of bacteria in the infection and those found in the upper respiratory passages.

According to the results obtained by the supporters of the embolic theory, they were unable to secure lung abscess experimentally by the intra-tracheal route. Never the less the supporters of the aspiration theory cite experimental work in which this was done.

A significant fact to be noted in this respect and which may explain the lack of harmony is the result of the various experimentors is that they did not carry out their respective experiments in the same manner and using the same methods. Another point that should be

mentioned is that the various investigators did not take into consideration the separate resistance present in individual animals of the family and different species of animals. A fact not stressed sufficiently is that the resistance and immunity in animals varies as much in animals as it does in human beings. It is entirely possible that a given strain of dog for instance is more susceptible to the various factors that result in lung abscess formation than another given strain. For this reason it is rather hard to draw up comparative statistics when a number of unknown factors are known to be present.

The fact that there is an overlapping of arguments which may be interpreted in one way or other lends some strength to a theory that both embolic and aspiration play a part in the formation of lung abscess.

Evidence presented indicates that the lung puts up a barrier against aspirated material. This act in its self plus the resistance inherent in the animal decreases the tendency to abscess formation due to bacterial invasion. It should be remembered that aspirated material in a bronchus is still out side of the body. If however such material plugs up a bronchus with the result of atelectasis of a portion of of the lung. That portion involved becomes abnormal- physiologically and anatomically so. With this abnormal state the natural resistive forces will of necessity become decreased.

With the resistance to invasion lost or decreased, invasion can readily take place. In this manner the buccal organisms which normally are not virulent enough to invade can invade weakened tissue.

On the other hand if a septic emboli becomes lodged in a lung vessel following a upper respiratory operation. The lung tissue being deprived of its circulation a pathological condition results. The resistance is lowered. The area lacking normal resistance is easily invaded by bacteria. The result of which is suppuration. Suppuration not due to organisms aspirated but by those in the emboli who's normal habitus being in the mouth.

It is entirely possible that many lung abscesses are the result of the combination of the two modes of infection. A pathological change first probably results in the lung. Resulting in a lowered resistance. The change may be a result of an embolism or the result of aspirated material. Following which invasion occurs either from the emboli or from the aspirated material. Regardless of origin the fact remains that the organisms are normally found in the mouth.

According to the ease in which material is aspirated during operative procedures it is possible that in every so called normal human being there is a certain amount of material aspirated at all times. It is a clin-

ical fact that lipiodol is easily aspirated by a normal individual without the aid of an anaesthetic. Normally the amount of material reaching the finer bronchi and alveolai is limited due to ciliary action and coughing. The small amount of material finding its way into the smaller bronchi and alveolai is full of micro-organisms. These are incapable of invasion unless the proper conditions are in existence.

Most of the clinical and laboratory evidence indicate that the lung is much more susceptible to abscess formation from septic embolism than from bronchogenic invasion. This is explained in that the lung is at all times subjected to the presence of organisms of buccal origin due to the fact that mucus and other material is always being aspirated. Hence over a long period of time a certain amount of resistance is built up which limits invasion.

No specificity of organisms is apparent from all information up to this time. Many varieties of organisms are found in post operative lung abscesses. Many of these are probably saprophytes, some few are known to be pathogenic and nothing is known of others. All indications are that there are no specific organisms other than a possibly a group common to the oral cavity.

Conclusions.

1. The Embolic theory explains the etiology of some of the cases of post operative lung abscess.
2. The Aspiration theory accounts for the etiology of other cases of post operative lung abscess.
3. Both theories may play a part in the production of other cases of post operative lung abscess.
4. No specific bacteria are known.

Bibliography

1. Murphy J. B. Surgery of the lung J.A.M.A. V.21 281
1898
2. Most quoted by Oschner A. and Nesbit W. Archives of Otolaryngology, Pulmonary abscess following tonsillectomy. V. 6, 330-337, 1927
3. Miller W.S. Some essential points in the anatomy of the lung. A. J. Roentgenology V. 4, 269, 1917
4. Richardson C.W. Abscess of lung following operations on the tonsils and upper respiratory tract. Laryngology V. 26, 1001, 1916
5. Cohen A.J. and Fisher L. Pulmonary abscess in adults following tonsillectomy under general anesthesia. J.A.M.A. V. 77, 1313 1921
6. Chipman C.N. Relation of the anaesthetic to pulmonary abscess following nose and throat surgery. J.A.M.A. V. 77, 539 1922
7. Moore W.F. Pulmonary abscess- An analysis of 202 cases following operative work about the upper respiratory passages. J.A.M.A. V. 78, 1279, 1922.
8. Hedblom, C.A. The surgical treatment of acute pulmonary abscess and chronic pulmonary suppuration: With special reference to the post tonsillectomy type. J.A.M.A. V.83, 1577, 1924
9. Hedblom C.A. The etiology and treatment of pulmonary abscess. Nebr. Med. Journal V. 14, 300-304, 1929

10. Cutler E.C and Schleuter S.A. The experimental production of abscess of the lungs. Ann. Surg. V.84 256, 1926
11. Fetterolf G.A. and Fox Reaction of the peritonsillar tissues to tonsillectomy: Post tonsillectomy pulmonary abscess Am. J. M. Sc. V.166, 802 1923
12. Cutler E.C. and Hunt A.M. Post operative pulmonary complications. Arch. Internal Medicine V. 29, 449, 1922
13. Jackson C. Suppurative diseases of the lung due to inspired foreign body contrasted with those of other etiology. Surg. Gyn. and Obstet. V. 42, 305-317, 1926
14. Holman E. The etiology of the post operative pulmonary abscess. Ann. Surg. V. 83, 240- 245 1926
15. E.C. The etiology of post operative abscesses of the lung. The Ohio State M. J. V. 24, 109-115 1928
16. Schlueter S.A. and ^{Wendler} ~~Wendler~~ J. Post operative lung abscess: An experimental study. Arch. Surg. V. 36 114-457 ,1927
17. Iglauer S. Aspiration of blood into larynx and trachea during tonsillectomy under local anaesthesia.: A contribution to the etiology of lung abscess. Ann. Otol. Rhin. and Laryng. V. 37, 231-234 1928
18. Lemon W.S. Aspiration experimental study. Arch. Surg. 14, Pt 1 231, 1927

19. Smith D.I. Experimental aspiration abscess. Arch. Surg. V. 14, Ptl, 231, 1927
20. Myerson Pulmonary aspect of tonsillectomy under general anaesthesia. Laryngoscope V. 32, 1929, 1922.
21. Chow S.J. and Scarff J.E. Experimental production of lung abscess. Arch. Surg. V. 18, 1960 , 1929
22. Joannides M. The etiology of pulmonary abscess. Surg. Gynecolog. and Obstet. V. 27, 299-459 1928
23. Allen D.S. Etiology of abscess of the lung. Arch. Surg. V. 16 179-191 Jan Pt2 1928.
24. Harkavy J. The pathogenesis of aspiratory abscess of the lung. Arch. Int. Med. V. 43, 767-784, 1929
25. Ermatinger L.H. Micro organisms of lung abscess and bronchiectasis. J. of Inf. Diseases V. 43, 391-398 1928.
26. Heuer G.J. The etiology and treatment of pulmonary abscess. Surg. Gyne. and Obstet. V. 52, 394-405 1931.
27. Bucher C.J. Abscess of the lung-A bacteriological study based on 118 cases A. J. M. Sc. V. 179, 406-411 1930.
28. Lambert A.V.S. and Weeks C. Experimental production of abscess of the lung. Arch. Surg. V. 18 pt1 516-519 1929
29. Lambert A.V.S. and Miller Abscess of the lung Arch. Surg. V. 8, 446, 1924.
30. Miller J.A. Lung abscess- Some aspects of etiology and medical treatment. Laryngoscope V. 39, 1929.

31. Varney The bacterial flora of treated and untreated
abscess of the ling. Arch. Surg. V. 19.2 1602- 1617
1929.

32. Kline B.S. Experimental Gangrene J. Inf. Disease
V. 32, 481-483 1923.

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