Pulmonary Abscess as Complication of Hiatal Hernia*

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With the advent of newer antibiotics and improved surgical procedures, the early diagnosis and prompt treatment of pulmonary abscess assumes an increased importance. Since the prognosis in this disease is closely correlated with the promptness and accuracy of diagnosis, it has become imperative for the internist and surgeon, working in close cooperation, to be thoroughly familiar with the variable and often partially concealed signs and symptoms of this entity.

The purpose and scope of this article is to review the salient features of etiology, diagnosis, and therapy of lung abscess, and also to present a case of abscess secondary to a hiatal hernia. Lung abscess as a complication of hiatal hernia has not previously been described.

CASE SUMMARY

This 57-year-old white male entered the hospital on April 15, 1948 with a history of recurrent, right upper quadrant pain radiating to the epigastrium during the preceding four to five months. The pain usually occurred at night, or after meals, and was most evident with the patient in the prone position. It lasted two to three hours, was often followed by vomiting, and was unaffected by soda, milk, or foods.

He had a particularly severe episode of vomiting seven weeks before entry that awakened him from sleep and was accompanied by choking and marked dyspnea. Ten days to two weeks after this episode, he began running a low grade fever, occurring every afternoon and ranging between 100 and 102 degrees. He also developed symptoms of profuse sweating, weight loss of 15 pounds, marked anorexia, marked weakness, and easy fatigability. He had no history of dental or oral infections, ingestion of foreign bodies, or previous ENT surgery.

Physical findings on entry revealed an acutely ill patient with rapid shallow respirations, moderate pallor, and showing evidence of recent weight loss. Examination of the chest revealed a decrease in expansion of the left side. There was dulness to flatness on percussion at the left base and decreased breath sounds, and voice sounds in the left base and left axillary regions. The right base showed inspiratory rales, but no changes in percussion or voice sounds. There was no tracheal or medias-
tinal shift by physical findings. The liver was enlarged two finger-breathths below the costal margin and was moderately tender.

Laboratory studies on entry revealed RBC of 3.6 million, hemoglobin of 70 per cent, WBC of 14,800 with a differential smear showing 80 per cent polys including many young forms, sedimentation rate of 29 mm. per hour, negative serology, and normal urinalysis. Chest film on entry revealed an elevation of the left dome of the diaphragm, several horizontal linear lines of increased density above the right diaphragmatic dome, a slight shift of the mediastinum to the right, and a diffuse area of increased density in the left base, at the top of which appeared a ring-like area of increased density with a light center.

Two days after entry the patient had an episode of severe vomiting, coughing, and developed marked dyspnea together with a spiking temperature of 103.4 degrees. Physical findings several hours later revealed numerous ronchi and rales in the right base, and inspiratory rales in the left base above an area of decreased breath sounds with dulness to percussion. Following this episode temperature was 103.4 degrees, pulse 160, and respirations 36. WBC at this time showed 18,000 with 92 per cent neutrophiles. Urinalysis showed 2.5 per cent sugar and no acetone. Chest film revealed a mottled increased density in the right base suggestive of pneumonitis, and an increased density in the left base, also suggestive of pneumonitis—the previously described cavity had now disappeared.

The patient was placed on large doses of penicillin and sulfonamides at this time. For the following two weeks he received 60,000 units of penicillin every three hours and one gram of sulfadiazine every four hours with an initial dose of four grams. At the end of the two week period the dose of penicillin was increased to 200,000 units every three hours, and the dose of sulfadiazine was increased to 1.5 grams every four hours. Chest films revealed a persistence of the pneumatic area in both the right and left base with evidence of pleural effusion in the left base. Urinalyses continued to show 3 to 4 per cent sugar with no acetone, and a fasting blood sugar showed 225 mg. per cent. The liver enlarged to four finger-breathths below the costal margin and was tender. Liver function tests revealed four plus cephalin flocculation in 24 hours, a thymol turbidity of eight units, albumin-globulin ratio of 2.2 to 3.7, and prothrombin time of 55 per cent. Sputum studies on entry revealed a predominance of gram-positive cocci.

The patient's course was stormy, but improvement was progressive and continual. He received the previously mentioned doses of penicillin and sulfonamides for a period of three months and during this time maintained a blood sulfonamide level ranging between 13 and 17 mg. per cent. He also received aerosol penicillin therapy for the first month, but because of an allergic reaction manifested by hoarseness, laryngitis, and soreness of the mucous membranes the aerosol penicillin was discontinued. At the end of the first month he received a course of intratracheal penicillin three times weekly for an additional 30 days. The diabetic condition cleared fairly rapidly on insulin and diet and at the end of three weeks diet alone sufficed. The hepatic enlargement and abnormal liver function tests persisted during the first two months of hospitalization; then gradually began returning to normal without any specific therapy for this condition. At the end of three months the thymol turbidity was three units, cephalin flocculation was negative, urinary urobilinogen was normal, and albumin globulin ratios showed a ratio of 4.2 over 3.0.
Throughout his three months' course he continued to bring up large amounts of purulent foul sputum. He became afebrile at the end of 28 days of therapy and his symptoms after that time were persistent cough with expectoration, marked weakness, anorexia, and a dull aching pain in the lower left chest region. The right upper quadrant pain radiating to the epigastrium, which had been a principal symptom prior to entry.

FIGURE 1: (a) X-ray film of chest taken April 15, 1948 showing evidence of walled-off abscess in left lower lung together with band-like atelectatic areas in the lower right lung.—(b) Film made April 19, 1948 following rupture of abscess with development of pneumatic areas in both lower lung fields.—(c) Left lateral view, April 29, 1948 showing pneumonitis and suggestion of abscess site.—(d) Film made May 19, 1948 showing beginning resolution of pneumatic areas.—(e) Film made June 29, 1948 showing continued resolution.—(f) Left lateral view August 29, 1948 showing clearing of pneumonitis.—(g) Film of chest August 24, 1948 showing almost complete reversal to normal.
was not apparent throughout his hospital course. Gastro intestinal series taken shortly before entry demonstrated a large hiatal hernia. The patient was bronchosced every two weeks for the first 10 weeks and the edematous lining of the bronchial lumen was reduced with adrenalin. Repeated sputum studies for tuberculosis including smear culture and guinea pig inoculation were negative. Repeated stool studies for amoebae were negative, and amebic complement fixation test was negative.

At the end of 90 days' therapy the patient still had residual findings in both lungs by physical findings, but was asymptomatic and afebrile. He was discharged on July 15, 1948, with residual thickened pleura in the left base, normal blood count, urinalyses, liver function tests and a sedimentation rate of 10 mm. per hour. Follow-up studies every two weeks thereafter for several months revealed a gradual clearing of the pulmonary process with no recurrence of symptoms.

In consideration of the pathogenesis of the lung abscess in this case, we shall postulate that during the episode of vomiting, coughing, and regurgitation of stored material from the hernia, some material was aspirated into the lung. This is borne out by the finding of areas of plate-like atelectasis on the entry chest film which probably arose from the plugging of small bronchi at the time of aspiration. Further, we may assume that one of the areas of atelectasis developed secondary infection and gave rise to a silent lung abscess manifested only by systemic signs up to the time of entry. At this time (March 15, 1948) the roentgenogram showed a circumscribed dense area with a radiolucent center at the apex of the left lower lobe. Shortly after entry, the rupture of the abscess was initiated by another episode of vomiting, coughing, and straining, and bronchogenic dissemination occurred. Pneumonic areas appeared in both lung fields and the abscess cavity was no longer evident (March 19, 1948). The appearance of foul sputum at this time further confirmed this sequence of events.

Discussion

Numerous classifications of lung abscess have been proposed depending on etiology. Rubin divides pulmonary abscesses into four groups:

1. Pyemic abscesses secondary to emboli (these usually arise secondary to osteomyelitis, suppurative appendicitis, otitis media, urinary infection, bacterial endocarditis, or secondary to skin trauma. These abscesses are usually multiple, bilateral, and form small lesions in the cortical portions of the lung.

2. Bronchogenic abscesses including non-putrid, putrid, and chronic.

3. Abscesses secondary to pulmonary disease including infarction, neoplasm, or bronchiectasis.

4. Abscesses secondary to pathological processes of the thoracic wall, esophagus, mediastinum, or spine.
The relative frequency of these various etiologies varies somewhat among different series. Lord and King,4 in analyzing 210 cases, found that 117 followed surgery involving the upper respiratory tract. Valle,5 in a series of 245 cases, found that 30 per cent were secondary to aspiration, 65 per cent secondary to pneumonia, 3 per cent secondary to a foreign body, and 1 per cent secondary to subphrenic abscess. Chester and Krause6 found 17 out of 344 cases of lung abscess to be secondary to aseptic pulmonary infarction. Levin et al7 stated that 23 cases of abscess occurred in a series of 550 cases of infarction. They felt that the sources of infection and abscess following infarction were the organisms present in chronically infected bronchi or in foci of the mouth or throat. Pyorrhea and carious teeth were also emphasized by Aufses8 discussing the etiology of putrid lung abscess. Stats and Neuhofer9 in a series of 115 cases of acute putrid abscess, stated that the etiology was not apparent in 64 per cent of the cases, and they felt that aspiration of infected material from grossly diseased teeth or gums was probably responsible for many of these. Sweet10 found that 56 per cent of abscesses followed ENT surgery.

The problem of when aspiration gives rise to lung abscess has long been the subject of controversy. Allen11 felt that aspiration of infected material could give rise to abscess in the absence of bronchial obstruction, but Rubin1 stated that atelectasis, following impaction by a clot in the bronchus, must precede abscess formation. Cutler12 pointed out in experimental work that secondary infection may be caused by the aspiration of buccal material during the night. He felt that an abscess was the result of aspiration of particular organisms superimposed on a thrombotic process in the lung. Kline and Berger13 emphasized the importance of the buccal-pharyngeal region as a source by markedly reducing the incidence of postoperative abscess in a large series by rigid, preoperative, oral prophylaxis. Crowe14 and Hedblom15 concluded that, for infection by aspiration to occur, the cough reflex must be sufficiently controlled to allow infected liquids to settle into the alveoli. However, Faulkner16 felt that the cough reflex was inefficient and cited as evidence the fact that when lipiodol was introduced into the nares before sleep, it was found in the bronchi the following day.

The bacteriology of lung abscess may assume considerable importance both in diagnosis and prognosis. In one series Valle5 found mixed organisms with pneumococci and hemolytic staphylococci predominating. Varney17 stated that bacillus melaninogenicus was responsible for most putrid lung abscesses. Smith18 felt that the
presence of fusospirachetal organisms following an upper respiratory infection was often the earliest sign of lung abscess.

Lung abscesses tend to occur in the lower lobes most commonly in a ratio of about 2 to 1, and in the right lung in a ratio of about 3 to 1. The right lower lobe is most commonly involved, the left lower lobe next, and the right upper lobe is third. About 75 per cent of abscesses originate in the periphery of the lung, since the smaller bronchioles tend to become occluded most easily. Abscesses usually arise in the apical segments of the lower lobe or the basal segments of the upper lobe; anatomically, these are the favorite sites for aspiration with the patient supine.

The diagnosis of lung abscess is often delayed because of the variable signs and symptoms which may predominate in a given case, or because an etiology has not been established in taking the history. We have previously indicated the importance of a history of vomiting during an alcoholic episode as an example. Particularly in children where aspiration of a foreign body is so often the precursor to the establishment of an abscess, a careful search both by history and laboratory methods is essential in establishing a possible etiology. In the series of more than 200 cases reported by Valle, the presenting findings were cough, foul sputum, pleuritic pain, and fever. Hemoptysis was present in over one-half of the cases. Physical signs tend to be extremely variable and are largely dependent upon the size of the abscess, its location, and its proximity to the surface of the lung. Cabot stated that the signs may only be those of inflammation of the lung parenchyma surrounding the abscess. Clubbing frequently occurs, particularly in abscesses which remain unresolved after many weeks, but has been reported during the third week of an abscess.

In the laboratory diagnosis of pulmonary abscess, there are again no specific diagnostic features. The presence of fusospirachetal organisms in the sputum in conjunction with a respiratory infection may suggest an early abscess.

In contradistinction to the usual type of putrid lung abscess described previously, State and Neuhofer have emphasized the existence of "walled-off" putrid abscesses without foul sputum because of complete obstruction of a bronchial segment. This type of abscess will present symptoms of a generalized toxemia without localization in the respiratory tract. Pain is an important finding in putrid abscess because it frequently shows the position of the abscess by overlying an area of pleuritis. The recurrence of pain during the course of an abscess frequently indicates pleural spread.

A chronic abscess is exemplified by periodic exacerbations of fever, chills, productive cough, and often pleuritic pain. The symptoms in this case are due to an inadequate drainage of en-
cysted pus pockets. A chronic abscess may be the result of fibrosis around the original area of suppuration, or may represent a diffuse involvement of neighboring tissues with associated fibrosis and bronchlectasis. Complications include amyloid degeneration of other organs, the occurrence of metastatic abscesses, or cardiac decompensation secondary to extensive pulmonary fibrosis.

Roentgenologic aids may be almost diagnostic at times, and on other occasions may show little or nothing such as in the case of abscesses following bland pulmonary infarction. The x-ray findings can be considered in three stages: (a) in the early stage, the x-ray appearance may closely simulate a pneumonitis except that two lobes are often involved; (b) in the pyogenic cavity stage, the x-ray may show a fluid level, and an air fluid level may be demonstrated when the abscess communicates with the bronchus; (c) the third stage may be one of resolution; the abscess may become larger and chronic with a thick-walled cavity predominating; or a large fibrous ring may be left around the entire area so that a large empty space results. In the localization of an abscess for operative intervention, the x-ray may be extremely valuable. The site of incision is usually at the roof of an abscess where it is nearest the surface, and Rabin\textsuperscript{18} has emphasized the value of the “spot” method using radio opaque dye for the precise localization of a pulmonary abscess.

A sudden elevation of temperature during the course of an abscess should always be an indication for a careful roentgen study since this is often the result of the occlusion of a bronchus with the loss of air and collapse of the cavity. The continued accumulation of pus with no outlet results in signs of increasing toxicity. Conversely, a sudden change in the roentgen appearance with a fall in temperature and expectoration of large amounts of purulent sputum usually indicates that the abscess has ruptured into a bronchus and spontaneous drainage is occurring.

Among the most serious effects of lung abscesses are the complications to which they frequently give rise; namely, metastatic abscesses to the brain, spleen, liver, or kidney, bronchogenic aspiration with spread to the same or opposite lung, regional extension with resultant mediastinitis, pericarditis, or empyema. The latter may be of a small putrid type or may result in a pyopneumothorax with a bronchopleural fistula. Brown et al\textsuperscript{18} felt that surgical drainage, preceded by penicillin therapy, was the treatment of choice in these cases.

The therapy of pulmonary abscesses has long been the subject of controversy and widely divergent viewpoints. Both medical and surgical methods have been in vogue at varying times, but today the basic principles of therapy embody features of both
methods. From the standpoint of the internist, medical therapy has assumed increasing importance with the development of newer antibiotic agents. Notwithstanding the newer developments in medical and surgical therapy, the overall mortality had not changed appreciably until recently. Allen and Blackman in a review of 2,000 cases before 1936 found a mortality of slightly more than 34 per cent and Smith in a review of a similar number after 1936 found almost as high a mortality.

The value of a nutritious diet affording adequate calories, proteins for tissue regeneration, and vitamins, particularly C for wound healing, is well accepted. Frequent small transfusions for the anemia, which usually occurs in any long-standing abscess process, are of considerable benefit. Postural drainage is an invaluable aid in promoting drainage, but its usage is frequently abused. Postural drainage should be reserved not for the early pneumatic stage of an abscess but later when the sputum is becoming more profuse. The frequency of its use must be limited by the physical capacity of a sick patient. Frequent employment of drainage for short periods of time is superior to infrequent attempts for prolonged periods.

Bronchoscopy has an important role both in the diagnosis and treatment of lung abscess. In the early stages, it serves to establish drainage and relieve atelectasis by clearing an occluded bronchus; in the later stages it serves to maintain drainage. In addition, it is an aid in diagnosing foreign bodies or neoplasm as etiologies for the obstruction. It is usually felt to be contraindicated during hemorrhage. Allen and Blackman in a series of over 2,000 patients utilized bronchoscopy in one-third with a 61 per cent improvement rate and 20 per cent mortality; of their patients treated by surgery alone, 62 per cent improved and there was a 39 per cent mortality.

In a consideration of drug therapy, we find that the arsenicals were utilized extensively in the past two decades, and Smith stated that they were most useful in the first 10 days, resulting in a 60 per cent recovery incidence in his series. The highest recovery rate from this type of treatment was reported by Kline and Berger with a 68 per cent recovery incidence.

D’Ingianni pointed out that sulfonamides were particularly valuable in pyogenic infections but were poor in fuso-spirochetal infections.

Reports on the use of penicillin have been quite encouraging. Smith reported that 63.3 per cent of patients recovered, 16.7 per cent died, and 20 per cent developed chronic abscesses in a series treated by penicillin. Stivelman and Cave used penicillin in six cases of acute putrid lung abscesses with recovery in five patients,
and in seven cases of chronic abscess with improvement in five patients. They stated that spontaneous cure was rare averaging about 10 per cent. They administered penicillin every three hours in a dose of 25,000 units together with sulfonamides, and felt that therapy should continue until symptoms had subsided and the x-ray had returned to normal. Most clinicians today feel that the dose should be closer to 50,000 units every three hours, and many use 500,000 units daily in divided dosage. Alorcan obtained good results in eight cases of acute suppuration of the lung, and he advocated penicillin instillation through a bronchoscope in some cases.

The introduction of aerosol penicillin marked a significant forward advance in the development of a method for achieving high local concentration. Although the blood level may not be any higher with this method, the local penetration appears to be better than that achieved by parenteral administration. The value of this form of therapy has been amply stressed by Segal and Ryder, Vermilye, and Findley and Sweet. We have used 50,000 units in 1 c.c. of saline at four hour intervals as an average dose. Allergic reactions to this form of administration have been described, and we have observed one patient who developed edema of the tongue which responded to benadryl.

A newer development in the administration of penicillin has been the intra-bronchial instillation of moderate doses. The method as described by Stevenson involves the instillation of 20,000 to 30,000 units of penicillin diluted in saline or a modified Ringer's solution into the trachea through a catheter or cannula after preliminary local anesthesia. Stevenson and also Stitt emphasized the precautions to be observed by reviewing the reactions which have been observed; namely, pontocaine sensitivity, which may be minimized by decreasing the amount used and employing the 1 per cent solution, dyspnea secondary to bronchial spasm, acute febrile episodes, and transient pleurisy. We have found the use of a curved metal catheter to be superior to that made of rubber. 30,000 to 40,000 units of penicillin has been our average dose of two-day intervals.

The drug therapy of chronic lung abscess is palliative at best. Kay and Meade felt that extirpation was the treatment of choice and they reported only one death in nearly 100 cases.

The main problems which arise in a consideration of the surgical therapy of lung abscess are those of the type of surgery to be utilized in a given case and the optimal time for surgical intervention. Samson felt that abscesses should be treated definitively in the acute stages before irreversible changes occur. He stated that the odor of expectorated sputum might serve as a
guide in determining the need for surgical intervention, i.e. more putrid odors suggest more anaerobes and emphasize the need for early external drainage. He felt that an abscess which ruptured into the pleural cavity required immediate external drainage and suggested that surgery should be employed after two or three weeks of medical therapy or at least before the sixth week. Samson advocated internal drainage plus bronchoscopy early and external drainage later or, if chronicity or bronchiectasis developed, resection. Iselin et al. treated with penicillin 27 patients of whom 19 had pneumonotomy together with penicillin. Of these 19 patients, 15 recovered and three died during the following year. Neuhof treated 86 putrid abscesses with an 85 per cent recovery rate and 3 per cent mortality; his treatment was thoracotomy and drainage. He felt that surgery was indicated for subacute or chronic abscesses (those persisting at least six weeks) and he stated that the surgical treatment of localized abscesses afforded good results.

Stats and Neuhof felt that surgical therapy was the treatment of choice in "closed-off" putrid abscesses since these infections were usually of long duration at the time of diagnosis. Touroff and Neuhoff in differentiating between putrid (anaerobic) and non-putrid lung abscesses pointed out that the latter tended to be multiple, not to have a foul odor, to respond better to medical therapy, and to be easily spread by surgery. If any surgery were required for these, resection was the method of choice. In the case of the putrid abscesses, surgical intervention was advised within the first six weeks. Lindskog showed that the mortality rate for drainage ranged between 21 and 45 per cent for the period of 1921-1937 while in 1944 there was only a 7 per cent mortality in 24 resected cases. Glover and Clagett have recently summarized the indications for pulmonary resection in lung abscess. They had 20 recoveries with 1 death in 21 lobectomies but only seven recoveries with 9 deaths in 16 pneumonectomies. Their indications for resection were: (1) persistent symptoms due to pathological changes secondary to open drainage; (2) multiple or multilocular abscesses; (3) abscesses with secondary surrounding changes; (4) abscesses not accessible to open drainage by virtue of their position; (5) abscesses with possible malignancy; (6) abscesses with excessive bleeding; (7) abscesses in children because of the tendency to chronicity and the development of drainage sinuses; and (8) abscesses secondary to a foreign body which cannot be removed by bronchoscopy.

In correlating medical and surgical therapy, it is generally felt that an early diagnosis is essential. The medical forms of therapy enumerated previously are indicated in the early stages, and the need and time for surgical intervention should depend upon the
response of the patient to medical management. It is generally felt that an acute abscess not responding in the first two or three weeks or not cleared by the sixth week should be treated surgically. In addition surgical management is definitely indicated for abscesses with secondary complications or in abscesses where drainage is inadequate.

SUMMARY

1) An unusual case of lung abscess arising secondary to a hiatal hernia has been presented.
2) A review of the etiology, pathogenesis, and diagnosis of pulmonary abscess has been given.
3) The present concepts of therapy have been reviewed. Penicillin administered in its various forms would seem to offer the best promise for success of any of the medical agents.
4) The indications and optimal time for surgical intervention have been emphasized.

RESUMEN

1) Se refiere un raro caso de absceso pulmonar subsiguiente a hernia del hiato esofágico.
2) Se presenta un repaso de la etiología, patogenia y diagnóstico del absceso pulmonar.
3) Se repasan los presentes conceptos terapéuticos. De todos los agentes médicos, la penicilina, administrada en sus varias formas, parece ofrecer la mejor promesa de resultados halagüeños.
4) Se han recalado las indicaciones y el tiempo óptimo para la intervención quirúrgica.

REFERENCES