Percutaneous Small Bore Catheter Drainage in the Management of Lung Abscesses*

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For patients with pyogenic lung abscesses who do not respond to medical therapy, thoracotomy with pulmonary resection is the widely-accepted treatment of choice. Six patients with lung abscess who failed to respond to conservative medical management were treated by percutaneous catheter drainage using small catheters (10 Fr or smaller). Five patients showed prompt clinical improvement and the sixth improved after a modification in antibiotic therapy. All patients recovered with radiographic resolution of the abscess and were well at followup periods from two months to two years. In such patients, percutaneous drainage with small catheters provides an excellent clinical result with minimal risk and trauma.

Antibiotic therapy has proven an effective method of treatment for the majority of patients with pyogenic lung abscesses.1,6 When medical therapy fails, thoracotomy and pulmonary resection are the current generally-recommended therapy.1,4 In patients who are judged to be unsuitable for surgery, percutaneous drainage using large catheters or chest tubes has been described as an alternative.5,6 We report our experience with six patients who did not respond to antibiotic therapy and were successfully treated by percutaneous drainage using small (10 Fr or smaller) catheters.

MATERIALS AND METHODS

Patient Selection and Data Collection

Medical records and radiographic studies performed on all patients treated with percutaneous catheter drainage of a lung abscess between January, 1983 and December, 1985 were reviewed. Followup was obtained by chart review at the referring hospital or personal contact with the referring physician. All of the percutaneous drainage procedures were carried out under local anesthesia.

Technique

Fluoroscopy was used to accurately determine the location of the abscess and the most appropriate route of approach, as well as to monitor advancement of the catheter. Fluoroscopic observation during respiration was utilized to assess possible pleural symphysis and, if possible, entry was made through this region. In most cases, an 8.2 or 10 Fr Cope catheter (Cook Inc, Bloomington, IN) was placed using standard techniques. In two cases, initial entry was achieved with a 7 Fr catheter-trocar system. With either technique, advancement was made under fluoroscopic guidance, and entrance into the abscess cavity was confirmed by aspiration of purulent material. Following aspiration, or if initial aspiration did not yield pus, gentle lavage was performed with saline solution to remove any relatively viscid material. Samples of the aspirate were retained for microbiologic analysis. Once the catheter was in place and pus could no longer be aspirated, the catheter was sutured to the skin, connected to suction, and an occlusive dressing applied. The catheter was irrigated with 5 to 10 ml of bacteriostatic saline solution and aspirated dry every 4 hr. Catheter drainage was discontinued when there was radiographic evidence of the abscess resolving, the patient was afebrile with a decreasing white blood cell count, and there was no longer purulent drainage from the catheter.

RESULTS

All patients were men and ranged in age from 2 to 78 years (Table 1). Five of the six patients had a history of disorders producing altered states of consciousness. Aspiration was believed to be the common denominator in the development of abscess in all six patients. Sputum cultures grew normal oropharyngeal flora in three of the cases. However, in the other three cases, sputum cultures and/or tracheal aspirates grew the same organisms later grown from the material drained from the abscess (Table 2). Antibiotic therapy was selected based on sensitivity studies of cultured material. In addition to intravenous antibiotic therapy, all patients were given chest physiotherapy and postural drainage. Three patients (4 through 6) underwent bronchoscopic examination to rule out obstructing tumor or foreign body and to obtain culture specimens. In general, during medical management these patients remained febrile and had prolonged leukocytosis with little or no improvement of symptoms and a worsening or unchanging radiographic appearance. The decision to drain the abscess was made when a patient failed to improve after 11 to 33 days of antibiotic therapy, or when patient survival without drainage seemed unlikely. Following catheter drainage, patients 1, 2, and 5, who were institutionalized, were returned to the referring institution. Patients 3, 4 and 6 were discharged; one, and two days, respectively, after catheter drainage was discontinued.

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Table 1—Patient Population

<table>
<thead>
<tr>
<th>Patient no.</th>
<th>Age (yrs)</th>
<th>Sex</th>
<th>Underlying conditions</th>
<th>Abscess location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>74</td>
<td>M</td>
<td>Senile, dementia</td>
<td>RUL</td>
</tr>
<tr>
<td>2</td>
<td>78</td>
<td>M</td>
<td>Chronic organic brain syndrome</td>
<td>LUL</td>
</tr>
<tr>
<td>3</td>
<td>40</td>
<td>M</td>
<td>Seizures, alcoholism</td>
<td>RLL</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>M</td>
<td>Probable foreign body aspiration</td>
<td>LLL</td>
</tr>
<tr>
<td>5</td>
<td>25</td>
<td>M</td>
<td>Schizophrenia, chronic aspiration secondary to lye ingestion</td>
<td>RUL</td>
</tr>
<tr>
<td>6</td>
<td>33</td>
<td>M</td>
<td>Seizures, alcoholism</td>
<td>RUL</td>
</tr>
</tbody>
</table>

RUL = right upper lobe; LUL = left upper lobe; RLL = right lower lobe, LLL = left lower lobe.

Table 2—Results

<table>
<thead>
<tr>
<th>Patient</th>
<th>IV Antibiotics to Drainage</th>
<th>Days Prior to Drainage</th>
<th>Catheter Size</th>
<th>Days Drained</th>
<th>Tracheal Aspirate and/or Sputum Culture</th>
<th>Aspirate Culture</th>
<th>Outcome</th>
<th>Followup</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Clindamycin, gentamycin</td>
<td>23</td>
<td>10 Fr</td>
<td>-13</td>
<td>Same Staph. aureus, <em>Pseudomonas aeruginosa</em></td>
<td>Same</td>
<td>Failed to improve with drainage, catheter removed antibiotics modified, then improved</td>
<td>Well at 3 mo.</td>
</tr>
<tr>
<td>2</td>
<td>Cefamandol, gentamycin, carbenicillin, metronidazole, ampicillin</td>
<td>33</td>
<td>10 Fr</td>
<td>-18</td>
<td>Same <em>Proce dentia stuartii</em>, <em>Mor ganella morgani</em>, <em>Strep. viridans</em>, <em>Peptococcus magnus</em></td>
<td>Same</td>
<td>Slow improvement, then more rapid following replacement of clogged catheter</td>
<td>Well at 2 mo.</td>
</tr>
<tr>
<td>3</td>
<td>Penicillin, tobramycin, clindamycin</td>
<td>13</td>
<td>7 Fr (followed by 10 Fr)</td>
<td>-10</td>
<td><em>Neisseria species</em>, <em>Hemophilus species</em>, <em>Strep. viridans</em></td>
<td><em>Eubacterium aerofaciens</em></td>
<td>Afebrile after 2 days, rapid decrease in size of cavity</td>
<td>Asymptomatic at 1 mo., well at 11 mo.</td>
</tr>
<tr>
<td>4</td>
<td>Oxacillin, chloramphenicol</td>
<td>11</td>
<td>8.2 Fr (followed by 10 Fr)</td>
<td>-11</td>
<td>Normal flora <em>Streptococcus intermedius</em>, <em>Peptostreptococcus species</em></td>
<td>Same</td>
<td>Afebrile after 3 days, WBC 30K+10K. Rapid resolution of abscess</td>
<td>Well at 2 yrs.</td>
</tr>
<tr>
<td>5</td>
<td>Oxacillin, gentamycin, clindamycin</td>
<td>13</td>
<td>10 Fr</td>
<td>-59</td>
<td>Normal flora</td>
<td><em>Propionibacterium acnes</em></td>
<td>Afebrile after 2 days. WBC 19.6–6.9. Slowly decreasing amount of drainage. Steady resolution of abscess</td>
<td>Well at 2 mo.</td>
</tr>
<tr>
<td>6</td>
<td>Penicillin, clindamycin</td>
<td>16</td>
<td>7 Fr (followed by 10 Fr)</td>
<td>-10</td>
<td>Same <em>Peptococcus magnus</em></td>
<td>Same</td>
<td>Afebrile after 3 days. Rapid decrease in size of cavity and disappearance of air/fluid levels</td>
<td>Well at 6 mo.</td>
</tr>
</tbody>
</table>

Case Reports

Case 3

A 40-year-old man with a history of alcoholism and a seizure disorder presented to his local emergency room with a one month history of productive cough, fever, and night sweats; and malaise for the preceding two weeks. Chest radiographic examination revealed a cavitating lesion in the right lower lobe containing fluid. On admission, his temperature was 38.5°C (101.3°F) and his white blood cell count was 17,600 cu mm. Intravenous antibiotic therapy was administered, along with vigorous pulmonary toilet. Sputum cultures grew normal flora. The patient remained febrile and serial chest radiographic study showed progressive enlargement of the cavity. The patient did not improve and was transferred to our institution after one week of therapy. Upon transfer, his temperature was 40°C (104°F) and white blood cell count was 23,500 cu mm. Chest x-ray film showed a large, rounded mass with an associated air fluid level in the right lower lobe. There was an associated...
and 100 ml of purulent material aspirated. Remarkable alleviation of symptoms was noted within minutes of decompression. *Eubacterium aerofaciens* was recovered from culture samples. The catheter was placed on suction and irrigated every 4 hr with 10 ml of bacteriostatic saline solution. Two days after the procedure, the

**FIGURE 1A (left).** Frontal and lateral (B, right) chest radiograph showing large abscess in right lower lobe and right middle lobe infiltrate (arrow).

**FIGURE 2.** Chest radiograph showing 7 Fr pigtail catheter in abscess cavity.

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**FIGURE 3.** A 10 Fr pigtail catheter has been inserted in place of the 7 Fr catheter.

parenchymal infiltrate in the right middle and right lower lobes (Fig 1). Intravenous antibiotic therapy was administered based on cultures obtained from transtracheal aspiration. The patient remained febrile with persistent racking cough for two additional weeks while receiving intravenous antibiotic therapy before percutaneous abscess drainage. Under fluoroscopic guidance, a 7 Fr pigtail catheter was inserted into the abscess without complication.

Intravenous antibiotic therapy was administered based on cultures obtained from transtracheal aspiration. The patient remained febrile with persistent racking cough for two additional weeks while receiving intravenous antibiotic therapy before percutaneous abscess drainage. Under fluoroscopic guidance, a 7 Fr pigtail catheter was inserted into the abscess without complication. Parenchymal infiltrate in the right middle and right lower lobes (Fig 1). Intravenous antibiotic therapy was administered based on cultures obtained from transtracheal aspiration. The patient remained febrile with persistent racking cough for two additional weeks while receiving intravenous antibiotic therapy before percutaneous abscess drainage. Under fluoroscopic guidance, a 7 Fr pigtail catheter was inserted into the abscess without complication.
after the patient was afebrile and his white blood cell count had decreased to 12,000 cu mm. Chest x-ray film showed some decrease in the size of the abscess cavity. At this time, catheter occlusion was questioned and it was exchanged for a 10 Fr pigtail catheter. This was accomplished without difficulty and an additional 10 to 15 ml of purulent material was aspirated (Fig 3). The patient experienced a transient temperature increase to 37.4°C (99.4°F) during the 24 hr following catheter exchange and remained afebrile thereafter. Drainage from the catheter decreased continuously as the cavity resolved. The catheter was removed after ten days of drainage (Fig 4). The patient remained on intravenous treatment with clindamycin and tobramycin for an additional four days and was then switched to therapy with oral medication and discharged. When seen in the clinic for routine followup two weeks after discharge, the patient remained asymptomatic. Chest radiograph showed continuing resolution of the lung changes (Fig 5). The patient remained asymptomatic without recurrence when last seen at 11 months following catheter drainage.

RESULTS

Dramatic clinical improvement followed percutaneous drainage in five of the six cases. Among these five patients, patient 2 had a somewhat slower rate of improvement but eventually recovered fully after a clogged catheter was replaced and additional pus aspirated. The patients with an immediate response after drainage were given intravenous antibiotic therapy for a period of one to two weeks, followed by oral antibiotic therapy for up to one month with the antibiotic regimen modified in response to cultures of the aspirated material. Length of drainage ranged from nine to 18 days, with the exception of patient 5 who continued to have small amounts of drainage (1 to 2 ml/day) from the catheter for almost two months. Two of the patients required exchange of the catheter for a larger size for better drainage. This was easily accomplished using standard catheter exchange procedures. Neither patient developed an empyema. All patients recovered completely as determined by clinical and radiologic findings and were well at followup periods of two months to two years.

There was one case (patient 1) which was not clearly successful. He had been admitted to a mental institution with severe dehydration, was unresponsive even to deep pain, and was given a very poor prognosis. On the fifth hospital day, chest radiographic examination showed a right upper lobe infiltrate with cavitation. Sputum cultures grew Staphylococcus aureus. The patient was given intravenous antibiotic therapy but continued to have a low-grade fever with little clinical improvement for three weeks. Chest x-ray film showed enlargement of the cavity, and on the 26th hospital day the patient underwent percutaneous drainage with removal of 75 ml of thick purulent material. Five days after percutaneous drainage, antibiotic therapy was altered because of a drug reaction to the previous antibiotic regimen. The patient did not defervesce, demonstrate a reduction in his white cell count or improve radiographically and was transferred to our institution after 11 days of catheter drainage. Records indicate minimal drainage from the catheter and repeated difficulty with irrigation, suggesting catheter occlusion. After transfer the catheter was removed because of concern about catheter occlusion and the
possibility of developing a bronchopleural cutaneous fistula. The patient's antibiotic regimen was changed to ampicillin, clindamycin and tobramycin. The patient showed clinical improvement, accompanied by a corresponding improvement in his chest radiograph, during the next seven days.

Discussion

Primary treatment of lung abscess is the administration of antimicrobial agents with postural drainage. Bronchoscopic examination is usually performed to exclude bronchial obstruction. In some instances, antibiotic therapy may be required for periods of two to four months to achieve complete resolution. Recent reviews have reported mortality rates of 25 to 28 percent even with aggressive therapy. Surgical intervention is reserved for those patients who do not respond to medical management with antibiotics (ie, persistent febrile course and toxicity for two weeks, or no clear progress after six to eight weeks of antibiotic therapy or develop other complications such as significant recurrent hemoptysis, empyema or bronchopleural fistula. In some series, surgery may be required in 11 percent of patients. Surgical mortality in these patients is reported to be 11 percent and may be as high as 18 percent in those with massive hemoptysis. These data suggest that there is still considerable mortality with lung abscesses, even with aggressive medical and surgical therapy.

Keller et al demonstrated that percutaneous interventional catheter therapy could be used successfully to treat a wide range of lesions of the chest and lungs with minimal risk, morbidity and complications. Yet, in patients with pulmonary abscess, percutaneous drainage is generally recommended only as a last resort in those who fail medical management and in whom the risk of surgery is prohibitive. There are several concerns which have precluded consideration of percutaneous drainage in less critically ill patients. These include contamination of the pleural cavity with resulting empyema, hemorrhage, and residual bronchopleural fistula. However, in his review of the literature, Mengoli found that empyema was actually more common in post-pulmonary resection patients (21 to 29 percent) than in those who underwent large bore drainage, where it was only reported occasionally. Hemorrhage was found to occur in 6 percent of tube drainage patients, and bronchopleural fistula in only 8 percent. Thus it would seem that these expected complications are not encountered frequently, and may be related to the use of standard chest tubes for drainage. There was only one complication among the six patients. Patient 2 developed a small pneumothorax during the initial drainage procedure. This was treated by percutaneous placement of an 8.2 Fr catheter into the pleural space, aspiration of the accumulated air and connection to underwater seal. The catheter was subsequently removed the following day without difficulty or recurrent pneumothorax. We used fluoroscopic examination to assess possible pleural symphysis, as it seemed this reduces the risk of contaminating the pleural space. It is worth noting that we had one patient who had a small pneumothorax and two who underwent catheter exchange but did not develop empyemas.

Although cases have been described in which percutaneous drainage has been employed in similar patients with lung abscesses, these generally have utilized rather large tubes for drainage, frequently standard chest tubes (number 28 or 36). Weissberg reported his results inserting number 36 chest tubes under general anesthesia. This seems to represent considerable risk in patients who are generally severely debilitated and who are considered poor candidates for general anesthesia and surgical resection. Yellin described patients drained under local anesthesia using an Argyle trocar catheter or Foley catheter (size unspecified) or a 12 g intravenous catheter. Vainrub has reported his experience with three patients using a number 16 or 18 chest tube. Aronberg describes a single patient who successfully underwent percutaneous drainage of a lung abscess using an 8 Fr catheter. We used the smallest catheter possible as it would seem the smaller the catheter, the less trauma and lower risk of complications. In our experience, the two 7 Fr catheters had difficulty maintaining adequate drainage and exchange for a 10 Fr catheter greatly facilitated removal of purulent material. It appears that a 10 Fr catheter provides adequate drainage.

It is unknown to what degree the difficulty in catheter drainage affected the first patient's course. Removal of pus from the cavity aided his recovery and resulted in increased responsiveness in this previously moribund patient. The modification of antibiotic therapy after catheter removal bears a strong temporal relationship to his abrupt defervescence and reduction in white cell count, and was probably the primary factor.

Patient 5 had a prolonged catheter drainage time of 59 days. However, the patient was afebrile two days after percutaneous drainage and had a significant reduction in white blood cell count. He was transferred back to the referring institution when he was clinically stable, eight days after percutaneous catheter placement. Subsequent review of his records revealed that the patient was clinically well, but the catheter was left in place because of the 1 to 2 ml/day continued drainage of yellow fluid. Since the abscess had resolved and the patient was clinically well, it is quite likely that this catheter could have been removed considerably earlier without affecting his clinical course.
Although there are many concerns regarding the technique of percutaneous catheter drainage of lung abscesses, one should also bear in mind that conservative medical management with intravenous antibiotic therapy is not without some risk. We have had experience with a patient whose abscess decompressed endobronchially in a rather sudden manner, resulting in his demise. One assumes that if an air/fluid level is present within the abscess cavity, significant tension is not present. However, when the abscess does not contain an air/fluid level and is homogeneous, then some degree of tension may be present and sudden decompression endobronchially becomes a real concern. Indeed, in a postmortem review of patients with lung abscesses, Harber and Terry 12 found that death could be attributed to aspiration of the contents of the abscess cavity in 22 percent of patients.

Percutaneous drainage is safe, effective, has fewer complications, and avoids the unnecessary trauma, risk, long convalescent period, stress, and cost involved in thoracotomy and pulmonary resection, as well as preventing the loss of functioning lung parenchyma. Given the experience described by others, as well as our own experience, we conclude that percutaneous drainage with a 10 Fr catheter should be considered as the primary treatment of patients with pyogenic lung abscess who fail to respond to adequate medical management within 10 to 14 days of antibiotic treatment. This should be considered early in a patient's course. Drainage should be accomplished with 10 Fr catheters, which are simple to insert, exchange, involve minimal risk, and avoid the unnecessary trauma to the patient associated with insertion of large bore chest tubes.

REFERENCES
14 Aronberg DJ, Sagel SS, Jost RG, Lee JI. Percutaneous drainage of lung abscess. AJR 1979; 132:282-283