Percutaneous transthoracic needle aspiration, lavage and instillation of clindamycin–gentamycin in peripheral pyogenic lung abscess

Ahmed Mohamed Said a, Nagat Ali Mohamed a,*, Doaa Mostafa Gad a, Alaa Brik b, Saeed B. El-Sayed c, Ghada Mohamed Al-Akad d

a Chest Diseases, Zagazig University, Egypt
b Cardiothoracic, Zagazig University, Egypt
c Radiology, Zagazig University, Egypt
d Clinical Pathology, Zagazig University, Egypt

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KEYWORDS
Percutaneous transthoracic needle aspiration; Lavage; Instillation of clindamycin–gentamycin; Peripheral pyogenic lung abscess

Abstract  Background: Lung abscess are defined as localized suppurative necrotizing collection occurring within the pulmonary parenchyma. Some authors emphasized image-guided aspiration of lung abscess before antibiotics use in order to identify the pathogen. Antibiotic lavage is currently widely used in the treatment of patients with peritonitis, but not used previously in lung abscesses.

Aim of the study: Is to asses the role of percutaneous transthoracic needle aspiration, lavage and instillation of clindamycin–gentamycin on the treatment of peripheral pyogenic lung abscess.

Materials and methods: Twenty-six patients with peripheral pyogenic lung abscess are included in this study and classified into two groups. Group I received systemic empirical antibiotic, remodulated after the result of sputum culture and sensitivity. While group II underwent ultrasound guided percutaneous transthoracic needle aspiration, lavage and local instillation of antibiotics (clindamycin–gentamycin) associated with receiving systemic empirical parental antibiotics, that were remodulated after the result of aspiration culture and sensitivity. Chest X-ray and chest ultrasound were done pre, post and after intervention by one week and before discharge.

Results: There was a statistically significant difference between group I and II as regard duration of systemic antibiotic use, duration of hospital stay, duration of radiological improvement, and size of abscess after intervention. Moreover complications occurred in group I were higher than in
Percutaneous aspiration of peripheral lung abscess has an accurate determination of the causative organisms inside the abscess. The resolution of the abscesses clinically and radiologically was hastened by needle aspiration, lavage and instillation of clindamycin–gentamicin. Early intervention can improve symptoms, decrease morbidity and complications.

Introduction

Primary lung abscess usually results from aspiration of anaerobic oropharyngeal bacteria into gravity-dependent portion of the lung. It is seen most commonly in alcoholics and in patients with altered consciousness, patients with gastroesophageal dysmotility, and those with poor dental hygiene [1].

Until the early 1940, surgical pneumonotomy and drainage were the accepted treatment for lung abscess. Subsequent advances in anesthesia and surgical techniques lead to the advent of lung resection as the preferred therapy, until the availability of effective antibiotics rendered open drainage unnecessary in most patients [2].

Current first line therapy for lung abscess is antibiotic therapy directed at the likely causative organisms, usually anaerobic or mixed aerobic and anaerobic bacteria [3].

However still some patients display no radiologic evidence of improvement or show signs of persistent sepsis or develop complications like hemoptysis, bronchopleural fistula and empyema. Therefore, some authors emphasized external drainage via image guided drainage as a preferred method of treatment of pleural based abscesses [4].

Moreover, other authors stated the importance of image-guided aspiration of lung abscess before antibiotics use in order to identify the pathogen [5].

On the other hand antibiotic lavage is widely used in the treatment of patients with peritonitis [6]. But, not used previously in lung abscess. Lavage removes large quantities of toxins from a great absorptive area and many bacteria which should be death with body’s defense mechanisms [7].

So, the aim of this study was to assess the role of percutaneous needle aspiration, lavage and instillation of clindamycin–gentamicin on the treatment of peripheral pyogenic lung abscesses.

Materials and methods

This study was carried out in Chest, Cardiothoracic and Radiological Departments, Faculty of Medicine, Zagazig University in the period from January 2011 up to June 2013.

Subjects

This study included 26 cases with single peripheral pyogenic lung abscess classified into group I (13 cases) who received systemic empirical antibiotics started at first day of diagnosis which were remodulated after the result of sputum culture and sensitivity, and group II (13 cases) who underwent ultrasound guided fine needle percutaneous transthoracic aspiration of the abscess in a single sitting and also received systemic empirical antibiotics started at first day of diagnosis. These empirical antibiotics were remodulated after the result of aspirates culture and sensitivity. Both groups were matched regarding their age, sex, site and size of the peripheral lung abscess.

All studied patients were submitted to:

1. Thorough medical history taking.
2. Full general and local examinations.
3. Laboratory investigations:
   (a). Blood samples:
       - Complete blood count.
       - Liver function tests.
       - Kidney function tests.
       - Erythrocyte sedimentation rate.
       - Random blood sugar.
       - Coagulation profile (INR, PT, and PTT).
   (b). Microbiology: Sputum and abscess aspirate were taken and send for bacteriological examination as following [8]:

      I Z.N. stain was done for exclusion of tuberculosis.
      II Gram stain smear was done for diagnosis of gram positive and negative bacteria.
      III The specimens were cultured on blood agar and macConkey agar aerobically and were inoculated into thioglycated broth media anaerobically.
      IV The bacterial isolates were identified by conventional methods and by Matrix-assisted laser desorption Ionization-Time of flight mass spectrometry (maldi-TOF-MS).
      V Antibiotic culture and sensitivity were done to bacterial isolates by the disk diffusion method.

4. Chest X-ray postero-anterior and lateral views before, after intervention and follow up after one week and before discharge.
5. Contrast enhanced conventional computed tomography: for detecting the site, size of abscess and to exclude obstructing foreign body or endobronchial neoplasms and for detecting complications such as empyema with bronchopleural fistula.
6. Chest ultrasonography was done by (GE, Logic III, expert) machine:
   I Diagnostic chest ultrasound for both groups, to detect site, size of peripheral lung abscess and for follow up after one week and before discharge.
   II Interventional chest ultrasound for group II: for guidance during the procedure Technique.
a. A 3.5–7.5 MHZ convex or sector transducer was used, depending on site and size of the lesion [9].
b. Lung abscess was considered suitable for ultrasound guided aspiration if its diameter was \( \geq 4 \) cm [10] and in contact with chest wall for at least 1 cm [11]. In this study maximum transverse diameter of lung abscesses was 4–12 cm divided into two groups (\(< 8\)) and (\(\geq 8\)) cm [12].
c. The transducer was parallel to the rib space to ensure maximum contact to chest wall and allow easy passage of the needle through the rib cage [11].
d. The patient is sitting in a proper position to avoid spill-over of saline to other lung especially in cases of abscess with bronchial communication.
e. The chosen entry site was prepared and draped in a sterile fashion and 2% lidocaine was administrated for local anesthesia [13]. Fine needle aspiration was performed by using a 18–22 gauge needle [14].
f. Once the needle is in place, the abscess was evacuated (aspirates was sent for culture and sensitivity) gentle irrigation with 10 ml normal saline was performed twice till the retrieved fluid is clear [15] followed by single instillation of gentamycin 2 ml (80 mg) and Clindamycin 4 ml (600 mg) [16] completed with 4 ml saline during a single sitting.

7. Both groups were followed up after one week by CXR and chest ultrasound, then categorized according to Chaturbhuj lai Rajak [17] into:
   - Success group was considered if all of the following criteria were met:
     - The patients improved clinically (subsidence of fever and local signs and symptoms), elevated leukocytes counts were normalized, follow up imaging showed resolution of abscess or reduction in size, and no evidence of relapse or recurrence was seen during follow up.
   - Failure group was considered if all the following criteria were met:
     - The patients who did not improve clinically after the first aspiration and continued to have leucocytosis or showed refilling of the abscess cavity on follow up sonography were subjected to a second aspiration.

### Statistical analysis

Data were checked, entered and analyzed by using SPSS version 19. Data represented as number and percentage for categorical variables chi-squared (\(x^2\)) or Fisher's exact test were used when appropriate \(p < 0.05\) was considered statistically significant.

### Results

Table 1 shows that both group I and II were matched as regard age, sex, size and location of the abscess with statistically insignificant difference between both of them \((P > 0.05)\).

Table 2 shows a statistically significant difference \((p < 0.05)\) between both group I and II as regard duration of systemic antibiotic use, duration of hospital stay (days) and size of abscess after 1 week of intervention assessed by chest ultrasound and CXR.

Table 3 clarifies a significant efficacy of clindamycin–gentamycin instillation documented by aspirates culture and sensitivity which shows the presence of more gram negative and anaerobic bacterial infection in success group than in failure group.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Demographic data, site and size of abscess in all studied groups.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group I (no = 13)</td>
</tr>
<tr>
<td>Age</td>
<td>56.5 ± 9.3</td>
</tr>
<tr>
<td>Sex (male/female)</td>
<td>8/5</td>
</tr>
<tr>
<td>Size of abscess</td>
<td></td>
</tr>
<tr>
<td>(\geq 8) cm</td>
<td>7 (58.3%)</td>
</tr>
<tr>
<td>(&lt; 8) cm</td>
<td>6 (46.2%)</td>
</tr>
<tr>
<td>Location of abscess:</td>
<td></td>
</tr>
<tr>
<td>Rt upper lobe</td>
<td>5 (38.4%)</td>
</tr>
<tr>
<td>Left lower lobe</td>
<td>2 (15.4%)</td>
</tr>
<tr>
<td>Rt lower lobe</td>
<td>3 (23.3%)</td>
</tr>
<tr>
<td>Left upper lobe</td>
<td>2 (15.4%)</td>
</tr>
<tr>
<td>Rt middle lobe</td>
<td>1 (7.6%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Duration of systemic antibiotics, duration of hospital stay and resolution of the abscesses in all studied groups.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group I (no = 13)</td>
</tr>
<tr>
<td>Duration of systemic antibiotic (days)</td>
<td>31.1 ± 7.1</td>
</tr>
<tr>
<td>Duration of hospital stay (days)</td>
<td>32.5 ± 5.42</td>
</tr>
<tr>
<td>Size of abscess after 1 week of intervention</td>
<td></td>
</tr>
<tr>
<td>(\geq 8) cm</td>
<td>6 (46.2%)</td>
</tr>
<tr>
<td>(&lt; 8) cm</td>
<td>7 (53.8%)</td>
</tr>
<tr>
<td>Duration of radiological improvement</td>
<td>25.3 ± 16.14</td>
</tr>
</tbody>
</table>
Lung abscess are defined as localized suppurative necrotizing collection occurring within the pulmonary parenchyma. They have serious implications for the patient with risk of several complications, sequelae and death [18].

Image guided percutaneous drainage or aspiration of abscess and abnormal fluid collections have become the diagnostic and therapeutic treatment of choice. The procedures have resulted in reduced morbidity, mortality and have helped to reduce length of hospital stay and costs [19].

In the present study 26 patients were included, suffering from single peripheral pyogenic lung abscess. They are classified into two groups, group I (13 patients) received systemic empirical antibiotics which were remodulated after the result of culture and sensitivity of sputum and group II (13 patients) who underwent single percutaneous transthoracic aspiration and instillation of gentamycin–clindamycin under ultrasound guidance at first day of diagnosis. This was associated with taking systemic empirical antibiotics remodulated after the result of aspirates culture and sensitivity.

In this study there was no statistical significant difference between both groups regarding age and sex with \( p > 0.05 \), but in both groups males were more than females (8/5, 7/6), respectively and their ages are more or less in fifth decade of life. Luisa et al. [18] had explained that male predominance is due to high prevalence of alcoholism.

As regard site of the abscesses, they were more at right lung than left one with upper and lower lobes predominance with undetected statistical significant difference between both groups (\( p > 0.05 \)). Kelogrigris et al. [12] had explained this finding was due to primary lung abscess usually results from aspiration of anaerobic oropharyngeal bacteria into gravity dependent portions of the lung, most often the posterior segments of upper lobes and superior segments of the lower lobes.

In the present study, both groups were matched regarding size of the abscesses, where the maximum diameter was 4–8 cm in 11 patients and 8–12 cm in 15 patients.

Regarding duration of using systemic antibiotics, it was significantly prolonged in group I (15.3 ± 3.2) days than group II (11.3 ± 5.6) days with \( p < 0.05 \). This finding was attributed to the exposure of bacteria to a higher concentration of antibiotics (gentamycin–clindamycin) which were instilled inside the abscess cavity and consequently a lower duration of systemic antibiotics would be required and also, systemic antibiotics were modulated according to aspirates culture and sensitivity. This result is in accordance with that of Yang et al. [3] who described 10 patients (43%) whose antibiotic regimen was changed based on the results of percutaneous aspiration culture and sensitivity tests. Seven out of 10 (70%) patients improved within in 1–3 weeks with the new antibiotic coverage.

Regarding duration of hospitalization, this study revealed longer duration in group I (32.5 ± 5.42) days than group II (13.7 ± 2.31) days with statistical difference (\( p < 0.05 \)). This difference can be explained by the prolonged duration of systemic antibiotics in group I, moreover they were suffering from more complications which necessitate more hospital care. Pei-Chun Chan et al. [10] concluded from their study that, fatal cases had longer hospitalization and longer parenteral antibiotic therapy than survival cases (\( p = 0.023 \) and 0.016), respectively.

In the current study the maximum diameter of lung abscess in 7 cases (>8 cm) was decreased to be <8 cm after one week from aspiration and instillation of clindamycin and gentamycin, while in group I only one patient whose abscess decreased in size (<8 cm) with a detected statistical difference between both groups (\( p < 0.05 \)). This may be explained by Hoffer et al. [20] who stated that the resolution of the abscess was hastened by needle aspiration especially in large abscess (15 cc).

Regarding duration of radiological improvement, patients underwent percutaneous aspiration were reduced in size in 7.6 ± 5.26 days, faster than group I (25.3 ± 16.14) with a statistical difference (∼0.05). This marked difference could be explained by the effect of abscess aspiration and abscess instillation of clindamycin–gentamycin. This result is in

### Table 3

Complications occurring in all cases enrolled in this study.

<table>
<thead>
<tr>
<th>Complications</th>
<th>Group I (no = 13)%</th>
<th>Group II (no = 13)%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumothorax</td>
<td>0 (0.0)</td>
<td>1 (7.7%)</td>
</tr>
<tr>
<td>Empyema with bronchopleural fistula</td>
<td>3 (23.2%)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Chronic abscess</td>
<td>3 (23.2%)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Septicemia</td>
<td>2 (15.4%)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Incomplete aspiration</td>
<td>–</td>
<td>2 (15.4%)</td>
</tr>
</tbody>
</table>

### Table 4

Success and failure groups in all the studied patients.

<table>
<thead>
<tr>
<th>Success group</th>
<th>Failure group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I (no = 13)%</td>
<td>Group II (no = 13)%</td>
</tr>
<tr>
<td>Success</td>
<td>Failure</td>
</tr>
<tr>
<td>----------------</td>
<td>---------------</td>
</tr>
<tr>
<td>5 (38.4%)</td>
<td>8 (61.6%)</td>
</tr>
<tr>
<td>( P )-value</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

Table 4 shows a significant difference between both groups including complications of the abscesses and complications during aspiration.

Table 5 showed a statistical significant increase in success cases in group II than in group I (\( P < 0.05 \)), also there is a significant increase in failure cases in group I than in group II (\( P < 0.05 \)) (Fig. 1 and 2).

### Table 5

Culture and sensitivity of percutaneous aspirates from lung abscess among success and failure groups.

<table>
<thead>
<tr>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Success</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Failure</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
accordance with that of Jefferys. Klein [21] who reported that mean time for abscess resolution is 10–15 days after percutaneous lung abscess interference. In contrary to Kelogrigoris et al. [12] who recorded longer duration (4 weeks) for complete resolution of the abscess cavity in 33/40 patients, 3 patients needed extracatheter and resolved within 6 weeks. This prolonged duration may be attributed to the performance of percutaneous aspiration of the abscess without instillation of local antibiotics.

In the current study the incidence of complications among group I was higher than among group II (8 cases versus 3 cases) with a statistical difference ($p < 0.05$). Two cases in group II were suffering from incomplete aspiration because of thick pus and one case had got pneumothorax mostly due to needle puncture of normal lung parenchyma. While 8 cases in group I had got the following complications; empyema with bronchopleural fistula (3 cases), chronic abscess (3 cases) and septicemia (2 cases).

The same conclusion was reached by Mark J. Hogar [22] who stated that early intervention can improve symptoms, decrease the length of morbidity and reduce complications. Also, Michael et al. [19] stated that complications of percutaneous drainage reported to occur in 10% of cases.

Otherwise Yunus [23] reported that pneumothorax, hemothorax and hemoptysis are potential complications of percutaneous transthoracic drainage of lung abscess and reported six pneumothorax cases and one hemothorax case. While Luisa et al. [18] reported complications of lung abscess without intervention as follows; sepsis 5/45, empyema with bronchopleural fistula 2/45 cases, hemoptysis 1/45, and treatment failure 3/45 cases.

In the current study revealed success cases (according to clinical and radiological improvement) were statistically higher in group II (76.8%) than in group I (38.4%) with $p < 0.05$. This result could be explained according to the following reasons:

First: these patients were exposed to less invasive manoeuver with less rate of complications [17].
Second: the accuracy of the aspirates culture and sensitivity followed by receiving more proper systemic antibiotics [3].

Third: the higher sensitivity of the inside organisms (mainly gram negative bacteria and anaerobic micro-organisms) to percutaneous instillation of clindamycin–gentamycin [15].

Otherwise, failed patients in group II were represented (23.2%) in this study due to the inability of needle aspiration to completely evacuate the thick viscous pus that presented inside the abscess, with occurrence of one case suffering from iatrogenic pneumothorax. In consistent with the result of Van Sonnenberg et al. [15], who reported 84% success rate in 19 patients underwent percutaneous transthoracic intervention. Also Kelogrigoritis et al. [12] noted a successful percutaneous radiological drainage of 83%.

From this study the overall success rate of percutaneous transthoracic aspiration and lavage with clindamycin–gentamycin of peripheral lung abscess reached 76.8% in group II, with failure rate of 23.2% while failure rate of group I was 61.6%. This supports the efficacy and safety of percutaneous aspiration and instillation of clindamycin–gentamycin in the treatment of peripheral pyogenic lung abscess.

In this study the aspirates culture and sensitivity revealed more gram negative bacteria, anaerobes and mixed infection in the success group. This result was mostly due to marked improvement after instillation of clindamycin–gentamycin.

In consistent with the result of Jaime Ruiz-Tovar et al. [24] who reported from his study that an antibiotic lavage (clindamycin–gentamycin) is very effective and demonstrated that it impairs microbiologic growth and reduced the positive culture from 59% to 4% (after antibiotic lavage).

Also, Hoffer [20] performed single percutaneous aspirates to 10 patients nine of them responded and recovered completely, while the remaining patient required percutaneous drainage. They concluded that percutaneous aspirates culture and sensitivity were often diagnostic and informative and hence treatment plan could be modified accordingly. Moreover, Siraji wali [25] had concluded that interventional drainage can be diagnostic as well as therapeutic value in managing lung abscess.

Conclusion

We concluded from this study that:

1. Percutaneous aspiration of peripheral lung abscess has an accurate determination of the causative organisms inside the abscess.
2. The resolution of the abscesses clinically and radiologically was hastened by needle aspiration, lavage and instillation of clindamycin–gentamycin.
3. Early intervention can improve symptoms, decrease morbidity and complications.

References