Case Report

ANNALS OF MEDICINE & SURGERY

OPEN

Percutaneous management of complicated empyema thoracis using pigtail, report of a case from University Hospital of Nepal: a case report

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Introduction and importance: Empyema thoracis is a condition characterized by the accumulation of pus in the pleural cavity of the lungs. Empyema thoracis is a cause of high mortality in man and its occurrence is increasing in both children and adults. Traditionally, chest tube drainage has been a preferred method of treatment, but recent studies have shown that pigtail catheter drainage is a more effective and less invasive alternative. Image-guided drainage is also preferred over blind drainage, and alternative drainage sites are being explored. These management changes have improved patient outcomes and reduced the risk of complications.

Case presentation and clinical discussion: A 66-year-old female presented with complaints of cough, fever, and chest pain. A clinical examination was done and relevant investigations were sent. She was then treated in the line of left-sided empyema thoracis. A pigtail catheter was inserted into the loculated empyema via the left 9th intercostal space through a posterolateral approach with ultrasonography guidance.

Conclusion: The main aim of this article is to provide an overview of a rare management approach for empyema, a condition characterized by the accumulation of pus in the pleural cavity of the lungs. In this case report, the authors have focused on pigtail catheter drainage over traditionally performed chest tube drainage, and image-guided drainage has been performed over blind drainage ensuring accurate placement and reducing the risk of damage to surrounding tissues. Another notable change in empyema management is the shift in drainage sites from the safety triangle to other sites based on the site of loculations under ultrasonography guidance.

Keywords: British thoracic society (BTS), case report, empyema thoracis, image-guided drainage, parapneumonic effusion (PPE), pigtail

Introduction

Empyema is a complex infectious process characterized by frank pus accumulation in the pleural space between the lungs and chest wall[1]. It can result from various infections, including pneumonia, and is associated with significant morbidity and mortality. Several risk factors have been identified for empyema, including advanced age (>65 years), poor oral hygiene, aspiration-prone disorders (e.g. seizures, alcoholism, and central nervous system disease), intravenous drug misuse, diabetes, cardiovascular disease, liver cirrhosis, and other immunocompromised states such as HIV[2].

HIGHLIGHTS

- Treatment of empyema involves antimicrobials, pleural drainage via tube thoracostomy, video-assisted thoracoscopic surgery, or open thoracostomy and decortication.
- Pigtail catheter is a primary therapeutic option for empyema these days and the position of insertion need not to be safety triangle, instead, can be dictated by the site of the locule as determined by imaging.
- Imaging-guided chest tube placement is preferred over "blind" bedside insertion of the chest tube.

Community-acquired empyema is usually caused by aerobic Staphylococcus and Streptococcus species and Gram-negative bacteria like Escherichia coli, Hemophilus influenzae, and Klebsiella pneumoniae. On the other hand, hospital-acquired empyema is often caused by methicillin-resistant *Staphylococcus aureus* and Gram-negative bacteria such as Pseudomonas and Enterobacteriaceae[3].

The natural course of empyema can be divided into three stages: exudative, fibrino-purulent, and organizing phases. Clinical features of empyema include cough, fever, pleuritic chest pain, dyspnoea, and sputum production. Compared with those with pneumonia alone or pneumonia with simple parapneumonic effusion (PPE), patients with empyema may experience a longer course with several days of fever and malaise. Some patients may

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Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.

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Annals of Medicine & Surgery (2023) 85:4112–4117

Received 12 May 2023; Accepted 10 June 2023

Published online 20 June 2023

http://dx.doi.org/10.1097/MS9.0000000000001014

present with loss of appetite and weight loss over weeks to months, especially those with anaerobic infections[1].

Physical examination may reveal the presence of pleural fluid with dullness on percussion, decreased breath sounds, and decreased fremitus. However, imaging is necessary for diagnosis in most patients[1].

Treatment of empyema involves the eradication of the infection through antimicrobials and pleural drainage via tube thoracostomy, video-assisted thoracoscopic surgery, or open thoracostomy and decortication. Tube thoracostomy, the least invasive and most common non-surgical modality for empyema, involves chest tube placement under radiologic guidance. The ultimate goal of therapy is to remove the pus and promote the re-expansion of the lung[1].

This case report has been reported in line with the SCARE Criteria[4].

Case presentation

A 66-year-old female with complaints of cough for 10 days, fever for 7 days, and chest pain in the left hypochondrium for 7 days. The patient party gives no history of chronic illness like diabetes mellitus, hypertension, tuberculosis, no history of any previous surgical interventions in the past. There is no history of any drug intake in regular basis and no significant allergic history to drugs and any foreign bodies like dust, wool. Patient party gives no history of similar illness and no significant genetic and psychosocial history in other family members. Clinical examination revealed a respiratory rate of 28 bpm, pulse of 140 beats per min, systolic blood pressure of 160 mmHg, and diastolic blood pressure of 100 mmHg. Saturation at the time of presentation was 82% at room air. Later saturation was maintained at 96% at 5 l of oxygen via face mask. On auscultation, there was decreased air entry in the left infra-scapular region. For further evaluation following investigations were sent.

Investigations

Complete blood count showed leukocytosis (18 800/ microliter) with neutrophilia ($N = 87\%$). C-reactive protein raised to levels > 150 mg/l (Table 1). Chest X-ray showed increased radio-opacity over the left lower lung field with obliterated left costo-phrenic angle—likely left-sided pleural effusion (Fig. 1). Ultrasonography (USG) of the abdomen and pelvis showed left-

Table 1

Showing reports of blood parameters and diagnostic pleural tapping that was carried during the treatment process of the case

Blood parameters	Result	Flag	Reference range
Total WBC count	18 800	High	4000–11 000/ microlitre
Neutrophil	87	High	50–70%
CRP quantitative	> 150	High	< 10
	Diagnostic pleural tapping		
Sample	Pleural fluid		
Gram stain	Gram-positive cocci in groups, plenty of pus cells seen.		
acid fast bacillus stain	No acid-fast bacilli seen		

AFB, acid-fast bacilli; CRP, C-reactive protein; whole blood cells, whole blood count.

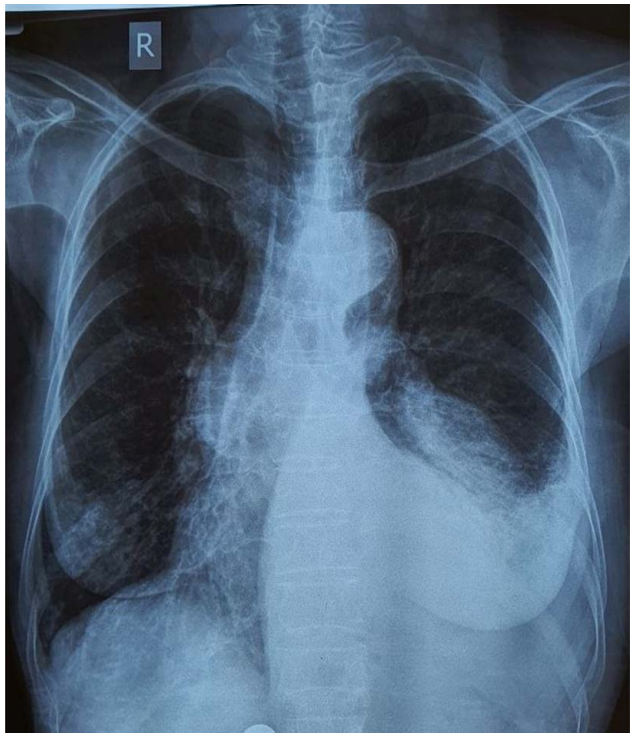

Figure 1. Chest X-ray posteroanterior view showing increased radio-opacity over left lower lung field with obliterated left costo-phrenic angle—likely left-sided pleural effusion.

Figure 2. USG abdomen and pelvis showing left-sided effusion with septations likely pleural empyema. USG, ultrasonography.

sided pleural effusion with likely pleural empyema (Fig. 2) and upon diagnostic pleural tapping there was leukocytosis with predominant neutrophils and few lymphocytes (total count = 64 000, N95 L5 E0 M0 B0) with no atypical cells. Gram staining of the pleural fluid showed Gram-positive cocci in groups with plenty of pus cells, with no acid-fast bacilli.

On further evaluation with contrast enhanced computed tomography Chest, 2 loculated collections (6 × 7 cm) were noted in the left lower part of the chest cavity with the larger one being posteriorly located and the smaller one being posterolateral with the presence of a connection between each other (Fig. 3). contrast enhanced computed tomography showed an estimated collection of about 380 ml.

Provisional diagnosis

Left-sided community-acquired pneumonia with empyema thoracis

Management

The patient was then admitted to the medicine ward with a diagnosis of left-sided community-acquired pneumonia with empyema thoracis.

Parenteral antibiotics ceftriaxone, Piptaz, and Paracetamol were initiated. Oral medications with tab azithromycin, tab pantoprazole, and tab losartan were also administered.

Percutaneous imaging-guided catheterization was planned for left-sided empyema thoracis. A pigtail catheter of 16Fr was inserted into the loculated empyema via the left 9th intercostal space through a posterolateral approach with USG guidance (Figs. 4–6). A drainage catheter was placed and connected to an underwater seal drainage system with the oscillatory movement of water columns.

Outcome and follow-up

After the successful insertion of a pigtail catheter for the treatment of empyema thoracis, the patient displayed good tolerance without experiencing any complications. Nearly 80 ml of pus-like fluid drained immediately after pigtail insertion with another 400 ml drainage in 24 h. Subsequently, the patient exhibited significant clinical improvement, with symptoms resolving within 48 h following the catheter insertion. As a result, the pigtail catheter was safely removed. A repeat chest X-ray was done which showed resolving empyema (Fig. 7) (Fig. 5). The dose of oral and parenteral drugs was completed and then the patient was discharged after the

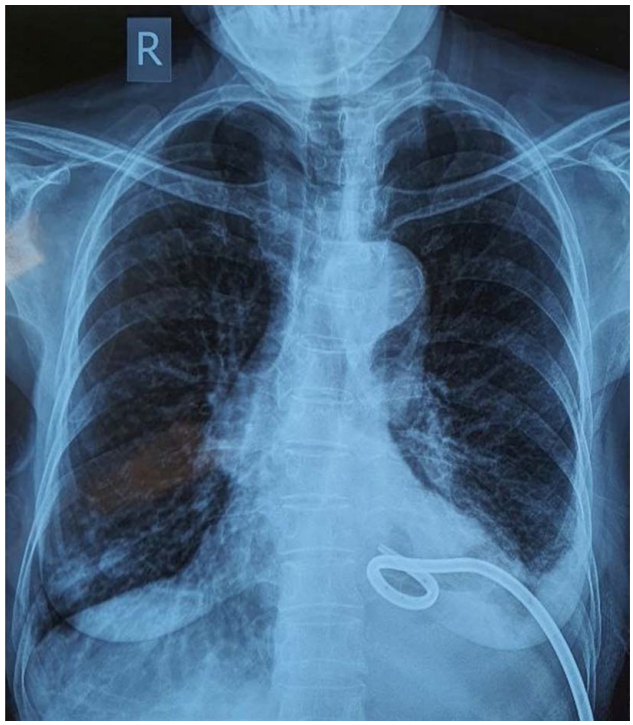

Figure 4. Chest X-ray posteroanterior view showing empyema under pigtail drainage.

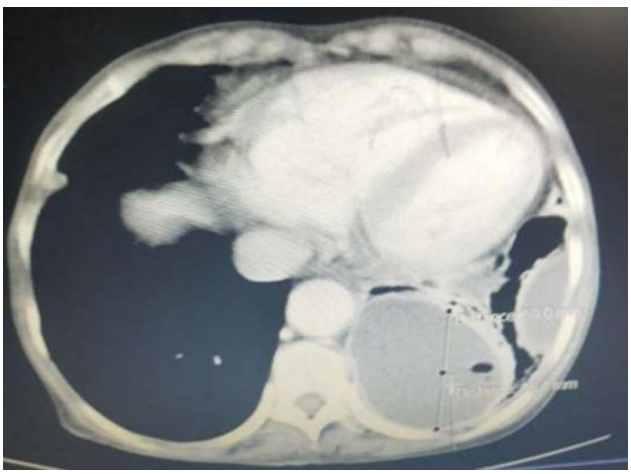

Figure 3. Contrast-enhanced chest CT revealing loculated fluid collections with variable sized locules largest measuring (6 × 7 cm) in the left chest cavity. CT, computed tomography.

Figure 5. contrast enhanced computed tomography chest showing pigtail catheter *in situ* for drainage of empyema thoracis.

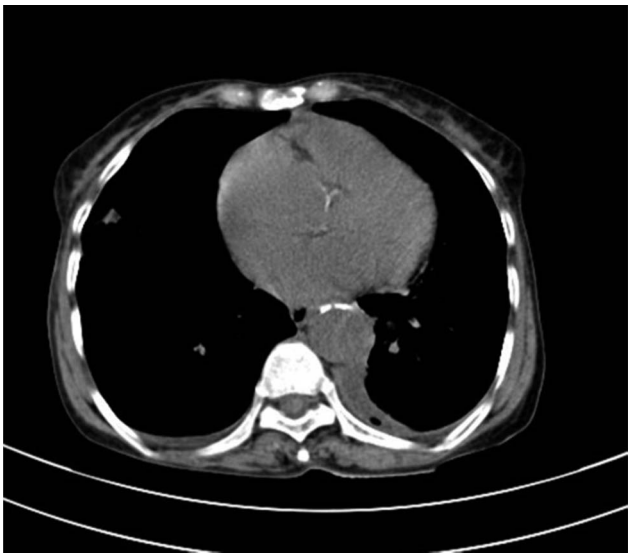

Figure 6. contrast enhanced computed tomography chest showing near total resolution of empyema with re-expansion of lungs.

complete resolution of the infection both clinically and radiologically (Fig. 8).

The patient was advised to schedule a follow-up appointment after 7 days. During the follow-up visit, the patient demonstrated continued improvement, indicating a positive response to the treatment.

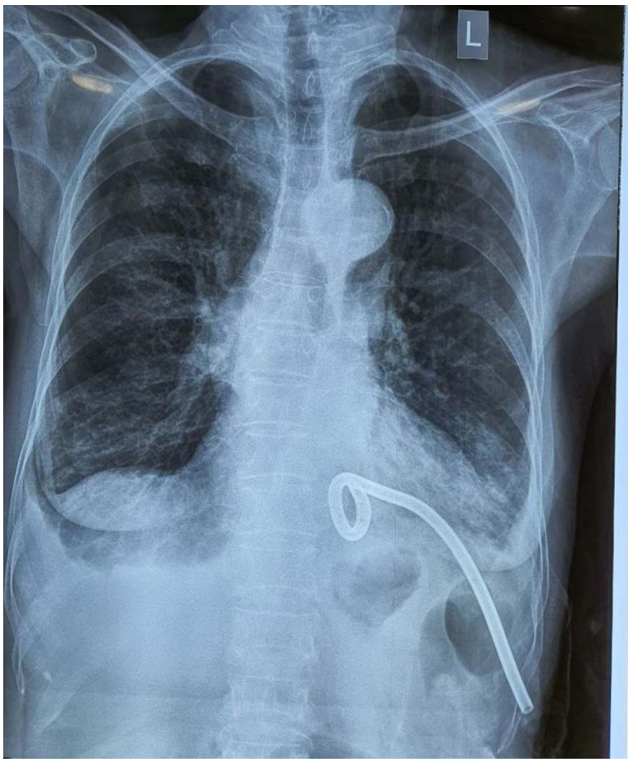

Figure 7. Serial Chest X-ray posteroanterior view day 2 showing empyema (resolving) under drainage with pigtail *in situ*.

Figure 8. Showing drainage site after removal of pigtail catheter that is left 9th intercostal space through a posterolateral approach.

Discussion

A chest radiograph showing pneumonia with significant pleural fluid; with evidence on ultrasound (US) of intrapleural loculations; with pyrexia (temperature $>38.0°C$) for more than 48 h despite appropriate parenteral antibiotics is a pragmatic definition of empyema[5].

Empyema progresses from exudative effusions to a fibrinopurulent phase characterized by loculated collections, thick peel, and areas of lung collapse. If earlier evacuation is not done the empyema can progress to the organized phase with the potential for trapped lung and long-term morbidity[6]. Empyema seems to be an uncommon complication of community-acquired pneumonia with an incidence of 0.7%[7]. Diagnosis of empyema is based on chest radiographs and thoracocentesis with a microbiological examination of the pleural fluid[8]. A diagnostic pleural fluid aspiration is essential if a pleural infection is suspected. If the pleural fluid characteristically has a pH of less than 7.2, glucose of less than 60 mg/dl, and lactate dehydrogenase of greater than 1000 IU/l d, it is highly suspicious of empyema[7]. Pleural fluid enhancement and increased attenuation of extrapleural subcostal fat on computed tomography (CT) chest have been associated with pleural infection and an absence of pleural thickening on CT are more suggestive of PPE than empyema[7].

For the management of pleural space infection in adults BTS guidelines have been published. BTS guidelines are centred around appropriate antibiotics use, early chest tube drainage for frank empyema and complicated PPE, consideration of intrapleural fibrinolysis, and prompt surgical referral if patients are not improving[5].

Antimicrobial therapy successfully resolves small, uniloculated pleural infections in 81% of patients with pleural fluid positive for Gram stains or cultures[9]. The British thoracic society (BTS) guidelines recommend a combination of cefuroxime and

metronidazole or co-amoxiclav for community-acquired empyema in adults and vancomycin plus meropenem for hospital-acquired cases (because of the high incidence of methicillin-resistant *Staphylococcus aureus*)[10].

Drainage should be carried out in all patients with exudative PPE with pleural fluid pH less than 7.2 and in those who have frank pus in the pleural space[11]. The drainage effects depend strongly on the virulence of the pathogens, which can also determine their subsequent therapies and prognosis. Most cases of complicated pneumococcal pneumonia present with a large amount of sticky pleural effusion and may need to be adequately drained or even surgically evacuated[12]. Most authors suggest that patients with empyema should initially be managed with large chest tubes and intrapleural thrombolytic therapy before attempting surgical evacuation[12]. Recently, the use of a pigtail catheter (flexible and small bore) by a seldinger technique has emerged as an effective alternative for thoracostomy and pleural drainage[12].

Intercostal tubes are the cornerstone for the management of pneumothorax and pleural effusion. A pigtail is beneficial for the drainage of non-viscid non-coagulable collections such as urine, pancreatic secretions, biliary secretions, or even air[13]. Study showed that the success rate of pigtail catheters in empyema was 72.2%[14]. It can be used as a primary therapeutic option for empyema.

The size of the pigtail catheters is generally small (~4 mm) in comparison to the intercostal space (around 9 mm). This will not impinge on neurovascular structures and will subsequently produce less pain. The flexibility of the catheter and the small scar size will additionally minimize the pain during and after the drainage procedure thus reducing ambulatory restrictions[13].

In contrast, chest tubes, with their excessive size increase the risk of injury to adjacent structures (such as arteries, veins, nerves, or lungs)[14]. Bleeding from intercostal arteries and pain due to impingement of neurovascular structures are more often encountered with large chest tubes than with pigtail catheters. Injury to the pleura may occur that results in open or tension pneumothorax[13].

However, Chest tubes being more rigid than pigtail catheters are associated with less liability to kinking or clogging. Additionally, the larger size available (up to 40 Fr) can drain thick fluids such as chylothorax or empyema, and hydrothorax with minimal obstruction[13]. In contrast Pigtail catheters are more likely to obstruct and get kinked, necessitating US-guided drainage.

Davies and colleagues described high overall complication rates (42%) with small-bore drains, but the majority of these were dislodgement (21%), blockage (9%), or pain (5%). However, the complications are less severe than one episode of possible lung laceration and a site infection in the large bore drain[15].

Some authors reported that there is no statistically significant difference between the initial use of a pigtail catheter and chest tube drainage of pleural empyema, particularly when there was no evidence of loculations[13].

Ideally, drains should be inserted in the triangle of safety, but direct US guidance identifies the optimal site for insertion, which may be outside the recognized safe area[16]. For loculated pleural collection the position of insertion can be dictated by the site of the locule as determined by imaging[15].

US has been proven to be a reliable, efficient, and informative imaging modality for the evaluation of pleural lesions. Chest US can be performed to locate the puncture site, and the USG pattern of the pleural effusion thus reducing complications and increasing the success rate[17,10]. Study showed that the success rate of US-guided pigtail catheter drainage of empyema was 42%[14].

In a study done in Taiwan, a low complication rate of 3% was found following pigtail catheter drainage which may have been due to ultrasonic guidance with well body position of the drain[17].

Another imaging modality of choice could be CT. US is better than CT at demonstrating septa. However, CT is preferred in complex pleural parenchymal disease as it is better at delineating the relationship between loculated pleural collections, parenchymal consolidation, and the mediastinum[15].

Evidence leads us to conclude that, wherever possible, site selection for all pleural aspiration should be US guided, which is even more important when aspirating small or loculated pleural effusions where there is a near or completely radio-opaque hemithorax[15].

As many patients with pleural infection have multi-septate pleural collections, imaging-guided chest tube placement often allows optimal placement of the drainage tube in the largest collections of infected material and is preferred over "blind" bedside insertion of the chest tub [10]. Overall, US prevented potential organ puncture in 10% of the procedures and increased the rate of accurate sites by 26%[15].

In our case, we managed loculated pleural effusion with US-guided pigtail thoracostomy outside the triangle of safety with successful drainage.

Conclusion

In conclusion, the management of empyema has evolved significantly in recent years, with the use of pigtail catheter drainage, image-guided drainage, and alternative drainage sites becoming more prevalent. These changes have improved patient outcomes and reduced the risk of complications, making them valuable additions to the physician's armamentarium in the fight against empyema. US-guided pigtail catheters provide a safe and effective method of draining various pleural diseases. We strongly suggest US-guided pigtail catheters be considered as the initial draining method for a variety of pleural diseases.

Ethical approval

This is a case report; therefore, it did not require ethical approval from the ethics committee.

Consent

Written informed consent was obtained from the patient for the publication of this case report and accompanying images. A copy of the written consent is available for review by the editor-in-chief of this journal on request.

Source of funding

The study did not receive any grant from public, commercial, or not-for-profit funding agencies.

Author contribution

All authors: writing the paper, reviewing and editing, and revising it critically for important intellectual content.

Conflicts of interest disclosure

The authors report no conflicts of interest.

Research registration unique identifying number (UIN)[18]

1. Name of the registry: Research Registry.
2. Unique identifying number or registration ID: research-registry9009.
3. Hyperlink to your specific registration (must be publicly accessible and will be checked): https://www.researchregistry.com/browse-the-registry#home/.

Guarantor

Binay Yadav.

Provenance and peer review

Not commissioned, externally peer-reviewed.

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