Radiographic Manifestations of Melioidosis: A Multi-organ Review

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Abstract

Melioidosis is a bacterial infection caused by gram negative bacilli called *Burkholderia pseudomallei*. Melioidosis usually affects people with underlying predisposing conditions, mostly diabetes mellitus. Clinical patterns vary from asymptomatic, localized abscess to septicemia with multiorgan involvement. Definite diagnosis is not made by imaging but radiologic examination can play an important role in raising the possibility of diagnosis. The most frequent radiographic finding is single or multiple abscess formation in almost all organs. The lung is the most common organ infected usually seen as diffuse small irregular nodules which can cavitate and progress to abscess formation or pulmonary consolidation with or without cavity. Visceral abdominal organ can also be involved. Hepatic and splenic melioidosis share the same radiographic findings seen as single or multiple abscesses formation, which vary in size from microabscesses to large multiloculated and multiseptated lesions. Musculoskeletal melioidosis is not common but can be depicted as septic arthritis, osteomyelitis, spinal infection and muscle or soft tissue infection with or without abscess formation. Neurological melioidosis is rare but the diagnosis is important due to high morbidity and mortality rate. Radiographic features include abscess formation, meningoencephalitis, brainstem encephalitis, transverse myelitis, paraspinal collection or infections of the neck region such as lymphadenitis, parotitis and sinonasal disease. Being aware of these radiographic manifestations in multiple organs can lead to more early diagnosis and appropriate treatment.

***Keywords*:** Melioidosis, Burkholderia pseudomallei, abscess, microabscess

1. Introduction

Melioidosis is an important infectious public health disease in Southeast Asia and Northern Australia. This bacterial infection is caused by gram negative bacilli called *Burkholderia pseudomallei* (White 2003). Melioidosis can affect all ages with peak incidence at 40-60 years. Males are more affected than female due to higher occupation risk exposure (Lim, Chong, 2009). The most common route of infection is by direct contact to logged water following the rain and wet soil in endemic areas such as rice paddies. Farmers easily get infected from spending most of the days in water and having minor cuts or abrasion during work (Alsaif, Venkatesh, 2016; White 2003). Meliodiosis usually affects people with underlying predisposing conditions, mostly diabetes mellitus. Other predispositions include chronic renal failure, hematological disorder, alcoholism, cirrhosis, connective tissue and other diseases with steroid or immunosuppressive drug treatment (Alsaif, Venkatesh, 2016; Chong, Fan, 1996; Lim, Chong, 2009).

Many organs can be infected. The most common site for melioidosis infection is the lung, followed by the spleen and liver. Other organs such as kidney, prostate, brain and musculoskeleton can also be involved. The clinical patterns vary from asymptomatic, localized abscess to septicemia with multiorgan involvement (Alsaif, Venkatesh, 2016; White 2003). Radiological findings are not specific and can mimic other infectious diseases. Diagnosis is by positive of direct smear or culture, serologic analysis by rising of indirect hemagglutination titers or a combination of both methods (Burivong et al. 2012; Muttarak et al. 2009; Palmer, Reeder, 2001). Definite diagnosis cannot be made by radiographic features alone. However, awareness of these radiographic manifestations in multi-organ can lead to more early diagnosis and appropriate treatment.

2. Radiographic thoracic melioidosis

The most common form of melioidosis is pulmonary involvement. Pleural and pericardial involvement is occasionally found (Burivong et al. 2012). Chest film is useful for diagnosis (Dhiensiri, Puapairoj, Susaengrat, 1988). CT scans of the chest can give more detailed information. Due to the wide range of clinical manifestations classified as acute septicemia, acute non-septicemia, subacute and chronic forms, correlation between radiographic findings and clinical assessment is important for imaging interpretation (Burivong et al. 2012; Dhiensiri, Puapairoj, Susaengrat, 1988; Muttarak et al. 2009).

In acute septicemia, hematogenous spread of melioidosis is the most common. Radiography shows diffuse and small irregular nodules which coalesce, cavitate and progress to abscess formation rapidly (Fig. 1). The second most common form is multilobar, segmental or non-segmental consolidation which also progress to cavities (Fig. 2A and 2B). The upper lobes are commonly affected (Alsaif, Venkatesh, 2016; Burivong et al. 2012; Chong, Fan, 1996; Lim, Chong, 2009; Muttarak et al. 2009).

Acute non-septicemic melioidosis usually presents as acute pneumonia. Radiography reveals alveolar infiltration and consolidation with or without cavity (Fig. 3). Small cavities often have thin walls with no air-fluid level while large cavities often have

thick walls with air-fluid level. Infection can start from the upper lobes, then spread to the lower lobes which are more commonly involved (Alsaif, Venkatesh, 2016; Burivong et al. 2012; Chong, Fan, 1996).

Subacute melioidosis can be seen as lobar or segmental alveolar infiltration or mixed infiltration and consolidation with or without cavity. Upper lobes are more predominant with single or multiple lobes involvement. Progression is slower than in the acute form (Alsaif, Venkatesh, 2016; Burivong et al. 2012; Lim, Chong, 2009; Muttarak et al. 2009).

Chronic melioidosis shows mixed infiltration with cavities and fibronodular lesions predominant at the upper lobes. The less fibrosis, apical sparing and no calcification after 3-6 months post treatment makes the difference from pulmonary tuberculosis (Alsaif, Venkatesh, 2016; Burivong et al. 2012; Dhiensiri, Puapairoj, Susaengrat, 1988; Reechaipichitkul 2004).

Other intrathoracic findings include isolated pleural effusion which is frequently found in subacute and chronic melioidosis rather than in the acute form. Rupture of a cavity into pleural space can lead to pneumothorax, pyo- or hydropneumothorax seen in subacute and chronic disease. Pericardial effusion is uncommon but could occur in acute, subacute and chronic disease (Fig. 4). Mediastinal and hilar lympha-denopathy are rare (Alsaif, Venkatesh, 2016; Burivong et al. 2012; Dhiensiri, Puapairoj, Susaengrat, 1988; Reechaipichitkul 2004).

3. Radiographic abdominal melioidosis

In visceral organ melioidosis, the spleen is more commonly involved than the liver. The acute form is usually a part of multiorgan involvement. Chronic forms perhaps are asymptomatic. Both splenic and hepatic melioidosis share the same radiographic finding usually seen as single or multiple abscess formation. Abscess size can vary from microabscesses to large multiloculated and multiseptate lesions. Imaging appearance can be categorized into two forms. The first appearance represents microabscesses, shown as multiple small hypoechoic lesions in ultrasound and small discrete hypodense lesions without septation in CT scan (Fig. 2C, Fig. 5 and Fig. 6B). Target sign or Bull's eye lesion which represents hyperechoic lesion with hypoechoic rim in ultrasound can be seen. The second form is described as honeycomb appearance which is found characteristic for hepatic melioidosis. Both ultrasound and CT imaging are described as large (more than 2 cm) single or multiple multiloculated and multiseptate lesions. Multiple peripheral radial loculations within the hypodense honeycomb lesion can be presented in an abscess size larger than 5 cm called the necklace sign (Alsaif, Venkatesh, 2016; Apisarnthanarak, Mundy, 2006; Lim, Chong, 2009; Muttarak et al. 2009; Reechaipichitkul 2004).

Pancreatic melioidosis can occur as a part of multiorgan involvement. CT scan is the preferred method of imaging. Radiographic findings show multifocal microabscess or focal large abscess formation, more involved at pancreatic body than in the head and tail. Other associated CT findings represent surrounding inflammation found as splenic vein thrombosis and peripancreatic fat stranding (Chong, Lim, Shari, 2010).

Prostatic melioidosis is an unusual manifestation and maybe under diagnosis. CT scan or transrectal ultrasound is used for imaging evaluation. Radiography shows ill-defined enlarged prostate gland with multiple small abscesses or a large abscess with multiloculations mainly found in the peripheral zone (Alsaif, Venkatesh, 2016; Lim, Chong, 2009).

Renal involvement is rare. Radiography shows abscess formation seen as bilateral, multiple ill-defined or well-defined hypodense lesions or rim enhancing fluid collections often associated with pyelonephritis or renal calculi (Alsaif, Venkatesh, 2016; White 2003).

4. Radiographic musculoskeletal melioidosis

Musculoskeletal melioidosis is not common and radiologic findings are non-specific. The joint is the most common musculoskeletal site infected, followed by the bone, muscle and soft tissue, respectively.

Joint infection or septic arthritis from melioidosis prefers a large weight-baring joint such as the knee, hip and ankle. Other sites such as the wrist, elbow, shoulder, sacroiliac joint, sternoclavicular joint and joints of hand and foot can also be involved. Radiography shows joint effusion with or without extraarticular extension. Ultrasound can detect joint effusion and periarticular abscess while CT scan is better for diagnosis of osseous erosions and periarticular abscess. MRI is the best modality to visualize synovial enhancement, periarticular osteomyelitis, muscle edema and microabscesses of the bone and muscle (Chong, Fan, 1996; Lim, Chong, 2009; Pattamapaspong, Muttarak, 2011).

Osteomyelitis usually occurs from adjacent soft tissue infection or via hematogenous spread. Metaphysis of the long bone and the vertebral bodies are the most involved sites. Plain radiograph and CT scans can demonstrate diffuse osteopenia or osteosclerosis with moth eaten, cystic or scalloping appearance which represents cortical and medullary osteolysis. Findings of periosteal reaction and sequestrations are uncommon. MRI reveals edematous change with microabscesses in the marrow and adjacent soft tissue (Lim, Chong, 2009; Muttarak et al. 2009).

Spinal infection involves both vertebral body and posterior elements. Radiography appears as bony destruction with varying degrees of vertebral collapse with or without extension to adjacent intervertebral disc. Multiple vertebral levels can be affected. MRI can detect epidural abscess, paravertebral abscess and spread of infection to the spinal cord (Pattama-paspong, Muttarak, 2011).

Muscle and soft tissue involvement occurs from the direct spread of melioidosis from adjacent skin and bone. Soft tissue melioidosis can present as cellulitis, necrotizing fasciitis, sinus tracks or abscess formation. Muscle infection usually involves multiple sites seen as muscle enlargement and edema with focal abscess in ultrasound, CT and MRI (Fig. 6C) (Alsaif, Venkatesh, 2016; Lim, Chong, 2009, Pattamapaspong, Muttarak, 2011).

5. Radiographic neurologic melioidosis

Neurological melioidosis is a rare condition previously described as neurological syndrome consisting of peripheral motor weakness, cranial nerve

palsies, headache and neck stiffness (Chadwick et al. 2002; Woods et al. 1992)

In spite of being present in only 4% of all melioidosis cases, neurological involvement is still important because of high mortality rate and survivors have significant morbidity (Chadwick et al. 2002).

Furthermore, neurologic melioidosis has different risk factors, comprising of younger age group (mean age = 38years), male predilection, and more likely to be Aboriginal (Currie et al. 2000).

The radiological features of neurological melioidosis can be negative findings or non-specific including abscess formation, meningoencephalitis, brainstem encephalitis, transverse myelitis, paraspinal collection, skull osteomyelitis, lympha-denitis, parotitis, and sinonasal disease (Alsaif, Venkatesh, 2016). However, the common imaging manifestations are rim-enhancing lesions and leptomeningeal enhancement (Fig. 7) (Deuble et al. 2013).

6. Conclusions

Melioidosis is an important public health bacterial infection, especially in Southeast Asia and Northern Australia. This infection has a wide variety of clinical manifestations and can affect many organs. The lung is most commonly infected followed by the spleen and liver. Musculoskeletal involvement is uncommon. Neurologic melioidosis is rare but the diagnosis is important. The most frequent finding is single or multiple abscess formation in almost all organs. Sizes of abscesses can vary from microabscesses to large multiloculated abscess formation. Imaging findings are not-specific and can mimic other bacterial infection. However, awareness of these radiographic manifestations in multiple organs can raise the possibility of diagnosis and lead to more early proper treatment.

Figures and Legends

Fig 1.

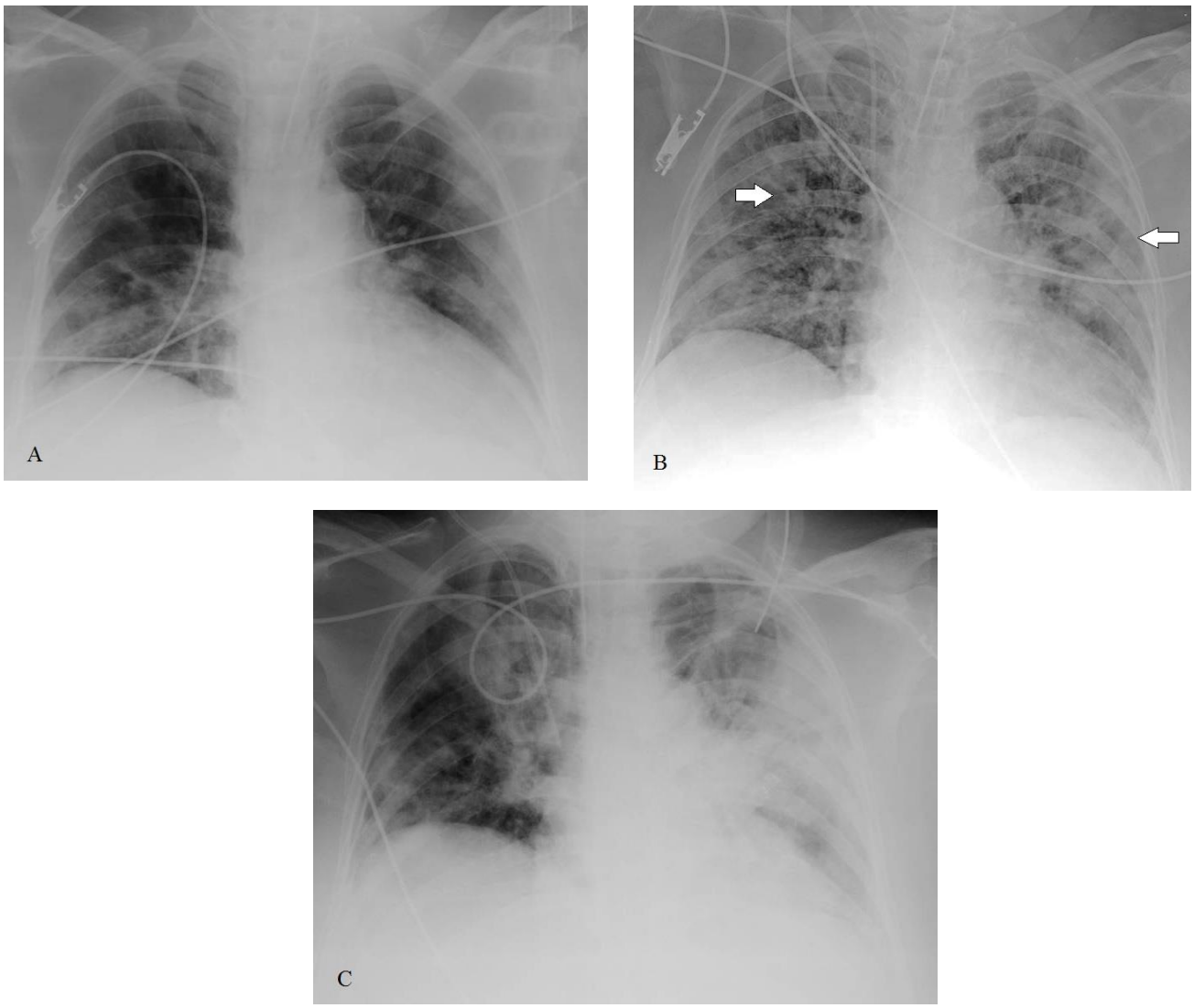

Figure 1. Acute septicemic pulmonary melioidosis in a 74-year-old woman with diabetes mellitus and gout who presented with acute febrile illness. **(A)** Her initial chest radiograph shows scattered small irregular nodules in both lungs. **(B)** Follow-up radiograph obtained 3 days later, small cavity formations are seen (arrows). **(C)** Follow-up radiograph performed 6 days later reveals conglomeration of these lesions into patchy pulmonary consolidation with cavities. Her blood culture was positive for *B. pseudomallei*.

Fig 2.

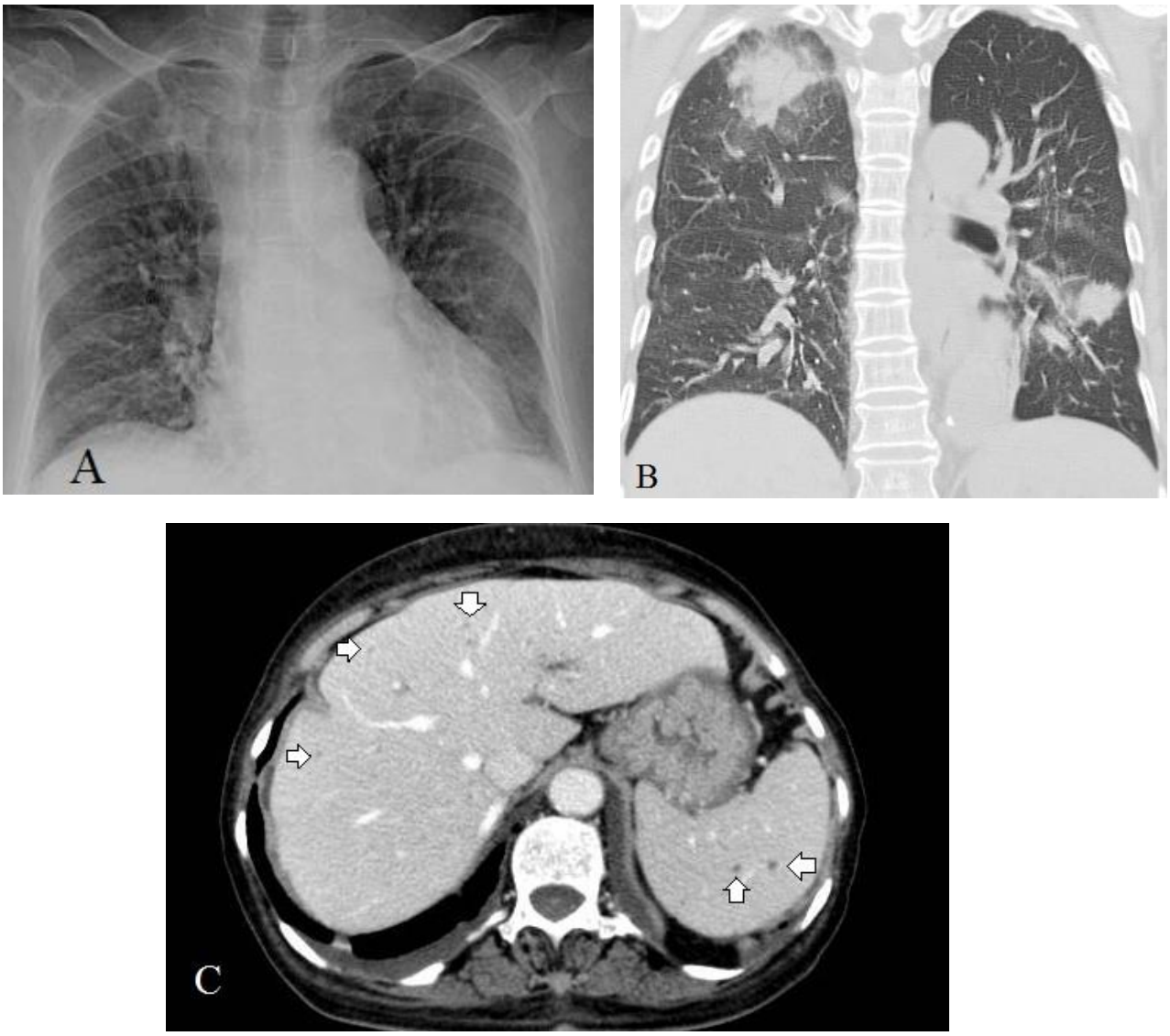

Figure 2. Multisystemic melioidosis in a 75-year-old woman with underlying myelodysplastic syndrome who presented with acute febrile illness. **(A)** Chest radiograph shows a mass-like lesion at the right upper lobe. **(B)** Coronal CT image obtained 2 days later reveals pulmonary consolidation in the right upper lobe and a smaller consolidation in the left lower lobe**. (C)** Contrast enhanced axial CT image reveals multiple tiny hypodense nodules scattered in the liver and spleen, suggestive of microabscesses**.** Blood culture was positive for *B. pseudomallei.*

Fig 3.

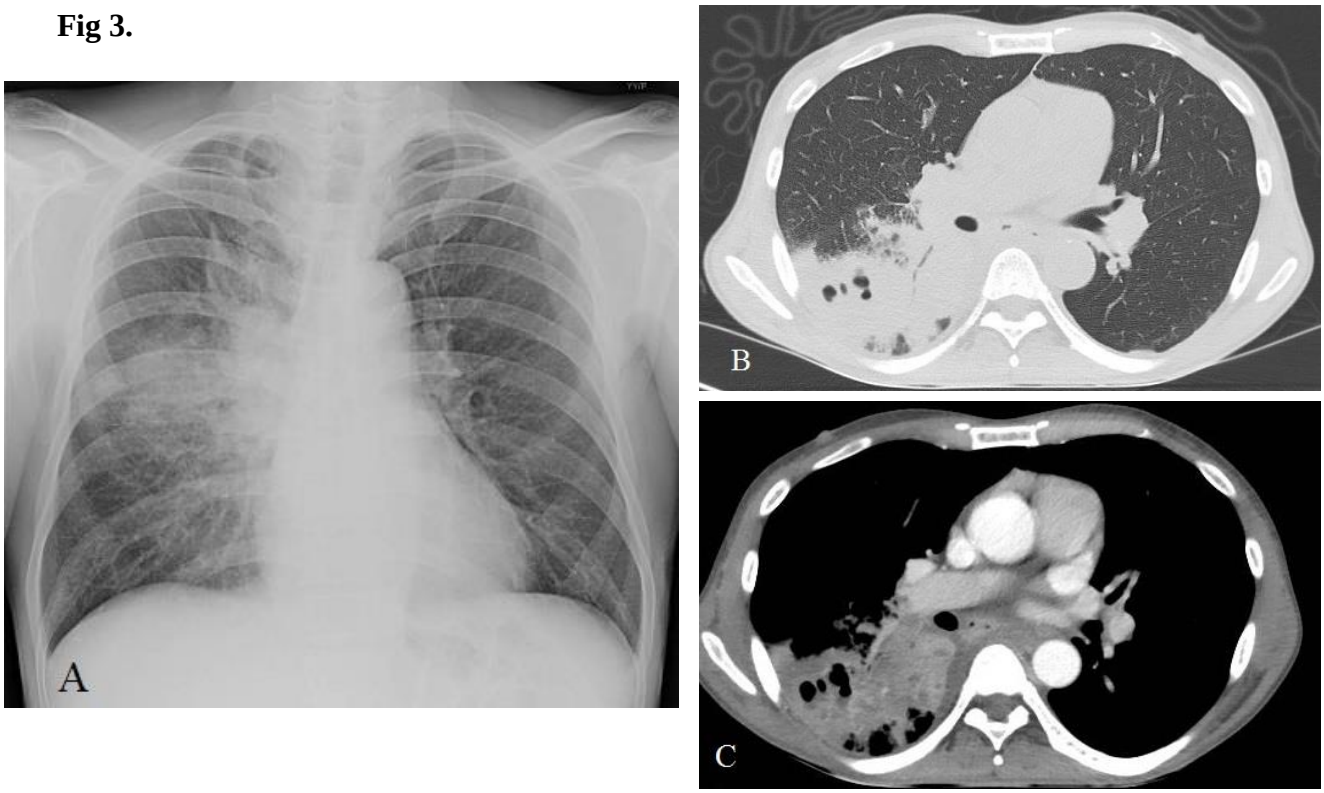

Figure 3. Acute non-septicemic pulmonary melioidosis in a 56-year-old man who presented with a 1-month history of fever and cough. **(A)** His initial chest radiograph shows alveolar infiltration and consolidation in the right lung. **(B) and (C)** Axial CT images obtained 3 days later show pulmonary consolidation with small cavities in the right lower lobe. Melioidosis was diagnosed from positive melioid titer of 1:2560 and positive sputum culture for *B. pseudomallei*.

Fig 4.

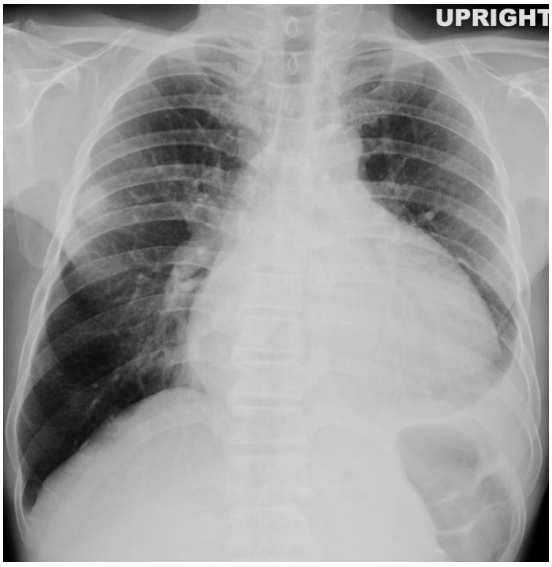

Figure 4. Pleural and pericardial melioidosis in a 61-year-old man who presented with prolonged fever for 2 months. Chest radiograph shows cardiomegaly with left pleural effusion and a well-defined nodular density at the right upper lobe. Pleural fluid and pericardial fluid cultures were positive for *B. pseudomellei*.

Fig 5.

Figure 5. Hepatosplenic melioidosis in a 66-year-old woman with underlying lymphoma admitted to the hospital with clinical manifestation of prolonged fever. **(A)** Ultrasound image reveals multiple small hypoechoic lesions without septation in both lobes of liver. **(B) and (C)** Contrast enhanced axial CT images shows multiple small rim-enhancing hypodense nodules scattered in the liver and spleen, suggestive of microabscesses. Ultrasound-guided needle aspiration of liver abscess was performed. The pus culture shows positive for *B. pseudomallei*.

Fig. 6

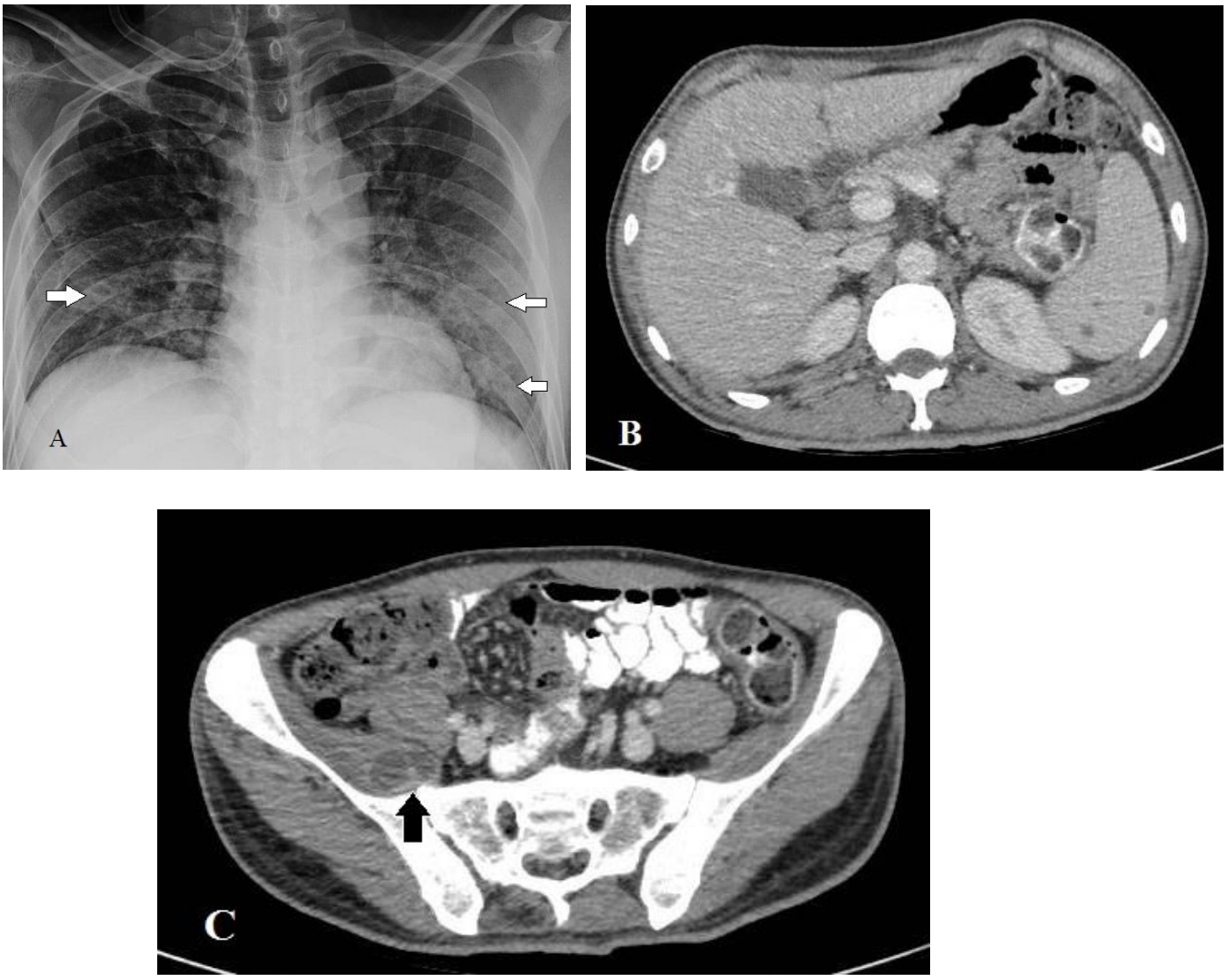

Figure 6. Multisystemic melioidosis in a 40-year-old man with underlying diabetes mellitus presented with prolonged fever for 2 weeks. **(A)** His chest radiograph shows patchy consolidation with cavitation in both lower lobes (white arrows). **(B)** Contrast enhanced axial CT image shows a few small hypodense nodules in the spleen, suggestive of abscess formation. **(C)** Contrast enhanced axial CT image shows a rim-enhancing hypodense lesion with internal septation at right iliacus muscle (black arrow), suggestive of intramuscular abscess. Melioidosis was diagnosed from positive melioid titer of 1:320 and positive blood culture for B. pseudomallei.

Fig. 7

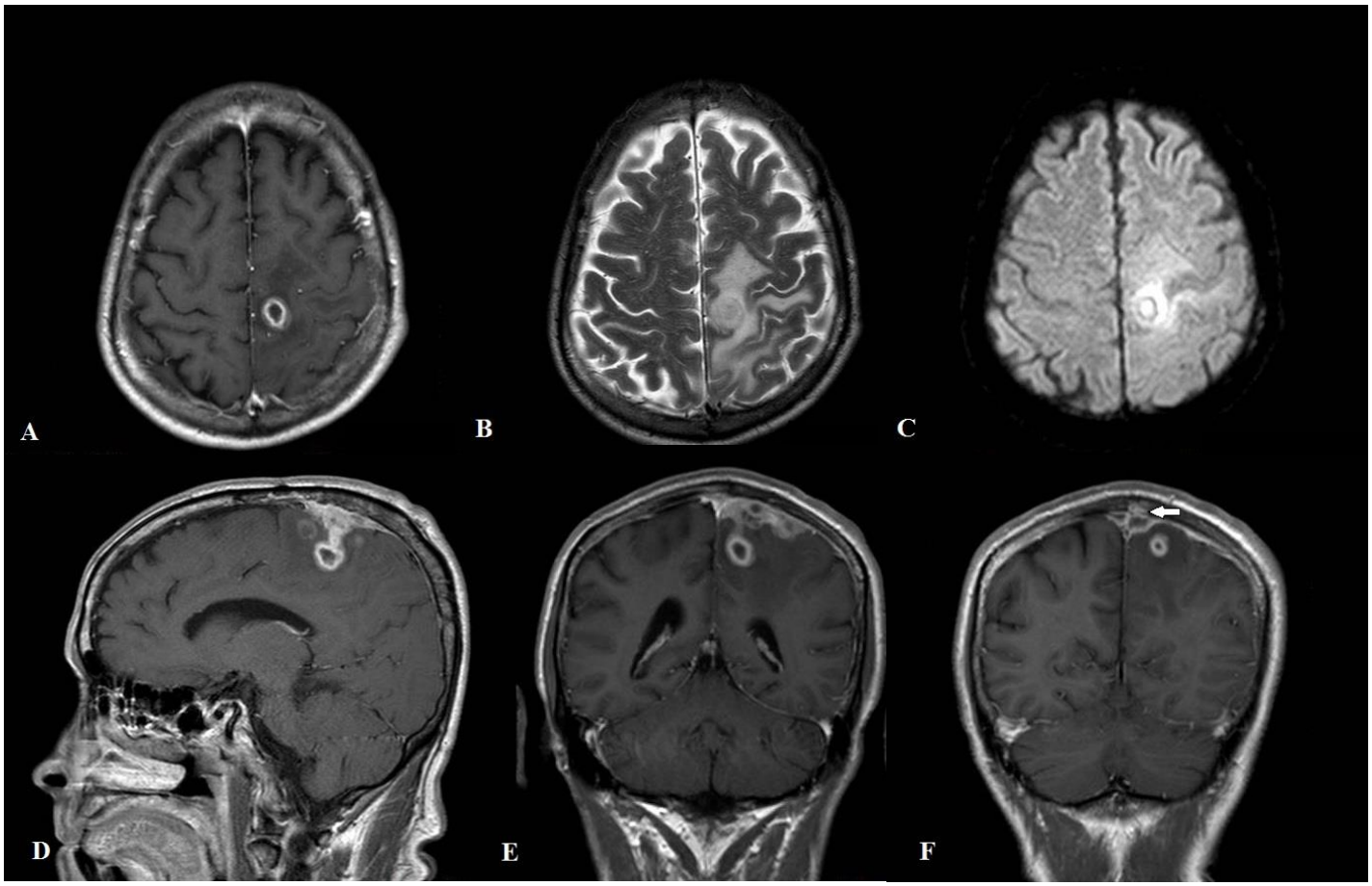

Figure 7. Neurological melioidosis in a 54-year-old man presented with right hemiparesis and focal seizure of the right leg. MRI brain with contrast was performed. **(A)** contrast-enhanced axial T1 weighted image, **(B)** axial T2 weighted image, **(C)** diffusion weighted image, **(D)** contrast-enhanced sagittal and **(E)** coronal images shows multiple rim-enhancing lesions in the left frontoparietal parenchyma and along adjacent cerebral convexity with perilesional vasogenic edema. These lesions are restricted on diffusion weighted image. The images revealed multiple intra- and extra-parenchymal abscesses with focal pachymeningitis of left frontoparietal area. **(F)** Contrast-enhanced T1 weighted coronal image demonstrates focal skull enhancement representing localized parietal osteomyelitis (white arrow). The patient underwent craniotomy with abscess removal. The diagnosis of neurological melioidosis was confirmed by tissue pathology.

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