

Post mortem computed tomography (PMCT) guided lung biopsy: A preliminary case report

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Abstract. Tuberculosis (TB) is a highly infectious disease on the rise caused by the organism *Mycobacterium tuberculosis* and health care workers working in emergency departments, medical wards and autopsy rooms are in danger of contacting this disease. We present a case of a 42 year old man found dead under a pedestrian bridge with no medical history available. Post mortem computed tomography showed multiple cavities involving upper lobes of both lungs and areas of consolidation in both lung fields raising the suspicion of pulmonary tuberculosis. This was followed by a computed tomography guided lung biopsy and a limited conventional autopsy done in situ in a special high risk autopsy suite with appropriate ventilation. This case highlights the importance of cross sectional imaging which can be coupled with image guided biopsy in cases of infectious disease to reduce the risk of transmission to health care workers.

INTRODUCTION

Forensic imaging allows non-invasive or minimally invasive detection of findings that may or may not be visible during conventional autopsy (Grabherr *et al.*, 2016). Thus, post-mortem cross-sectional imaging which includes the use of post mortem computed tomography (PMCT) is playing an increasing role as a diagnostic adjunct to conventional autopsy providing excellent anatomical detail, multi-planar reformatting as well as reducing the transmission of communicable disease (Aghayev *et al.*, 2007; Higginbotham-Jones & Ward, 2014; McLaughlin *et al.*, 2016; Rutty *et al.*, 2017; Usui *et al.*, 2012).

The use of PMCT as a routine investigation varies throughout the world whereby in some countries, all patients sent to forensic institutes will have a full body PMCT while in others, the use of PMCT will be restricted

to certain circumstances (McLaughlin *et al.*, 2016). In Malaysia, at the National Institute of Forensic Medicine (NIFM) Hospital Kuala Lumpur, there is a dedicated Computed Tomography (CT) machine to scan forensic cases sent to NIFM, whereby since 2010 all cases sent to the institute have a whole body CT scan prior to a conventional autopsy. The use of PMCT at the institute has been a valuable adjunct to conventional autopsy procedures as it allows the pathologist to plan aspects of the procedure in advance by identifying potential hazards, such as tuberculosis or sharp metallic objects.

We present a case which demonstrates the use of PMCT guided lung biopsy in a case diagnosed as pulmonary tuberculosis on PMCT. This case highlights the use of cross sectional imaging and PMCT guided biopsy aimed at reducing the risk of infection to health workers, in this case pathologists who were alerted to the diagnosis of tuberculosis

prior to autopsy and provided with an alternative method of obtaining tissue samples for confirmatory diagnosis.

CASE PRESENTATION

A 42 year-old male was found unresponsive by passers-by under a pedestrian bridge in Kuala Lumpur. He was declared dead by attending paramedics called to the scene and a police report was lodged. The deceased was then brought by the investigating police officer to NIFM, Hospital Kuala Lumpur for an autopsy to determine the cause of death. There was no next-of-kin or medical history made available to the Forensic Institute as he was a foreigner.

PMCT was performed on a 64-slice CT unit (Toshiba, Aquilion 64 CFX medical Systems Corporations, Tochigi, Japan) using the following parameters: 120 kVp, Auto set mAs (Caredose), FOV 500 (LL), 1.0 x 32 raw detector collimation, 0.844/standard pitch. Reconstructions were performed with a slice thickness of 2.0 mm and slice interval of 1.6 mm in soft tissue and lung window.

PMCT revealed multiple cavities involving both upper lobes and areas of consolidation in both lung fields raising the suspicion of pulmonary tuberculosis (Figure 1a). After a discussion between the

forensic pathologist and forensic radiologist at NIFM, it was decided that a PMCT guided lung biopsy would be performed to obtain lung tissue followed by a conventional limited autopsy in a special high risk autopsy suite with appropriate ventilation in order to reduce the risk of transmission of disease to the forensic pathologist and other health care workers (HCW) in attendance during the autopsy.

PMCT guided lung biopsy was performed using a 20-gauge automated cutting biopsy gun and needle used for core needle biopsy (Bard Magnum, Medicon). At least 3 passes each were made involving the cavitating lesions in both upper lobes (Figure 1b). Specimens collected were sent for TB culture and histopathological examination.

External examination revealed a medium built-male weighing 54kg and 168cm in height. There were several small abrasions seen at multiple areas on the body but no significant wounds. The internal examination was done *'in situ'* using basic personal protective equipment and revealed gross findings of pulmonary tuberculosis with caseous necrosis and cavities seen within upper lobes of both lungs upon cut section (Figure 2). Lung tissue samples were taken and sent for TB culture and histopathological examination. All other organs like the liver, spleen and kidneys although appeared

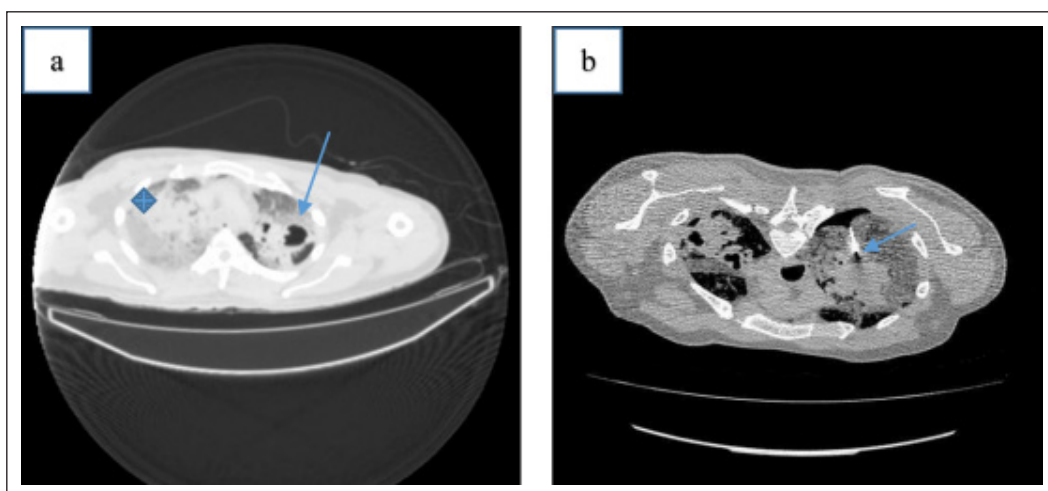


Figure 1a. Axial PMCT image of the lung showing left upper lobe cavity (blue arrow) with right upper lobe consolidation (◆), Figure 1b. Axial PMCT image of the lung showing the biopsy needle within the cavity involving the left upper lobe.

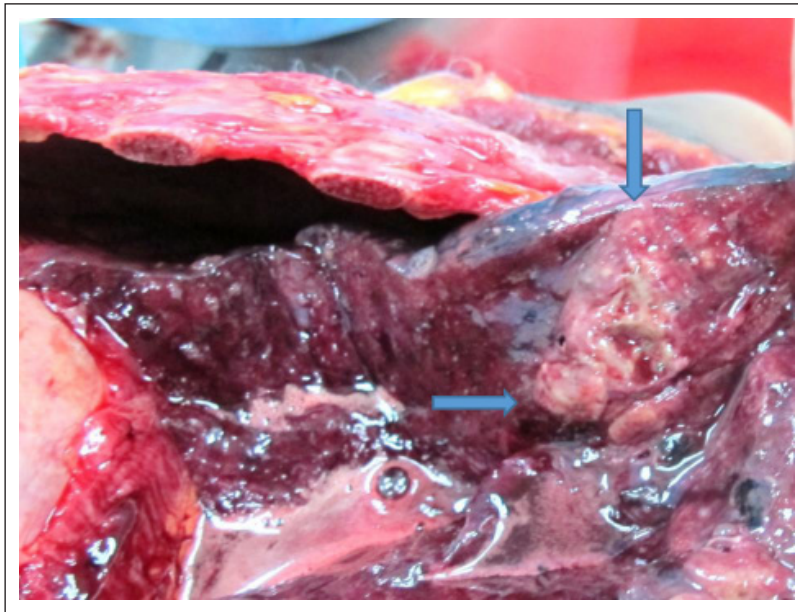


Figure 2. Limited conventional autopsy showing a cavity with caseous necrosis (blue arrows) of the lung upon cut section.

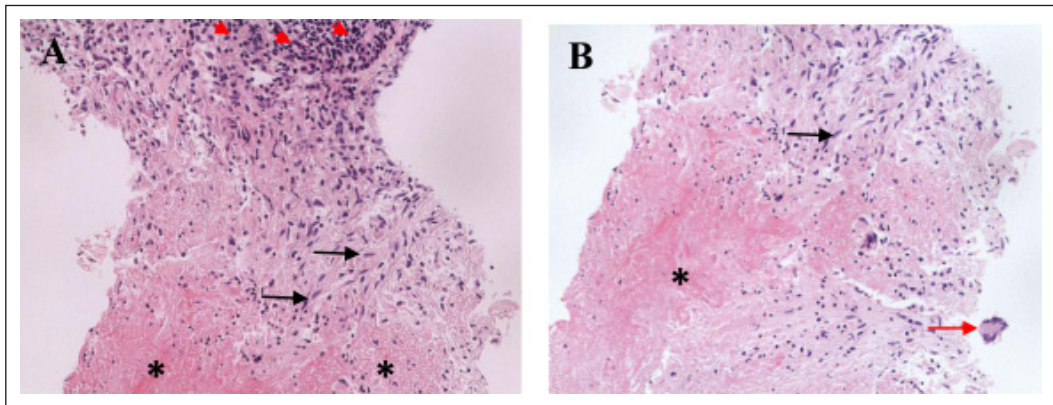


Figure 3 A&B. Sections from the lung biopsy shows a central caseation necrosis (*), with epithelioid cells in the periphery (black arrows) and lymphocytes (red arrowheads). A single multinucleated giant cell (red arrow) is seen in B.

normal were also sampled and sent for TB culture and histopathological examination.

PMCT guided lung biopsy tissue for TB culture came back positive for *Mycobacterium tuberculosis* although it was negative for acid fast bacilli (AFB) using immunofluorescent technique while histopathological examination showed granuloma, epithelioid cells and Langhans giant cell pathognomonic of tuberculosis

(Figure 3) and was also positive for AFB using Zahn Nielsen stain. The lung tissue for TB culture obtained during conventional autopsy showed positive results for *Mycobacterium tuberculosis* with positive results for AFB by immunofluorescent technique while the histopathological examination of lung tissue taken during the conventional autopsy revealed similar results to those from the PMCT guided lung biopsy.

DISCUSSION

Tuberculosis (TB) is a highly infectious disease caused by the organism *Mycobacterium tuberculosis* and although primarily a pulmonary pathogen, can cause disease in almost any part of the body. The World Health Organization (WHO) reported that worldwide, TB was one of the top 10 causes of death causing an estimated 1.3 million deaths among HIV-negative people with an additional 300 000 deaths from TB among HIV-positive cases in 2017 while in Malaysia itself the Ministry of Health reported an increase of about 14.7% in deaths due to TB in 2016 when compared to 2015 (Fong *et al.*, 2017; *Global Tuberculosis Report 2018*, 2018). TB which spreads through droplet infection especially when a patient coughs or sneezes can spread the disease to another individual. Thus, it has been documented that health care workers especially those working in the emergency department, medical wards and autopsy rooms are in danger of contacting the disease (Flavin *et al.*, 2006; Sharma D *et al.*, 2018; Templeton *et al.*, 1995).

This is where the use of imaging in the forensic world which is gaining popularity world- wide and being routinely used in some if not most forensic institutes plays an important role. As in this case the unexpected findings of active pulmonary tuberculosis, on PMCT, allowed the autopsy to be modified with tissue sampling done via PMCT guided technique followed by a conventional limited autopsy performed using personal protective equipment such as N95 masks in addition to 2 layers of latex gloves, disposable gowns and caps. The autopsy was also performed in a special high risk autopsy suite with appropriate ventilation and measures taken to reduce the number of medical personnel in the autopsy suite. Taking appropriate precautionary steps are important when dealing with TB as HCW and pathologists in autopsy rooms have an increased risk for tuberculosis especially in patients not suspected of the disease. In addition studies have shown that cutting an infected lung with a knife generates small particle aerosols

which increases the risk of infection due to TB (Templeton *et al.*, 1995).

However, it must be remembered that while CT and Magnetic Resonance Imaging (MRI) are suitable for visualizing macro-pathologies, they fail to provide tissue information on a cellular level. This can be overcome with the introduction of image-guided needle biopsy, a minimally invasive diagnostic technique that facilitates the fast and accurate collection of representative samples of organ tissue and body fluids delivering additional information to PMCT (Bolliger *et al.*, 2010; Martinez *et al.*, 2014; Ruddy *et al.*, 2017).

This case report shows that PMCT and PMCT guided lung biopsy can accurately collect representative samples of organ tissue as confirmed by the histopathology examination and culture report. This is extremely important in cases of infectious disease to reduce the risk of transmission of communicable disease or in cases where traditional dissection of the body is rejected by relatives.

CONCLUSION

This case report depicts the usefulness of cross sectional imaging coupled with PMCT guided biopsy in collection of representative samples of organ tissue. However as this is only a single case report, it is hoped that the successful result of this case will encourage more forensic pathologists and radiologists to consider this method when dealing with communicable disease or in cases where traditional dissection of the body is rejected by relatives.

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