Objective: To determine the rate of pneumothorax post CT-guided fine needle aspiration biopsy and the contributing factors.

Methods: This descriptive retrospective study was held at King Hussein Medical Center in the period between April 2012 and March 2014, and included 105 patients who were diagnosed to have lung nodules. All patients had a CT-guided fine needle aspiration biopsy for histological diagnosis. Operator, site and location of the nodule, emphysematous lung condition, and pneumothorax detection by CT-scan and chest X-ray were all reviewed.

Results: There were 83 males (79%) and 22 females (21%). Age ranged from 35 to 77 years (mean 62 ± 10.2). Right sided nodules constituted 50.3% of the studied sample, 79.1% of the nodules were located peripherally (83 patients) and 19% had associated emphysematous lung changes, 19 patients (18.1%) had post fine needle aspiration biopsy pneumothorax. Of those, seven patients (36.8%) were detected immediately on CT-scan table, eight patients (42.1%) were detected four hours later on chest X-ray, four patients were missed and 13 patients were treated with chest drain. Eleven patients (57.9%) out of the 19 who had pneumothorax had central lesions while eight (42.1%) had peripheral lesions and only six patients (31.5%) had emphysematous changes.

Conclusion: Pneumothorax post CT-guided fine needle aspiration biopsy is still a common complication in our center and there was no single factor contributing to it.

Key Words: Pneumothorax, CT-guided FNAB, Lung nodules,

Introduction
Lung cancer is still the most common cause of malignancy related deaths in Jordan[1] with most of the cases being discovered and diagnosed in relatively late stages. Screening and early detection of lung cancer can increase the incidence of early stage tumors and will offer better treatment options to patients. Diagnosing patients with lung
nodules is a multi step process that ends in pathology department were the definite histological diagnosis is made and confirmed. Many methods of obtaining histological diagnosis is present nowadays including Fiber Optic Bronchoscopy, CT-guided Fine Needle Aspiration Biopsy (FNAB), open and Video Assisted Thoracoscopic Surgery (VATS). CT-guided FNAB had proven its sensitivity and specificity in determining the histological diagnosis in lung nodules more than 7mm. Apart of post FNAB pneumothorax, it carries very low risk of complications as bleeding and infection. In this retrospective study we reviewed the data, CT-scans and X-rays of our patients in King Hussein Medical Center to evaluate the rate of pneumothorax and the contributing factors associated with it.

Methods
This retrospective descriptive study was held at King Hussein Medical Center, Thoracic and Pulmonology Divisions between the period starting April 2013 and ending March 2014. Approval from the ethical committee was obtained to carry out the study. It included 105 patients who were diagnosed to have lung nodule and/or nodules. All nodules more than 1cm were set to have CT-guided FNAB for histological diagnosis. All nodule/nodules regardless of site, size, location and lung condition were included. Patients less than 14 years were excluded from the study. Data were collected from the Radiological Department records, the Thoracic Division computerized data system and patients files. All CT scans and post FNAB chest X-rays were reviewed from the PACS system of the Radiology Department by thoracic surgery specialist and a radiologist.

CT-guided FNAB were done as an inpatient procedure. All patients had their Complete Blood Count (CBC) tested and had their bleeding profile (PT, PTT, INR) done at the same day of the procedure. All patient were kept fasting for four hours prior to procedure. The procedure was done in the radiology department using a Siemens CT scan. Two senior radiology consultants and two radiology specialists had done the procedure with no selection for patients per radiologist. Technique of CT-guided FNAB was standard for all patients and operators. An 18-gauge needle size (Fig. 1) was used for all patients. The procedure included positioning of the patient prone, supine or lateral according to lesion position so that there is a direct access to the nodule using CT scanning (Helical Siemens CT scan), a metal marker was used on the chest wall to determine site of needle insertion followed by needle marking on the chest wall and under CT scanning biopsy needle was inserted down to the nodule core under guidance followed by aspiration (Fig. 2). Patients were observed for pneumothorax at two stages; the immediate stage on CT-scan table while performing the biopsy and depended on the CT slices to show the presence or absence of pneumothorax, and it was done by the operating radiologist (Fig. 3). The late stage involved a standing chest X-ray four hours post the biopsy to check for pneumothorax, and it was read by the pulmonologist on call. All patients were monitored in the ward post biopsy for shortness of breath and respiratory distress.

All patients were given prophylactic dose of wide spectrum intravenous antibiotic half an hour prior to the procedure. Post procedure pain was managed according to pain scale and according to hospital protocol in pain management.

All patients with negative post FNAB chest X-ray for pneumothorax were cleared for discharge from the hospital on the same day and followed in the clinic as an outpatient bases. All patients with positive CT and/or Chest X-ray for pneumothorax were treated by thoracic surgeon on call in accordance with The British Thoracic Society (BTS) guidelines for treating Pneumothorax and follow up accordingly in The Surgical Ward. After discharge the patients were followed in the clinic one week later.

Continuous data are presented as mean ± standard deviation, categorical data are presented as frequency (percent).
Results

There were 83 males (79%) and 22 females (21%) who were included in this study. Their age ranged from 35 to 77 years and the mean age was 62±10.8 year. Fifty three patients had their nodules on right side (50.4%), where left sided nodules were found in 52 patients (49.5%). The right upper lobe was the most common site of nodules with 34 patients (32.3) (Table I). Almost two thirds of the nodules were peripheral and 19% of all patients had element of lung emphysema; focal lucencies (emphysematous spaces) which measure up to 1 cm in diameter and not bullous disease (Table II).

Four Radiologist were included in the study, two consultants (A, B) and two specialists (C, D). Majority of cases were done by A. Nineteen patients had pneumothorax post CT-guided FNAB (18%), of which 10 were right sided (52.6%) and nine were left sided (47.3%). Seven patients (36.8%) were detected on the immediate stage on the CT-scan table, eight patients (42.1%) were detected on follow up chest X-ray and four patients (21%) were not detected at time of the procedure and discovered during the follow up visit one week later in the clinic. Thirteen patients (86.6%) of the detected patients with pneumothorax were treated with chest drain at the day of the procedure.

Out of the 19 patients who developed pneumothorax, 11 patients (57.9%) had a centrally located nodule while eight patients (42.1%) had their nodule located peripherally. Out of 19, six patients had emphysematous changes (31.5%). The distribution of cases and post FNAB pneumothorax depending on the operator can be seen in Table III.
One patient had bleeding post chest drain insertion and needed exploratory thoracotomy to control bleeding (ligation of intercostal artery). There was no mortality associated with the procedure.

**Discussion**

CT-guided FNAB is a proven method in obtaining accurate histological diagnosis of lung nodules,\(^5\) in which a good and proven histological diagnosis is reached but although it is a safe procedure many complications can arise in the way. Beside from pneumothorax, hemoptysis, air embolism, bleeding, seeding of the track and death, have all been reported and encountered.\(^5\) Pneumothorax is the most common complication associated with the procedure,\(^6\) and it varies from simple pneumothorax that warrants only observation to a life threatening tension pneumothorax that needs urgent management and chest tube placement.

Rates of pneumothorax are variable from center to center, in our study the percentage of pneumothorax was 18%, it was almost equally distributed between right and left side. Pneumothorax rate reported in literature was to range from 8 – 61%, while 1.6 - 17% of patients needed chest drains.\(^7\),\(^8\) Serif et al. reported pneumothorax rate of 9.7% and 30% for 20 and 14 gauge respectively.\(^6\) Smith et al, reported over all incidence range from 8 - 64%.\(^7\) Chest drainage reported by Takuji et al. was 22 patients out of 24 required manual repetitive aspiration of pneumothorax and four patients required chest tubes,\(^8\) whereas in our study 13 patients out of 19 required drainage.

Multiple predisposing factors to predict the possibility for developing pneumothorax post CT-guided FNAB were studied, still none gave a definite clear cut cause relationship.\(^9\) Associated lung condition and diseases like emphysema and bullous disease of the lung were considered one of the leading factors. Intra-parenchymal lesions and deeply seated lesions were the lung parenchyma had to be trespassed to reach the lesion is also considered, the site of the lesion had no impact on the rate of pneumothorax. In our study neither the location of the nodule, nor the lung condition had a major effect on predicting post FNAB pneumothorax.

Human factor and experience played a role in choosing the more direct way to reach the lesion and so could have played a role in predisposing to pneumothorax as the amount of lung tissues that has to traversed by the needle and so the proportional increase of the possibility of developing lung tissue injury and pneumothorax.

The detection of the pneumothorax was the role of the radiologist in the immediate stage and the treating doctor (Pulmonologist or Thoracic Surgeon) in the late phase and follow ups. Missed pneumothorax were at the rim (less than 3% of lung space) and could inflict conservational treatment if detected at time of the procedure.

**Limitation of the Study**

The study sample was small to give major conclusions and guidelines, secondly it was a retrospective study and there were no national data or studies to compare with.

**Conclusion**

Pneumothorax post CT-guided fine needle aspiration is still a common complication in our center which had no definite single contributing factor to it, more studies should be conducted to clarify the contributing factors to reduce its incidence.

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**References**


