



Percutaneous CT guided lung biopsy in patients with pulmonary hypertension: Assessment of complications



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ABSTRACT

Purpose: To assess the complications of CT-guided percutaneous transthoracic needle aspiration and/or core biopsy (PTNAB) of lung nodules in patients with pulmonary arterial hypertension (PHTN).

Method and materials: We analyzed PTNAB of 74 lung lesions (mean size: 3.6 ± 2.1 cm) in 74 patients (M: F 38:36; age 68 ± 15 years) with documented PHTN on cardiac ultrasound. 39 patients with lung lesions (M: F 24:15; age 65 ± 14) who underwent PTNAB in the same period with right ventricle systolic pressure (RVSP) <35 mmHg were selected as controls. Pulmonary arterial pressures were estimated on cardiac ultrasounds by using the tricuspid regurgitation jet method. Two thoracic radiologists reviewed the medical records and PTNAB images on a PACS station and documented nodule size, location, distance traversed in lung, technical success and complications.

Results: Fine needle aspirates were obtained in all and core biopsy in 23% (17/74) of the nodules. 61% (45/74) of the nodules were in the middle and 39% (29/74) were in the outer third of lung. PHTN was mild, moderate and severe in 84% (62/74), 13% (10/74) and 3% (2/74) of the patients. Biopsy was complicated by hemorrhage in 26% (19/74), moderate hemoptysis in 1.3% (1/74), pneumothorax in 17% (12/74), chest tube in 1.3% (1/74) and hemothorax in 1.3% (1/74) of the patients. The complications rate in control group was similar, hemorrhage in 33% (19/39) ($p=0.6$), moderate hemoptysis in 5% (2/39) ($p=0.3$), pneumothorax in 28% (11/39) ($p=0.2$), chest tube in (0/39) ($p=0.3$), and hemothorax in 3% (1/39) of the patients ($p=0.7$).

Conclusion: Percutaneous needle biopsy of lung lesions in patients with mild to moderate PHTN can be performed without significant increase in complications.

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1. Introduction

The prevalence of pulmonary nodules on CT scans in the patients with a prior or current history of smoking has been reported to be up to 51% [1]. Although some imaging characteristics of pulmonary nodules are more indicative of malignancy, particularly their size [2], the optimal investigation and management of these nodules remain challenging. Tissue sampling with CT-guided percutaneous transthoracic needle aspiration and/or core biopsy (PTNAB) has become an established tool in the work-up of pulmonary nodules, with the reported accuracy, sensitivity and specificity ranging between 92 and 96%, 89–95% and 99–100%, respectively [3,4].

PTNAB has been demonstrated to prevent the need for diagnostic surgical procedures and decrease the number of diagnostic pulmonary resections for benign disease [5,6]. Several complications following PTNAB have been described in the literature, the commonest of which are pneumothorax and hemoptysis with the reported incidence of 23–27% and 5–9%, respectively [4–7]. The incidence of these complications depends on multiple factors including the technique used, the morphological characteristics of the lesion and the presence of patient's comorbidities [8]. The major contraindications are bleeding diathesis and anticoagulation therapy, while chronic obstructive pulmonary disease, bullous disease in the immediate proximity of the lesion and contralateral pneumonectomy are considered as relative contraindications [5,9,10]. Pulmonary hypertension (PHTN) has also been considered as relative contraindication [5,9,11], although it remains a subject of debate in the current literature.

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Pulmonary hypertension has been defined as mean pulmonary arterial pressure of 25 mmHg or higher at rest as measured by right cardiac catheterization (ESC-ERS). Pulmonary artery systolic pressure of ≥ 35 mmHg measured by cardiac echocardiography has also been suggested as an effective non-invasive tool for definition of PHTN, with reported close correlation with catheterization values [12–14]. It has been documented that PHTN is associated with higher rate of pulmonary hemorrhage [15] and higher risk of complications, morbidity and mortality following lung resection [16,17]. Studies regarding the safety of transbronchial lung biopsies in the setting of the pulmonary hypertension remain inconclusive [18–20], resulting in a wide range of mean pulmonary artery pressures considered unsafe for transbronchial lung biopsies among surveyed American College of Chest physicians [20]. Although PHTN is widely considered as relative contraindication, to our knowledge no recent studies have investigated the rate of complications of CT guided PTNAB of pulmonary nodules in patients with PHTN. The purpose of this study is to establish the complication rate of CT-guided PTNAB of lung nodules in patients with PHTN and to determine if it differs from the complication rate in patients without PHTN.

2. Materials and methods

This retrospective study was approved by the institutional review board and was compliant with the Health Insurance Portability and Accountability Act (HIPAA). The requirement for patient informed consent was waived.

2.1. Study group

Thoracic radiology database and a database of all radiology reports (Folio Views 4.2, Fien Group) were used to search for all patients who underwent PTNAB from January 2006 to December 2009. A total of 961 patients were identified, 732 (76%) of which were excluded because of lack of documented PA pressure measurement by cardiac ultrasound prior to PTNAB.

Patients who had their PA pressure measurements more than six months before the biopsy and those that underwent PTNAB of non-pulmonary lesions (ex.: chest wall, mediastinum, pleura) were further excluded from the study. 113 (12%) patients met all the inclusion criteria, and underwent CT-guided percutaneous transthoracic needle aspiration and/or core biopsy (PTNAB) of lung nodules and had documented pulmonary hypertension by cardiac ultrasound within six months of biopsy.

2.2. Demographics

Of the 113 patients, 74 (65%) patients had PHTN (Male: Female 38:36; age 68 ± 15 years), and 39 (35%) patients had normal pulmonary arterial pressure (Male: Female 24:15; age 65 ± 14 years).

2.3. Cardiac ultrasound and angiography details

Cardiac ultrasound and right heart angiography (if performed) reports were reviewed. Pulmonary arterial pressures were estimated on cardiac ultrasounds by using the tricuspid regurgitant jet method [21]. Right ventricular systolic pressure (RVSP) then can be estimated by adding the calculated transtricuspid pressure gradient to the right atrial pressure (estimated fixed value of 10 mmHg). In the absence of right ventricular outflow obstruction, RVSP can be considered equal to PA systolic pressure [21]. PA systolic pressure of ≥ 35 mmHg was considered diagnostic of pulmonary hypertension. In addition, RV morphological and functional data was abstracted from the ultrasound reports, including RV size

and RV wall motion. PHTN was graded as mild, moderate and severe (RVSP 35–50, >50 –70 and >70 mmHg; respectively).

Patients who underwent an additional right heart angiography before the biopsy and those who underwent the angiography after the biopsy had their reports reviewed, with specific attention to pulmonary arterial pressures. Mean PA pressure of >25 mmHg measured during right heart catheterization was considered diagnostic of pulmonary hypertension.

2.4. Biopsy technique

All patients had platelet count, prothrombin ratio and activated partial thromboplastin time within normal limits on the day of biopsy. Aspirin and Clopidogrel (Plavix, Bristol-Myers Squibb/Sanofi Pharmaceuticals) were stopped 7 days prior to PTNAB. IV-heparin, low molecular-weight heparin and warfarin (Coumadin, Bristol-Myers Squibb) were stopped 4–6 h, 12 h and at least 7 days before the procedure, respectively.

All biopsies were performed under CT guidance (Advantage, GE Healthcare) and by thoracic radiologists with expertise in performing lung biopsies, aspiration of pneumothorax and chest tube placement (range of experience between 5 and 20 years). Informed written signed consent was obtained before each procedure. In order to obtain the most optimal route for biopsy and minimize the number of pleural surfaces crossed by the biopsy needle, patients were placed in a prone, supine or lateral decubitus position depending on the location of the lesion. IV sedation with a combination of 25–200 μ g fentanyl citrate (Sublimaze, Taylor) and 1–2 mg midazolam hydrochloride (Versed, Roche) was administered to all patients and patients were breathing freely during the procedure with monitoring of vital signs.

All biopsies were performed with coaxial needle biopsy technique using 19-gauge introducer, 22-gauge (fine needle aspiration) and 20-gauge (core biopsy) needles. Multiple adjustments of the introducer needle were made before crossing pleura in order to ensure accurate needle placement. Great care was taken to puncture pleura only once during PTNAB.

Once in the lung, the introducer was advanced in small increments into the lesion, at which point fine needle aspirates were obtained with 22-gauge needle. If possible, core biopsy specimens were subsequently obtained with a 20-gauge needle. An on-site cytopathologist evaluated the obtained specimens for diagnostic adequacy. Once the biopsy needles were removed, patients were immediately rolled into a puncture-site-down position. As per our department protocol, patients remained in the observation area for 3 h with continuous monitoring of vital signs and under direct supervision of a nurse. Follow-up chest radiographs were obtained 1 h and 3 h after the end of procedure.

2.5. Analysis of biopsy images

Two experienced thoracic radiologists and a research fellow evaluated all cases in the PACS (Impax 4.1, Agfa HealthCare), and reviewed institutional medical records and relevant diagnostic, imaging and pathology reports. Radiological features of target lesions were abstracted, including size, morphology, location and distance of lung traversed by the needle.

Morphology of the lesion was characterized as groundglass, solid and mixed attenuation. Location of a lesion was determined after the lung was divided at thirds, with the outer third representing lung parenchyma closer to the pleura and the inner third parenchyma closer to the hilum. Distance of lung traversed represented distance from the pleura to the target lesion.

Technical success, number of core biopsies and diagnostic yield of the biopsy were also abstracted from the reports. Biopsy was characterized as technically successful if the biopsy needle reached

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