Percutaneous transthoracic lung biopsy (PTLB)
Percutaneous transthoracic lung biopsy (PTLB)

- Biopsy is important for identification and confirmation of lung cancer.
- Convenient approaches for accurate biopsy are extremely important to the diagnosis of lung cancer


Guiding techniques

• CT-guided biopsy

• CT fluoroscopy serves a real-time control of the procedure
Lung biopsy

Indications

• A new or enlarging nodule or mass not amenable to bronchoscopic biopsy.
• Nodules or masses that will likely require chemotherapy or radiation rather than surgery.
• Multiple nodules in a patient not known to have malignancy.
• Multiple nodules in a patient with known malignancy who has had prolonged remission.
• Multiple nodules in a patient who has more than one primary malignancy.
• Persistent focal infiltrates for which no diagnosis has been made based on other investigations.
• Hilar mass following negative bronchoscopy.
• Tissue for molecular testing (targeted therapy).
Relative contraindications to percutaneous lung biopsy

• uncooperative patients.
• severe respiratory compromise.
• pulmonary artery hypertension.
• severe interstitial lung disease.
• small lesions close to the diaphragm.
• central lesions adjacent to large vessels or bronchi.
Preprocedural Evaluation

- INR should be corrected if >1.5
- Transfusion should be performed for platelet counts <50,000/µL.
- Plavix should be held for 5 days prior to the procedure.
- Aspirin does not need to be held, but the last dose of low molecular weight heparin should be held prior to the procedure.

Patient Positioning

• Chosen based on the location of the lesion, size of the lesion, and the patient’s ability to tolerate positioning.
• The **prone** position is preferred because the posterior ribs move less than the anterior ribs, the posterior intercostal spaces are wider than the anterior intercostal spaces, and prone positioning prevents the patient from visualizing the needle during the procedure, which may decrease anxiety.
• The oblique and decubitus positions are less desirable because they are not as stable, but they can be utilized if necessary for lateral subpleural lesions.
CT guided Percutaneous transthoracic lung biopsy (PTLB)

• Biopsies plan is to avoid bullae and fissures
• Position to achieve minimizing the number of pleural surfaces crossed
• Avoiding crossing the aerated lung if possible.
Needle biopsy instrumentation
• Fine-needle aspiration. Aspiration is performed with a 10-mL syringe attached to an 18–25-gauge needle
• Cutting needle biopsy is usually performed with 18–20-gauge needles (automatic retrieval device)
• Coaxial biopsy technique employs a larger needle (18–21 gauge) that is guided through the pleura; a thinner needle (20–22 gauge) is then pushed through the guide needle to retrieve the tissue

Retrieval of material suitable for histological processing is an important consideration in the biopsy of tumours that may receive targeted therapy (i.e. telomerase, epidermal growth factor receptor, K-ras, somatostatin-receptor determination, etc)
FNA biopsy V Cutting needle biopsy

- FNA biopsy has a relatively high sensitivity of 82 to 99%, specificity of 86 to 100%, and accuracy of 64 to 97% for the diagnosis of malignancy.
- However, a definitive benign diagnosis can only be made in 20 to 50% of cases.
- Obtaining a core biopsy specimen increases the rate of a definite benign diagnosis from 52% to 91%.
- Although performing core biopsy improves the diagnostic yield of benign diagnosis, there is a slightly higher rate of complications such as pneumothorax and pulmonary hemorrhage.

Role of rapid on-site evaluation of CT-guided fine needle aspiration cytology of lung nodules.

- Access to a cytologist at the time of biopsy has been shown to improve diagnostic yield of fine needle biopsy.
- Cutting needles have been shown to increase diagnostic yield when compared with fine needle biopsies in the absence of a cytopathologist, specifically with respect to benign diagnoses.

Cytopathology. 2010 Aug 25. **Role and accuracy of rapid on-site evaluation of CT-guided fine needle aspiration cytology of lung nodules.**

Fassina A, Corradin M, Zardo D, Cappellesso R, Corbetti F, Fassan M
Lung biopsy

**Indications**

1. A new mass not amenable to bronchoscopic biopsy

*Bronchoalveolar carcinoma*
Lung biopsy

Indications

A new or enlarging nodule not amenable to bronchoscopic biopsy

adenocarcinoma
Lung biopsy

**Indications**

A new or enlarging nodule not amenable to bronchoscopic biopsy

pneumocytoma (so-called sclerosing hemangioma)
Lung biopsy

Indications

Multiple nodules in a patient with known malignancy who has had prolonged remission

Metastatic Carcinoma of the Ampulla of Vater
Lung biopsy

Indications

Persistent focal infiltrates for which no diagnosis has been made based on other investigations

suppurative pneumonitis
Lung biopsy

Indications

Hilar mass following negative bronchoscopy

Squamous cell carcinoma

EBUS-TBNA?
Comparison between endobronchial ultrasound-guided transbronchial biopsy and CT-guided transthoracic lung biopsy for the diagnosis of peripheral lung cancer: a systematic review and meta-analysis.

Zhan P1, Zhu QQ1, Miu YY1, Liu YF1, Wang XX1, Zhou ZJ1, Jin JJ1, Li Q1, Sasada S2, Izumo T3, Tu CY4, Cheng WC4, Evison M5, Lv TF1, Song Y1; written on behalf of the AME Lung Cancer Collaborative Group

Abstract

BACKGROUND:
With the release of the National Lung Screening Trial results, the detection of peripheral pulmonary lesions (PPLs) is likely to increase. Computed tomography (CT)-guided percutaneous transthoracic needle biopsy (PTNB) and radial probe endobronchial ultrasound (r-EBUS)-guided transbronchial lung biopsy (TBLB) are recommended for tissue diagnosis of PPLs.

METHODS:
A systematic review of published literature evaluating the accuracy of r-EBUS-TBLB and CT-PTNB for the diagnosis of PPLs was performed to determine point sensitivity and specificity, and to construct a summary receiver-operating characteristic curve.

RESULTS:
This review included 31 publications dealing with EBUS-TBLB and 14 publications dealing with CT-PTNB for the diagnosis of PPLs. EBUS-TBLB had point sensitivity of 0.69 (95% CI: 0.67-0.71) for the diagnosis of peripheral lung cancer (PLC), which was lower than the sensitivity of CT-PTNB (0.94, 95% CI: 0.94-0.95). However, the complication rates observed with EBUS-TBLB were lower than those reported for CT-PTNB.

CONCLUSIONS:
This meta-analysis showed that EBUS-TBLB is a safe and relatively accurate tool in the investigation of PLC. Although the yield remains lower than that of CT-PTNB, the procedural risks are lower.
CT Guided Transthorasic Lung biopsy

Complications

- pneumothorax
- pulmonary haemorrhage
- haemothorax
- tumour implantation
- air embolism
- subcutaneous and mediastinal emphysema
- empyema
- bronchopleural fistula.
Factors reported to increase the chances of producing pneumothorax

- Type of needle used—fine gauge (20–22 G) needles are less likely to cause this complication than larger (16–18 G) or cutting needles.
- Number of times the pleura is transgressed.
- Size and depth of the lesion
- Pre-existing lung disease, poor patient cooperation and operator inexperience.
CT Guided Transthorasic Lung biopsy

Complications pneumothorax (18% to 60%)
Sealing the biopsy tract, blood patch with autologous venous blood.
Place the patient in a position with the biopsy side down
Talking, moving, and coughing should be discouraged to minimize increases in intrathoracic pressure

Injection of Saline Into the Biopsy Tract and Rapid Patient Rollover Decreases Pneumothorax Size Following Computed Tomography-Guided Transthoracic Needle Biopsy.

Khorochkov E¹, Garvin GJ², Potoczny S², Kozak RI².

PURPOSE:
To determine if saline tract injection and rapid patient rollover following computed tomography (CT)-guided transthoracic needle biopsy (TTNB) affects pneumothorax incidence and size.

METHODS:
A retrospective cohort design was used to compare 278 patients who underwent post-biopsy saline injection and rapid rollover so that the biopsy site was dependent (N = 180) to a control group with routine post-biopsy care (N = 98). Post-procedure radiographs and CT were assessed for presence and size of pneumothorax, as well as requirement for chest tube placement.

RESULTS:
Pneumothorax size as estimated on post-procedure CT was 3.33% in the treatment group and 6.63% in the control group (P < .05). There was also a reduction in chest tube placements in the treatment group (3.9% vs 10%, P < .05). On post-procedure radiographs, pneumothorax rates were 20% in the treatment group, and 25% in the control group (P > .05).

CONCLUSION:
Saline injection with rapid patient rollover following TTNB significantly decreased pneumothorax size and chest tube placement but not incidence.
CT Guided Transthorasic Lung biopsy

Complications

pulmonary haemorrhage
CT Guided Transthorasic Lung biopsy

Complications
pulmonary haemorrhage

- PTNB-related hemoptysis is usually self-limiting, and amenable to conservative management.
- However, it may be fatal for elderly patients with certain comorbid conditions, such as congestive heart failure or pulmonary fibrosis.
- Prediction of hemoptysis before PTNBs is important for interventional radiologists as well as for clinicians and facilitates determination of the inclusion or exclusion of patients at risk.
- The rate of biopsy-related hemoptysis in PTNB ranged from 1.8% to 20.6%.

CT Guided Transthorasic Lung biopsy

*Complications*

pulmonary haemorrhage

- The small lesion may require more frequent needle re-direction during lesion targeting. Thus, the chance of bronchovascular injury is higher for small lesions.
- Longer distance from pleura to the target is a risk factor.
- Longer needle passage through pulmonary parenchyma

*Open Bronchus Sign on CT: A Risk Factor for Hemoptysis after Percutaneous Transthoracic Biopsy.*
Kim H, Park CM, Yoon SH, Hwang EJ, Lee JH, Ahn SY, Goo JM.
The presence of open-bronchus sign within target pulmonary lesions is a potential risk factor in PTNB-related hemoptysis in that internal open bronchi are directly connected to the central airways, and the hollow cylindrical structure of an open bronchus may not act as a tamponade against PTNB-related bleeding.

A majority of patients (69%) who manifested hemoptysis did not show open bronchus sign implying a multifactorial etiology of biopsy-related hemoptysis.

Asymptomatic systemic air embolism after CT-guided percutaneous transthoracic needle biopsy.

Jang H¹, Rho JY², Suh YJ³, Jeong YJ⁴.

Abstract

PURPOSE:
We presented details and incidence of systemic arterial embolism (SAE) following a CT-guided percutaneous transthoracic needle biopsy (PTNB) and evaluated risk factors for SAEs.

METHODS:
We retrospectively evaluated 1014 PTNBs performed in our hospital from 2005 to 2017. SAE was identified in the pulmonary vein, left heart, coronary artery, and aorta by reviewing post-biopsy CT images. Limited post-biopsy CT scans only covering the region biopsied were available until the first case of SAE was identified (n = 503). Then, the entire thorax was scanned for further examination of SAE (n = 511). Eighteen-gauge automatic cutting needles were used in all procedures. When SAE was evident on post-biopsy CT, subsequent brain CT was performed in order to confirm the cerebral SAE.

RESULTS:
Nine patients (0.89%) developed SAEs. In the univariate analyses, the location of the needle tip relative to the lesion (outside or inside of the lesion) as well as accompanying pulmonary hemorrhage were significant risk factors for SAEs (P = 0.021 and 0.036, respectively). Two patients developed neurological symptoms with cerebral SAEs, and one of these had sequelae. In seven asymptomatic SAEs with no cerebral SAE, four patients were retrospectively-diagnosed cases and three patients were detected on post-biopsy CT images. All seven of these patients had no sequelae.

CONCLUSION:
The incidence of SAE was higher than expected, due to radiologically detected asymptomatic SAEs. The location of the needle tip relative to the lesion and accompanying pulmonary hemorrhage were significant risk factors for the occurrence of SAEs. We proposed a guideline for treating asymptomatic SAEs.
CT Guided Transthorasic Lung biopsy safety

- Mortality rate 0.15% based on 5444 biopsies.

CT-Guided Transthoracic Needle Biopsy Efficacy

• In last 20 years, the overall sensitivity, specificity, and accuracy of CT-guided PTNB were 92.52±3.14%, 97.98±3.28%, and 92.28%±5.40%, respectively.

• The top two complications of CT-guided PTNB were pneumothorax (1111/4822:23.04%) and hemorrhage (287/3503:8.19%).

• Diagnostic accuracy and incidence of complications seemed to be decreased and increased, respectively, by smaller lesion size or longer needle path length (P<0.05).

CT-guided biopsy  V CT fluoroscopy

• Compared with conventional CT, CT fluoroscopy is faster and requires fewer needle passes, resulting in 27.1% shorter procedure times.
• CT fluoroscopy has also been associated with fewer complications compared with conventional CT, predominantly due to shorter procedure times and fewer needles passes.
• Heck et al showed a trend toward a lower pneumothorax rate in the CT-fluoroscopy group.
• The study by Kim et al showed a statistically significant decrease in pneumothorax rate from 27.1% to 11.1% when using CT fluoroscopy.
• However, CT fluoroscopy results in significantly increased radiation doses to both the patient and the radiologist, which may limit its widespread adoption.

ΥΠΕΡΗΧΟΓΡΑΦΙΚΑ ΚΑΘΟΔΗΓΟΥΜΕΝΗ ΒΙΟΨΙΑ ΠΝΕΥΜΟΝΟΣ:

Μία σύγχρονη μέθοδος προσέγγισης περιφερικών βλαβών του πνεύμονα και του υπεζωκότα

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ΕΝΔΕΙΞΕΙΣ US ΚΑΤΕΥΘΥΝΟΜΕΝΗΣ ΒΙΟΨΙΑΣ

Διαθωρακική υπερηχογραφία
- Το πιο γρήγορο μη επεμβατικό μέσο διαγνωστικής προσέγγισης του αναπνευστικού ασθενούς χωρίς επιπλοκές και ακτινοβολία
- Η χρήση της για την ασφαλή καθοδήγηση επεμβατικών τεχνικών στον πνεύμονα και τον υπεζωκότα αυξάνει συνεχώς

Η απεικόνιση σε πραγματικό χρόνο είναι ίσως το πιο σημαντικό πλεονέκτημα της διαθωρακικής υπερηχογραφίας. Οι υπό εξέταση ζώια ή μάζες και οι παρακείμενες δομές είναι άμεσα ορατές

Είναι δυνατό να ληφθεί υπό υπερηχογραφική καθοδήγηση βιοπτικό υλικό από:

- Υπεζωκοτικές βλάβες
- Ενδοπνευμονικές βλάβες σε επαφή με τον υπεζωκότα >3mm
- Ενδοπνευμονικές βλάβες χωρίς επαφή με τον υπεζωκότα, αν παρεμβάλλεται ατελεκτασία ή μεταποφρακτική πνευμονίτιδα
- Σε όλες τις ανωτέρω περιπτώσεις, απαραίτητη προϋπόθεση για να πραγματοποιηθεί η βιοψία είναι να είναι ορατές με τον υπέρηχο και προσβάσιμες με τη βελόνα βιοψίας
- Το ποσοστό των προσβάσιμων με διαθωρακικό υπέρηχο μαζών του θώρακα φτάνει το 40% των περιπτώσεων

Respiration 2014;87:441–451 DOI: 10.1159/000362930
http://radiology.rsna.org/content/210/3/721.full
http://www.medultrason.ro/assets/Magazines/Medultrason-2010-vol12-no1/14Rednic.pdf
Διαγνωστική ακρίβεια

- Σε ορατές υπερηχογραφικά βλάβες → 84-95%
- Η βελόνα λήψης κυτταρολογικού δείγματος (FNA) υπερέχει διαγνωστικά σε κακοήθεις βλάβες
- Η βελόνα λήψης ιστολογικού δείγματος (TCB) υπερέχει διαγνωστικά σε καλοήθεις / μη καρκινικές βλάβες

US guided vs CT guided biobsy βλαβών σε επαφή με τον υπεζωκότα

- Παρόμοια διαγνωστική ακρίβεια
  - Οι US καθοδηγούμενες βιοψίες είχαν μικρότερο κόστος
  - Οι US καθοδηγούμενες βιοψίες διήρκεσαν λιγότερο χρόνο
  - Οι US καθοδηγούμενες βιοψίες είχαν λιγότερες επιπλοκές
  - Οι CT καθοδηγούμενες βιοψίες εκθέτουν iatró και aσθενή σε ιοντίζουσα ακτινοβολία

ΕΠΙΠΛΟΚΕΣ

- Πνευμοθώρακας (0-60%). Διασωλήνωση του ημιθωρακίου απαιτείται στο 2-15%
- Πνευμονική αιμορραγία (5-17%)
- Αιμόπτυση (1,25-5%)
- Εμβολή από αέρα (άγνωστο ποσοστό)
- Αιμοθώρακας (πολύ σπάνια)
- Οι περισσότερες επιπλοκές συμβαίνουν κατά τη διάρκεια ή εντός μιας ώρας από την επέμβαση

Respiration 2014;87:441–451 DOI: 10.1159/000362930
Thorax 2003;58:920-936 doi:10.1136/thorax.58.11.920
Egyptian Journal of Chest Diseases and Tuberculosis (2014) 63, 113–118
ΥΛΙΚΑ/ΜΕΘΟΔΟΣ

• Η αξονική τομογραφία θώρακος χρησιμοποιείται συνήθως ως οδηγός για την ανεύρεση της ανατομικής θέσης της μάζας

• Χρήσιμα ανατομικά οδηγά σημεία για τον ακριβή εντοπισμό της είναι η ωμοπλάτη, η σπονδυλική στήλη, το στέρνο και τα ημιδιαφράγματα

• Η θέση της μάζας θα καθορίζει και την τοποθέτηση του ασθενούς κατά τη βιοψία. Συνηθέστερη και ασφαλέστερη θέση η πρηνής

• Σε κάθε περίπτωση και ιδιαίτερα σε μάζες <2 εκατοστά, είναι χρήσιμη η μελέτη της αξονικής θώρακος με τη συνεργασία έμπειρου στο θώρακα ακτινολόγου

• Αφού εντοπιστεί η μάζα, μετριέται η απόστασή της από το θωρακικό τοίχωμα, ώστε να γνωρίζουμε το βάθος διείσδυσης της βελόνας βιοψίας

• Στο σημείο εισόδου της βελόνας βιοψίας και πέριξ αυτού γίνεται τοπική αναισθησία με διάλυμα λιδοκαίνης ή ξυλοκαίνης 2%

• Εν συνεχεία η βελόνα βιοψίας προωθείται μέχρι το επιθυμητό βάθος και λαμβάνεται βιοπτικό υλικό. Η πορεία της βελόνας είναι συνηθέστατα ορατή τόσο κατά τη διάρκεια της προώθησης, όσο και κατά τη διάρκεια της απόσυρσής της

• Απαιτούνται τουλάχιστον δύο διαδοχικές βιοψίες για να έχουμε ανεξημένα ποσοστά επίτευξης διάγνωσης. Μπορεί να χρησιμοποιηθεί με βελόνα λήψης ιστολογικού ή κυτταρολογικού δείγματος

• 1-3 ώρες μετά την επέμβαση ζητείται ακτινογραφία θώρακος ώστε να αποκλειστεί η περίπτωση πνευμοθώρακα. Η πιθανότητα πνευμοθώρακα μπορεί να αποκλειστεί και υπερηχογραφικά

http://radiology.rsna.org/content/210/3/721.full
Respiration 2014;87:441–451 DOI: 10.1159/000362930
Χρησιμοποιήθηκε φορητός υπερηχοτομογράφος Logic Book XP της GE με κεφαλή convex 3C-RS συχνότητας 3,5-5MHz
Ημιαυτόματη βελόνα βιοψίας της εταιρίας Biomol, 18G, μήκους 100mm, βαθμονομημένη ανά 20mm
Η βελόνα προσαρμόστηκε στην κεφαλή του υπερήχου με τον ειδικό αντάπτορα της GE που δύναται να ασφαλίσει τη βελόνα σε 3 θέσεις, επιτρέποντας την προσέγγιση της υπό βιοψία βλάβης από 3 διαφορετικές γωνίες
Περιστατικό #1
Περιστατικό #2
Σας ευχαριστώ για την προσοχή σας