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Transthoracic Computed Tomography−Guided Lung Nodule Biopsy: Comparison of Core Needle and Fine Needle Aspiration Techniques

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Abstract

Purpose: To determine if there is a statistically significant difference in the computed tomography (CT)−guided trans-thoracic needle biopsy diagnostic rate, complication rate, and degree of pathologist confidence in diagnosis between core needle biopsy (CNB) and fine needle aspiration biopsy (FNAB).
Methods: A retrospective cohort design was used to compare the diagnostic biopsy rate, diagnostic confidence, and biopsy-related complications of pneumothorax, chest tube placement, pulmonary hemorrhage, hemoptysis, admission to hospital, and length of stay between 251 transthoracic needle biopsies obtained via CNB (126) or FNAB (125). Complication rates were assessed using imaging and clinical follow-up. Final diagnosis was confirmed via surgical pathology or clinical follow-up over a period of up to 10 years.
Results: CNB provided diagnostic samples in 91% and FNA in 80% of biopsies, which was statistically significant ($P < .05$). The sensitivities for CNB and FNAB were 89% (85 of 95) and 95% (84 of 88), respectively. The specificity of CNB was 100% (21 of 21) and for FNAB was 81% (2 of 11) with 2 false positives in the FNAB group.

The differences in complication rate was not statistically significant for pneumothorax (50% vs 46%; determined by routine postbiopsy CT), chest tube (2% vs 4%), hemoptysis (4% vs 6%), and pulmonary hemorrhage (38% vs 47%) between FNAB and CNB, respectively. Seven patients requiring chest tube were admitted to hospital, 2 in the FNAB cohort for an average of 2.5 days and 5 in the CNB cohort for an average of 4.6 days.
Conclusions: CNB provided more diagnostic samples with no statistical difference in complication rate.

Résumé

Objet : Déterminer s'il existe un écart statistiquement significatif entre la biopsie au trocart et la cytoponction (aspiration à l'aiguille) en ce qui a trait aux taux de diagnostic par biopsie transthoracique à l'aiguille guidée par tomodensitométrie (TDM), aux taux de complication et au degré de confiance diagnostique du pathologiste.
Méthodes : Un examen de cohorte rétrospectif a permis de comparer le taux de diagnostic, la confiance diagnostique et les complications (pneumothorax, insertion d'un drain thoracique, hémorragie pulmonaire, hémoptysie, admission et durée du séjour à l'hôpital) associés à 251 biopsies transthoraciques à l'aiguille, dont 126 biopsies au trocart et 125 cytoponctions. Les taux de complication ont été déterminés grâce au suivi en imagerie et au suivi clinique. Le diagnostic définitif a pour sa part été confirmé au moyen de résultats pathologiques chirurgicaux ou d'un suivi clinique pouvant s'échelonner sur 10 ans au plus.
Résultats : 91 % des échantillons prélevés par biopsie au trocart ont été utilisés à des fins diagnostiques, contre 80 % des échantillons prélevés par cytoponction (écart statistiquement significatif; $P < 0,05$). Le degré de sensibilité des biopsies au trocart a été établi à 89 % (85 sur 95), alors que celui des cytoponctions a été établi à 95 % (84 sur 88). Les biopsies au trocart ont affiché une spécificité de 100 % (21 sur 21) et les cytoponctions, une spécificité de 81 % (2 sur 11) avec deux résultats faussement positifs au sein du groupe.

En ce qui concerne les taux de complication, les écarts entre les cytoponctions et les biopsies au trocart ne se sont pas avérés significatifs sur le plan statistique au chapitre des pneumothorax (50 % contre 46 %; déterminés par la TDM postbiopsie d'usage), de l'insertion d'un drain thoracique (2 % contre 4 %), de l'hémoptysie (4 % contre 6 %) et de l'hémorragie pulmonaire (38 % contre 47 %). Enfin, des 7 patients

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qui ont été hospitalisés en raison de l'insertion d'un drain thoracique, 2 avaient subi une cytoponction et ont passé en moyenne 2,5 jours à l'hôpital, alors que 5 avaient subi une biopsie au trocart et ont passé en moyenne 4,6 jours à l'hôpital.
Conclusions : La biopsie au trocart prélève davantage d'échantillons diagnostics que la cytoponction. Toutefois, les deux interventions n'affichent aucun écart statistiquement significatif au chapitre des taux de complication.

Key Words: Core needle biopsy; Fine needle aspiration biopsy; Lung nodule; Transthoracic lung nodule biopsy

Computed tomography (CT)−guided percutaneous biopsy is commonly used to provide tissue diagnosis in indeterminate lung nodules and masses and is an essential element of the diagnostic algorithm [1]. Recent data from the National Lung Cancer Screening Trial showed a significant reduction in lung cancer mortality in high risk lung cancer subjects receiving screening low-dose chest CT examinations [2]. The results of this landmark randomized trial are expected to increase the demand for CT-guided percutaneous biopsy. The most commonly used CT-guided biopsy techniques are core needle (CN) and fine needle aspiration (FNA) biopsy. Despite numerous previous studies [3−11] debate remains around the optimal technique, with CN advocates focusing on the larger volume of tissue provided, while FNA advocates note the less traumatic aspect of a smaller needle gauge biopsy technique.

In addition to differences in the volume of tissue provided, there are substantial operational differences. At the majority of sites, FNA requires either a cytopathology technologist or cytopathologist presence in the CT scanner suite during the biopsy procedure to confirm an adequate tissue sample is obtained. Provision of this manpower is not possible in some institutions, and if not provided it has been documented that the rate of insufficient tissue may reach 20% [12]. In comparison, CN biopsy can be successfully performed in the absence of onsite pathology support since it only requires placing the sample in a labeled formalin container. However, it has been suggested that CN leads to increased complications including pneumothorax, hemorrhage, and hemoptysis compared to FNA [3,13]. Patient-specific factors have been associated with complications including lesion size, degree of emphysema and needle path length [14−16] suggesting the optimal technique may be patient specific. Finally, although previous studies have reported lower accuracy of FNA for both benign [1,4,8] and malignant [11] lesions compared to CN, a recent meta-analysis [9] did not show significant ($P < .05$) differences in diagnostic yield or complication rates. Thus, clinical equipoise exists at this time.

In 2004, due to retirement of the senior cytopathologist and operational restructuring, the preferred CT-guided biopsy technique changed from FNA to CN at our institution. This change provided an opportunity to compare the 2 techniques to an external gold standard consisting of surgical resection and/or a minimum of 6 years of clinical follow-up. We hypothesized that a larger volume of tissue from CN biopsy would lead to a decrease in the number of nondiagnostic samples, increase in pathologist diagnostic confidence, and no change in the rate of procedural complications.

Methods

CT-guided biopsies of 251 undiagnosed lung lesions were performed in 243 patients (126 male, 117 female) using a single 16-detector-row CT scanner without fluoroscopic capability (Siemens Healthcare, Forcheim, Germany). Biopsies were obtained by either a staff radiologist (J.R.M.) with 20 years of experience or a thoracic imaging fellow supervised by the same staff radiologist. This retrospective study was approved by the Institutional Review Board of the University of British Columbia (Vancouver, Canada).

We retrospectively reviewed 2 cohorts of biopsied lesions: 124 consecutive FNA biopsies (70 male, 54 female) between January 1, 2001, and July 31, 2003; 128 CN biopsies (60 male, 68 female) composed of 119 consecutive biopsies between July 1, 2006, and June 30, 2008; and 9 consecutive CN biopsies after unsuccessful FNA between January 2001 and July 31, 2003. Procedural informed consent was obtained from all patients prior to biopsy. All patients had normal coagulation parameters (prothrombin time, partial thromboplastin time, platelets, international normalized ratio) within 3 weeks prior to biopsy.

Pre biopsy imaging was reviewed prior to booking to evaluate for the presence and extent of emphysema, proximity of the lesion to central pulmonary vessels, needle path planning, and patient positioning. Patients with emphysema classified by visual estimation as either severe (50%-75% of lung volume) or very severe (>75% lung volume) received prebiopsy lung function testing. Biopsy was not attempted if the forced expiratory lung volume at 1 second (FEV 1.0) was less than 1 L, or if the patient was on home oxygen.

Immediately prior to FNA and CN biopsy, a planning CT was performed with the patient in the biopsy position to confirm feasibility of the planned needle path. The needle path was chosen to avoid crossing of interlobar fissures and large vascular structures. Once the needle path was confirmed, 3-7 mL of 1% Lidocaine (Alveda Pharma, Toronto, ON) was injected subcutaneously using CT guidance.

FNA biopsy was performed in the presence of a cytopathology technologist using a tandem needle approach with identical 10 or 15 cm long 22-gauge Westcott cutting needles (Cook Medical, Bloomington, IN). The initial needle was placed into the lesion and position confirmed using CT. The