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CT-guided percutaneous fine-needle aspiration biopsy of pulmonary nodules measuring 10 mm or less

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AIM: To determine the value of computed tomography (CT)-guided fine-needle aspiration biopsy (FNAB) of small pulmonary nodules measuring 10 mm or less.

MATERIAL AND METHODS: CT-guided FNABs of 55 nodules, measuring 10 mm or less, were performed between January 2003 and February 2006. A coaxial technique was used, with an outer 19 G Bard Truguide needle and inner 22 G disposable Greene biopsy needle. Adequacy of specimens was assessed on-site by a cytotechnologist. The sizes of the nodules, distance from pleura, number of pleural punctures and aspirates, complications encountered, cytological diagnosis, and outcome were recorded.

RESULTS: The mean nodule diameter was 9 mm (range 5–10 mm). The average distance from the costal pleura was 31 mm (range 0–88 mm). In 50 of the 55 FNABs, the pleura was crossed once. An average of four aspirates was performed per case. Twenty-five FNABs (45.5%) were adequate for diagnosis (24 malignant and one tuberculosis). In 11 cases, where no definite diagnosis was made following FNAB, the outcome was not affected. In 10 cases, samples were insufficient for diagnosis and the nodules were subsequently diagnosed as malignant. Eight cases were excluded in the final analysis as follow-up details were unavailable. The sensitivity for malignancy and overall accuracy were 67.7 and 78.8%, respectively. Pneumothorax occurred in 29 (52.7%) patients, with five (9.1%) requiring thoracostomy tubes.

CONCLUSION: CT-guided FNAB is a useful tool in the diagnosis and management of small pulmonary nodules, despite the lower diagnostic accuracy and higher complication rate than those of larger pulmonary lesions.

Introduction

Technical advances in computed tomography (CT) and the increasing use of CT in the clinical setting and in lung cancer screening programmes have resulted in the increased incidence of detection of small pulmonary nodules. The challenge for the radiologist is to distinguish malignant from benign lesions in order to facilitate earlier diagnosis and management. CT-guided percutaneous fine-needle aspiration biopsy (FNAB) is widely accepted as an accurate and safe procedure for characterizing pulmonary nodules.[1] Biopsy of lesions as small as 3 mm in diameter has been reported.[2] Diagnostic accuracy rates between 90 and 100% have been documented for pulmonary lesions above 10 mm.[2–6] However, several studies have reported decreased diagnostic accuracy for smaller lesions, in the range of 52–88%.[2,5–7]

Pneumothorax is the most frequently encountered complication with an incidence of 21–43%.[2,4–6] Higher rates of pneumothorax up to 65% have been reported for lesions 10 mm or smaller.[7,8] Treatment with thoracostomy tubes is occasionally required, varying from 4–35%.[3,7] Fatal complications from systemic air embolism and pulmonary haemorrhage have been reported, but are extremely rare.[9]

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The aim of this study was to determine the value of FNAB of small pulmonary nodules measuring 10 mm or less. The diagnostic accuracy, rates of pneumothorax, thoracostomy tube insertion, and impact on management are reported.

Materials and methods

Patients

This retrospective study was approved by the institution's Ethics Review Board. Between 30 January 2003 and 9 February 2006, 55 CT-guided FNAB of pulmonary nodules ($\leq$10 mm) were performed on 54 patients (biopsy of the same nodule in one patient was repeated). This number represented approximately 5% of the total number of FNABs performed at our institution during the same period. The biopsies were performed on an outpatient basis. The subgroup of patients analysed in this study included 28 men and 26 women, with a mean age of 63.3 years (age range 38—82 years). Informed consent was obtained from all patients before the procedure. Twenty-three patients (42%) had a known previous or concurrent malignancy. Two of the 23 patients had a diagnosis of two or more concurrent malignancies. The CT images at the time of biopsy were retrospectively reviewed (Y.L.N. and D.P.) at standard lung windows (width 1500 HU, level −600 HU).

CT-guided FNAB procedure

The FNABs were performed by six chest radiology fellows with indirect or direct supervision by staff chest radiologists. Patients were positioned either prone or supine depending on the location of the nodule. In most instances, the nodule was approached via the shortest intrapulmonary path. The exceptions were nodules adjacent to the visceral surface, to avoid large vascular structures or crossing fissures.

All FNABs were performed on a single or four-row multidetector CT (MDCT) machine (Asteion, Toshiba Medical Systems, Japan). Low-dose (120 kVp, 30 mA) CT images were obtained through the area of interest using a section thickness of 3—5 mm. Localization was determined by the CT gantry laser lights and grid on the skin.

The chosen cutaneous entry site was sterilized and draped. Approximately 10 ml of lidocaine solution (Xylocaine 10 mg/ml; Astra USA, Westborough, MA, USA) was administered subcutaneously for local anaesthesia. Intravenous conscious sedation (increments of 0.5—1 mg midazolam and 25—50 μg fentanyl as required while monitored by a radiology nurse and the operator) was administered in some patients. A coaxial technique was performed in all the cases, using a 19 G outer Bard Truguide coaxial needle (C.R. Bard, Inc., GA USA) and a 22 G inner disposable Greene biopsy needle (Cook Inc., IL, USA). The appropriate length of needles was chosen based on the depth of the lesion from the skin as measured by using the CT images. Core biopsies were not performed.

After needle insertion, CT images were obtained at 1.5 mm section thicknesses to check the position of the needle tip. After confirmation of adequate position of the needle tip, aspirates were obtained and submitted to an onsite cytology technologist. The decision to perform additional passes was based on adequacy of specimen assessed by the cytology technologist and on CT confirmation of the position of the needle tip.

After removal of the needle, a minimum dose CT of the thorax (120 kV, 10 mA, 8 mm section thickness) was performed to assess for pneumothorax. Patients were subsequently monitored by nurses in the Medical Imaging Department Day Unit. All patients had erect anteroposterior chest radiographs at 1 h after the FNAB. A second chest radiograph was performed 2 h after the FNAB on patients over the age of 70 years, with significant emphysema, who lived more than 30 min away or if there was a pneumothorax on the initial radiograph. Thoracostomy tubes were inserted in patients with moderate to large pneumothorax, enlarging pneumothorax on serial radiographs and patients who were symptomatic. The tubes (10.3 F All-Purpose Drain, Medi-tech/Boston Scientific, Watertown, MA, USA) were inserted in the second anterior intercostal space at the midclavicular line or the lateral fifth intercostal space at the anterior axillary line attached to a Heimlich valve (Becton Dickinson). Patients with thoracostomy tubes were observed overnight as inpatients.

The FNAB specimens transferred onto microscopy slides were read by a cytopathologist. Residual material in the fine needle and syringe were washed in sterile water to be centrifuged in order to produce cell blocks. Immunohistochemistry was performed at the discretion of the cytopathologist based on the cytology findings and was dependent on adequate specimen in the cell blocks.

We recorded the size of the sampled lesions, their distance from the pleura, the number of pleural punctures and fine-needle aspirates (FNAs), the complications encountered (pneumothorax and thoracostomy tube placement), the cytological diagnosis, and the outcome in all the cases.