The initial application of C-arm computed tomography guided percutaneous biopsy of lung lesions

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Purpose

Usually, the first step to assess a patient with a suspicious lung mass is bronchoscopy. Success rates of bronchoscopy for diagnosing malignancy range between 30-80% depending on the method of sampling. In the case of a nondiagnostic bronchoscopy, an image-guided percutaneous lung biopsy (PLB) is usually performed. Previously, CT is a good tool for mass puncture. Nowadays, C-arm Computed Tomography (CACT) needle guidance technology becomes a new method to perform this kind of procedure. It provides cross-sectional soft tissue imaging as well as real-time fluoroscopy for better procedure planning and monitoring.

The purpose of this study is to evaluate the accuracy of CACT needle guidance technology (syngo iGuide Needle Guidance, Siemens, Germany) in performing percutaneous biopsy of lung lesions.

Methods and Materials

110 patients (77 males and 33 females, median age 51.7 years, range from 5.0 to 88) with solid lung lesions (Fig.1) were enrolled. All of them were performed percutaneous biopsy under the guidance of syngo iGuide Needle Guidance from Sept. 2009 to May 2011. The average diameter of each lesion was 4.63 cm (ranged from 0.6 to 15 cm).

CACT (DynaCT, Siemens, Forchheim, Germany) imaging technique

DynaCT images of patients were acquired with an angiography flat detector C-arm (Artis zeego VC13; Siemens Healthcare, Forchheim, Germany) using the 8sDR program, the raw data was reconstructed on the workstation (syngo X Workplace, VB13; Siemens Healthcare, Forchheim, Germany).

iGuide Needle Guidance

Based on the reconstructed cross-sectional images, syngo iGuide Needle Guidance makes it possible to plan the insertion direction of a needle in the 3D volume and simultaneously display the needle path on the Live monitor of Artis. Three major steps are define path, check path and progress needle. Firstly, the needle path was planned by defining an entry point and a target point and the cross-sectional images (Fig.2-a). Secondly, the path was check by three system positions: one bull’s eye view and two progression views (Fig.3). At last, the needle was progressed with the guidance of the needle path overlayed on the fluoroscopy image. After the needle was in the target, a DynaCT was re-performed for check-up (Fig.2-b).
Images for this section:

Fig. 2: 2-a: DynaCT image with graphics shows planned needle path (yellow line) into lesion. The yellow cross indicates skin entry site, which on 90° tangent (progression view) appears as a line. Red point is actually indicating target site, which on 90° tangent (progression view) appears as a line. 3-D simulation maps showed the relation between the needle and lesion, The iGuide system provided angle, direction, and depth automatically. 2-b: Rescan DynaCT again to confirm the position which used the data acquired with a flat panel detector C-arm angiography system to reconstruct cross-sectional, CT-like images.

Fig. 3: Fluoroscopic images after placement of needle into phantom along graphics of planned path. Purple circle enhances visualization of skin entry site (purple dot) A. A-C, Entry point view(A), Progression view(B), and random C-arm position(C) are shown.
Fig. 1: A solitary pulmonary nodule (1.9cm×1.4cm) with metabolically active beside aorta arch
Results

108 patients got pathologic tissue successfully, and puncture success rate was 98.2%(108/110). Pathologic results were malignant lesions in 91 cases (lung adenocarcinoma in 45 cases, squamous carcinoma in 34 cases, small cell lung cancer in 7 cases, mesothelioma of pleura in 3 cases, carcinoid in 1 case, pulmonary blastoma in 1 case) and benign lesions in 17 cases (Lung inflammation diseases in 14 cases, pulmonary tuberculosis in 3 cases). To clinical followup or surgical pathology results for the standard, a puncture qualitative accuracy rate was 96.2% (104/108), pneumothorax rate was 6.5% (7/110), 1 patient accepted Pleural cavity catheterization for pneumothorax volume >30%, and the more than 6 cases had done no special treatment for pneumothorax volume all within 10%. Postoperative blood in phlegm were occured in 9 cases, most of those symptoms were selflimiting and disappeared within 3 days.

Conclusion

C-arm CT navigation technology incorporates the real-time fluoroscopy and cross-sectional soft tissue imaging for accurate positioning and precise puncture. The procedure time was shortened, the safety was enhanced.

References


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