Diagnostic and Interventional Imaging (2017) xxx, xxx—xxx

ORIGINAL ARTICLE /*Interventional imaging*

CT fluoroscopy-guided core needle biopsy of anterior mediastinal masses

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KEYWORDS
Biopsy;
Tomography;
Fluoroscopy;
Mediastinal tumor

Abstract
Objective: To retrospectively evaluate the safety, diagnostic yield, and risk factors of diagnostic failure of computed tomography (CT) fluoroscopy-guided biopsies of anterior mediastinal masses.
Materials and methods: Biopsy procedures and results of anterior mediastinal masses in 71 patients (32 women/39 men; mean [± standard deviation] age, 53.8 ± 20.0 years; range, 14—88 years) were analyzed. Final diagnoses were based on surgical outcomes, imaging findings, or clinical follow-up findings. The biopsy results were compared with the final diagnosis, and the biopsy procedures grouped by pathologic findings into diagnostic success and failure groups. Multiple putative risk factors for diagnostic failure were then assessed.
Results: Seventy-one biopsies (71 masses; mean size, 67.5 ± 27.3 mm; range 8.6—128.2 mm) were analyzed. We identified 17 grade 1 and one grade 2 adverse events (25.4% overall) according to the National Cancer Institute Common Terminology Criteria for Adverse Events version 4.0. Sixty-nine biopsies (97.2%) provided samples fit for pathologic analysis. Diagnostic failure was found for eight (11.3%) masses; the 63 masses diagnosed successfully included thymic carcinoma ($n = 17$), lung cancer ($n = 14$), thymoma ($n = 12$), malignant lymphoma ($n = 11$), germ

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https://doi.org/10.1016/j.diii.2017.10.007

Please cite this article in press as: Iguchi T, et al. CT fluoroscopy-guided core needle biopsy of anterior mediastinal masses. Diagnostic and Interventional Imaging (2017), https://doi.org/10.1016/j.diii.2017.10.007

cell tumor ($n = 3$), and others ($n = 6$). Using a thinner needle (i.e., a 20-gauge needle) was the sole significant risk factor for diagnostic failure ($P = 0.039$).

Conclusion: CT fluoroscopy-guided biopsy of anterior mediastinal masses was safe and had a high diagnostic yield; however, using a thinner biopsy needle significantly increased the risk of a failed diagnosis.

Anterior mediastinal masses include various benign and malignant lesions such as thymic neoplasms, malignant lymphomas, lung cancer, germ cell tumors, metastatic lymph nodes, granulomas, cysts, and inflammatory lesions. They are frequently difficult to diagnose with imaging alone, regardless of whether an ultrasound, computed tomography (CT), magnetic resonance imaging (MRI), or positron emission tomography (PET)-CT modality is used. Because treatment strategies differ depending on the diagnosis and clinical staging, an accurate pre-treatment pathologic diagnosis is clinically important for these masses.

The first step to diagnosis is usually an image-guided percutaneous needle biopsy employing conventional CT [1—6], ultrasound [7,8], cone-beam CT [9], or MRI [10]; unsuccessful procedures would be followed-up with a surgical diagnostic approach such as mediastinoscopy, mediastinotomy, thoracoscopy, or open chest surgery if necessary. Conventional CT-guided biopsy in particular is widely performed for pathologic diagnoses of anterior mediastinal masses as well as primary lung cancer [11] because of its safety and high diagnostic yield [1—6].

CT fluoroscopy is the result of advancements and improvements in equipment and technology. The rapid reconstruction of CT images in the procedure enables real-time confirmation of the location of the biopsy needle tip, as found with ultrasound and fluoroscopy imaging. Such real-time monitoring allows easier needle angle and depth adjustments, and thus enables the operator to advance the needle while avoiding critical organs and vessels and position the needle exactly inside the target lesion. CT fluoroscopy-guided biopsy has already been reported as an effective procedure for lung and kidney lesions; their diagnostic yields were 89.1—98.4% [12—14] and 79—97.4% [15—17], respectively. Although it is likely that CT fluoroscopy would also be an effective biopsy procedure for anterior mediastinal masses, more data are needed to properly assess its safety and diagnostic yield.

The aim of this study was to retrospectively review CT fluoroscopy-guided core needle biopsy procedures for anterior mediastinal masses to evaluate their safety and diagnostic yield, and identify the risk factors for diagnostic failure.

Materials and methods

Written informed consent was obtained from all patients before performing the biopsy. Our institutional review board approved this study and waived the requirement for informed consent because of the retrospective nature of the patients' data.

Patients and tumors

We retrospectively reviewed data on CT fluoroscopy-guided biopsies for anterior mediastinal masses performed between June 2006 and May 2017. Some patients underwent contrast-enhanced CT and/or MRI and PET-CT before the biopsy.

Biopsy procedure

All CT fluoroscopy — (Asteion or Aquilion; Toshiba Medical Systems, Tochigi, Japan) — guided biopsies were performed percutaneously with local anesthesia and under conscious sedation. To reduce the radiation exposure, the operator activated the CT fluoroscopy intermittently. CT fluoroscopic images (Asteion or Aquilion) were acquired at a scanning speed of 0.75 or 0.50 s per rotation (360°) with a tube voltage of 120 kV; current, 20 mA; and collimation, 4 mm.

The biopsy was performed by a staff (experienced interventional radiologist) or trainee (resident or fellow) under the direct supervision of a staff radiologist. The biopsy needles used were a 20-gauge core needle (Super-Core, Argon Medical Devices, Plano, TX, USA; Temno Evolution, Becton, Dickinson and Company, Vernon Hills, IL, USA; or STARCUT, TSK Laboratory, Tochigi, Japan) or an 18-gauge core needle (Super-Core; Temno Evolution; or STARCUT). The operator used a coaxial needle system with a 17-gauge and 19-gauge introducer for the 18-gauge and 20-gauge core needle, respectively. The size of the biopsy needle used and needle insertion pathway were determined by staff consensus during a pre-procedural conference. In procedures with a trans-sternal approach, after administering local anesthesia, the sternum was penetrated with a 14-gauge bone biopsy needle (Ostycut, Bard, Tempe, AZ, USA) to create a path for the coaxial needle system. The bone biopsy needle was then withdrawn and the coaxial needle system advanced through the pathway.

A conventional chest CT examination with 5-mm slice thickness was obtained to identify the location of the mass prior to biopsy. The operator then advanced the introducer needle step-by-step; between each advance step, a CT fluoroscopic image was used to assess the position of the tip and make any necessary adjustments prior to the next advance step. The operator advanced the introducer needle until its tip was in front of the target mass, at which point the internal stylet of the introducer needle was replaced with the biopsy needle. Thereafter, sequential specimens

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