

Computed Tomography Fluoroscopy-guided Core Needle Biopsy of Abdominal Para-aortic Lesions: A Retrospective Evaluation of the Diagnostic Yield and Safety

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Abstract

Purpose: To retrospectively evaluate the diagnostic yield and safety of computed tomography (CT) fluoroscopy-guided biopsy of abdominal para-aortic lesions.

Material and Methods: CT fluoroscopy-guided biopsy was performed for 30 lesions (median long diameter 2.4 cm; range, 1.3-12.4 cm) in 30 patients (11 women and 19 men; median age 64.5 years; age range 37-90 years) using 18- and/or 20-gauge needles. The median length of the biopsy needle tracts was 9.3 cm (range, 5.5-13.0 cm). The median number of biopsy fires was 3 (range, 2-6). The median duration of the procedures was 33 min (range, 14-80 min). The diagnostic yield and adverse events (AEs) were retrospectively evaluated. The AEs were categorized using the Society of Interventional Radiology classification system.

Technical success was determined by the acquisition of a sufficient number of specimens for pathological diagnosis. Diagnostic yield was defined as the match between the pathological and final diagnoses.

Results: In all 30 procedures, CT fluoroscopy-guided biopsies of the abdominal para-aortic lesions were technically successful. Twenty-six lesions were malignant (9 malignant lymphomas and 17 lymph node [LN] metastases) and four were benign (one schwannoma, one granular cell tumor, and two normal LNs). One case was insufficiently diagnosed as a B-cell lymphoma; thus, the diagnostic yield of the biopsy was 96.7%. AEs occurred in seven procedures (23.3%), including six cases of class A hemorrhage and one case of class B vasovagal reaction.

Conclusions: CT fluoroscopy-guided biopsy of abdominal para-aortic lesions is a safe procedure and provides a high diagnostic yield.

Key words: Lymph node, aorta, biopsy, computed tomography, fluoroscopy

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Introduction

Abdominal para-aortic lymph nodes (LNs) are occasionally enlarged due to various benign and malignant diseases (e.g., infection, tuberculosis, malignant lymphoma, and LN metastasis) [1-7]. They are detected using various imaging modalities, such as computed tomography (CT), ultrasound (US), magnetic resonance imaging (MRI), and

fluorodeoxyglucose-positron emission tomography (FDG-PET) and may be found accidentally or during the staging or follow-up of malignancy.

To obtain a pathological diagnosis of para-aortic LNs, surgical biopsy with laparoscopy guidance under general anesthesia is sometimes performed [8, 9]. However, image-guided percutaneous biopsy is preferred because it is less invasive, has lower complication rates, and has lower costs [2]. In addition, laparoscopic procedures require longer op-

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Table 1. Characteristics of 30 patients, 30 lesions, and 30 procedures

| Variable | | Value |
|-----------------------------------------|---------------------------|----------------|
| Patient characteristics | | |
| Age (years) | Median (Range) | 64.5 (37–90) |
| Gender | Man/Woman | 19/11 |
| History of malignancy | Yes/no | 16/14 |
| Lesion characteristics | | |
| Size (cm) | Median (Range) | 2.4 (1.3–12.4) |
| Location | Right/Left/Prior to aorta | 2/27/1 |
| Appearance | Solid/Cystic | 29/1 |
| Procedure characteristics | | |
| Length of inserted biopsy needle (cm) | Median (Range) | 9.3 (5.5–13.0) |
| Size of biopsy needle used (gauge) | 18/20/18 and 20 | 15/13/2 |
| Number of fires | Median (Range) | 3 (2–6) |
| Procedure time (min) | Median (Range) | 33 (14-80) |
| Adverse event | Yes/no | 7/23 |
| Needle insertion via psoas major muscle | Yes/no | 24/6 |

eration times and more medical resources, such as anesthesiologists, compared to percutaneous biopsy. For image-guided biopsy of abdominal para-aortic LNs, various modalities, including conventional CT, US, and MRI, have been used [1-3, 10, 11].

Percutaneous conventional CT-guided core needle biopsy is established as an effective and safe procedure to confirm pathological diagnosis in many clinical settings. In addition, core needle biopsy plays an important role in the confirmation of genotype identification and molecular analysis [12]. Therefore, many investigators have already reported excellent results of conventional CT-guided biopsy in various organs, such as the liver, lung, kidney, pancreas, bone, and soft tissue [13-17]. When comparing fluoroscopy and US guidance, advantages to CT guidance include a larger field of view and better visualization of the structures and needle [18]. Since the development of CT fluoroscopy in 1993 [19], this modality has been widely used for biopsy procedures in various organs [20-22] because it provides rapid reconstruction of CT images and contributes to safe and accurate procedures [23, 24].

Abdominal para-aortic lesions are adjacent to critical organs such as the aorta, bowel, and ureter. Therefore, real-time confirmation of the needle position would contribute to a safer and more accurate needle insertion. Although US enables real-time visualization of the needle, it is sometimes difficult to continuously localize abdominal para-aortic lesions located at deeper sites (i.e., those with a further location from the body surface), especially in obese patients. Because CT fluoroscopy enables real-time visualization even for such deeply located LNs, it may be a more suitable modality for biopsies of abdominal para-aortic lesions.

The purpose of this study is to retrospectively evaluate the diagnostic yield and safety of CT fluoroscopy-guided biopsy of abdominal para-aortic LNs and nodules.

Material and Methods

We retrospectively reviewed medical data on CT fluoroscopy-guided biopsies of abdominal para-aortic lesions performed between April 2006 and March 2018. In all cases, biopsy was initially performed for diagnostic purposes.

Written informed consent was obtained from all patients prior to undergoing CT fluoroscopy-guided biopsy of abdominal para-aortic lesions. Our institutional review board approved this study (ken 1902-021) and waived the requirement for informed consent because of its retrospective nature.

Patients and tumors

The characteristics of the patients, lesions, and procedures are summarized in **Table 1**. During the study period, 33 biopsies of abdominal para-aortic lesions were performed at our institution. Of the 33 biopsies, three were excluded from the study because the target lesions were not nodules but were actually retroperitoneal fibrosis. In total, 30 biopsies of 30 abdominal para-aortic lesions (median long diameter 2.4 cm; range, 1.3-12.4 cm) from 30 patients (19 men and 11 women; median age 64.5 years; age range 37-90 years) were evaluated. The lesions were located to the right (n = 2), left (n = 27), or anterior side (n = 1) of the aorta. Twenty-nine lesions were solid, and one was cystic. In the case of cystic lesion, specimens were obtained from the thick-walled cyst without rupture or dissemination. Sixteen patients (53.3%) had a history of prior malignancy (prostate cancer [n = 5]; mixed cellularity classical Hodgkin lymphoma [n = 1]; diffuse large B-cell lymphoma [n = 1]; undifferentiated sarcoma [n = 1]; urothelial cancer [n = 1]; endometrial cancer [n = 1]; cholangiocarcinoma [n = 1]; hepatocellular carcinoma [n = 1]; colon cancer [n = 1]; cholangiocarcinoma,

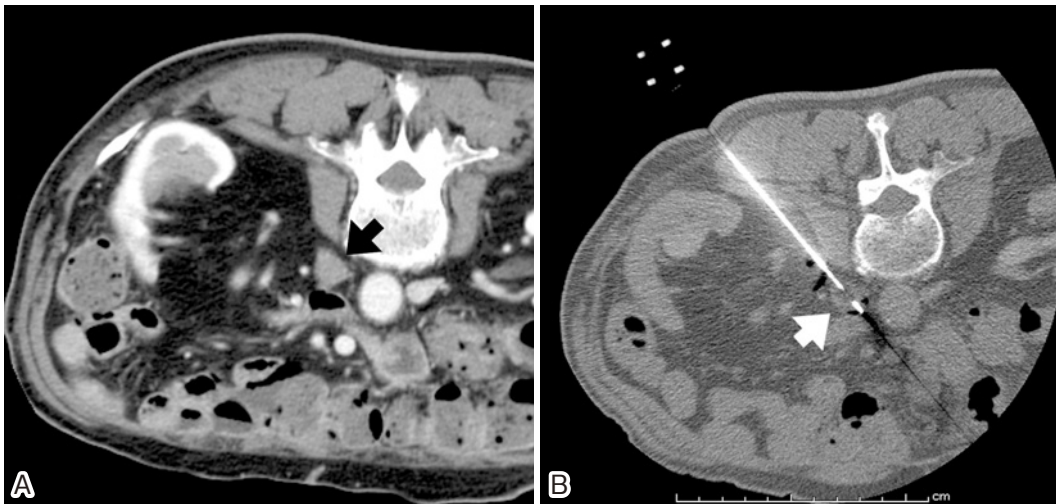


Figure 1. Computed tomography images of an 82-year-old man with a history of malignant lymphoma and suspected right clear cell renal cell carcinoma demonstrate a biopsy-proven diffuse large B-cell lymphoma on the left side of the aorta.

A. Conventional computed tomography image obtained immediately before biopsy shows an enlarged para-aortic lymph node with a diameter of 14 mm (arrow).

B. Computed tomography fluoroscopic image shows the insertion of a biopsy needle (arrow) in the target via the para-psoas major muscle route. No complications occurred.

hepatocellular carcinoma, and duodenal papilla cancer [n = 1]; hypopharyngeal cancer and esophageal cancer [n = 1]; and stomach cancer, esophageal cancer, and hepatocellular carcinoma [n = 1]).

Biopsy procedure

All biopsy procedures were performed percutaneously under local anesthesia and CT fluoroscopy guidance (Asteion or Aquilion; Canon Medical Systems Co., Otawara, Japan) in an interventional radiology suite.

Each procedure was performed using a coaxial introducer and semiautomatic cutting needle system. A 19-gauge introducer and 20-gauge biopsy needle (SuperCore, Medical Device Technologies, Gainesville, FL, USA; Temno Evolution, Carefusion, McGaw Park, IL, USA; or Starcut, TSK Laboratory, Tochigi, Japan) or a 17-gauge introducer and 18-gauge biopsy needle (Temno Evolution or Starcut) were used.

For each procedure, the patient was placed in a prone position on the CT table, and CT scanning was performed to identify the target location and plan the needle path. Axial images were reconstructed with a 5-mm slice thickness for the planning of the needle tract. After the administration of lidocaine, an introducer was advanced until its tip was in front of the lesions. Once in place, the internal stylet of the introducer was replaced with the biopsy needle, and specimens were obtained. The acquisition of specimens was repeated and judged by a radiologist until an amount sufficient for pathologic evaluation (i.e., at least two good cores) was obtained (**Fig. 1**). Pathologists were not available on site; therefore, the biopsy specimens were preserved in formalin and sent out for pathologic sectioning. In two cases, specimens preserved in saline were also sent for flow cytometry.

Upon completion of the biopsy, CT scanning was performed to evaluate for procedural adverse events (AEs).

To decrease the radiation exposure, operators used CT fluoroscopy intermittently and also hold the needle with a 19-cm plastic forceps to minimize radiation exposure to the hand. A double-folded 0.35-mm lead apron was placed on the patient to decrease scatter radiation.

Biopsies were performed using 18- (n = 15), 20- (n = 13), or both gauge (n = 2) needles. For two cases, both needles were used; the initially used 18-gauge needle could not penetrate the target satisfactorily and had to be replaced with a 20-gauge needle. Interventional radiologists were allowed to choose their preferred needle sizes. The median length of the needle tract (i.e., the distance from the skin entry point to the target) was 9.3 cm (range, 5.5-13.0 cm). The median number of biopsy fires was 3 (range, 2-6). The median duration of the procedure (defined as the duration between the initial and final CT scans) was 33 min (range, 14-80 min).

Evaluation of technical success, safety, and diagnosis

The technical success of the biopsy was defined as the procurement of a sufficient number of specimens [18]. Procedural AEs were evaluated using the Society of Interventional Radiology classification system [25]. The pathological diagnosis from the biopsy specimens was compared to the final diagnosis made during clinical and radiologic follow-ups or the surgical outcome, and diagnostic yield was defined as the match between the pathological and final diagnoses.

Table 2. Biopsy results in 30 abdominal para-aortic lesions

| Histological findings | Number |
|-----------------------------------------|--------|
| Malignancy | 26 |
| Lymphoma | 9 |
| Follicular lymphoma grade I | 4 |
| Follicular lymphoma | 1 |
| B-cell lymphoma | 1 |
| Hodgkin lymphoma | 1 |
| Diffuse large B-cell lymphoma | 1 |
| B-cell lymphoblastic lymphoma | 1 |
| Metastasis | 17 |
| Prostate Cancer | 4 |
| Lung cancer | 1 |
| Ovarian cancer | 1 |
| Renal cell carcinoma | 1 |
| Urothelial cancer | 1 |
| Esophageal cancer | 1 |
| Endometrial cancer | 1 |
| Cholangiocarcinoma | 1 |
| Duodenal papilla cancer | 1 |
| Hepatocellular carcinoma | 1 |
| Undifferentiated sarcoma | 1 |
| Pituitary adenocarcinoma | 1 |
| Primary unknown adenocarcinoma | 1 |
| Primary unknown squamous cell carcinoma | 1 |
| Benign lesion | 4 |
| Normal LN | 2 |
| Schwannoma | 1 |
| Granular cell tumor | 1 |

LN: lymph node

Results

In all 30 procedures, CT fluoroscopy-guided biopsies of abdominal para-aortic lesions were technically successful. All 30 biopsy specimens were pathologically diagnosed (**Table 2**). One case was insufficiently diagnosed as B-cell lymphoma, which was surgically resected after biopsy and proven to be a diffuse large B-cell lymphoma. Thus, diagnostic yield of the biopsy was 96.7%. Twenty-six LNs were malignant (9 malignant lymphomas and 17 metastases) and 4 were benign. Out of 16 patients with positive history of malignancy, 13 were diagnosed with a recurrence or relapse of primary cancer or malignant lymphoma, 1 with a history of bladder cancer had an enlarged LN that was diagnosed as Hodgkin's lymphoma, and 2 patients had enlarged LNs that were diagnosed as benign. Out of 14 patients with no history of malignancy, 7 had enlarged para-aortic LNs that were diagnosed as malignant lymphomas, 5 were diagnosed with metastatic LNs with confirmed primary lesions, and 2 patients were diagnosed with benign lesions. Of those four benign lesions, one was surgically resected after the biopsy and was proven to be a schwannoma, one granular cell tu-

mor was stable on CT imaging 24 months later, and two normal LNs (3.6 cm and 2.1 cm in diameter, respectively) were also carefully followed up after biopsy and showed no remarkable change on CT images 18 months and 20 months later, respectively.

AEs occurred in seven procedures (23.3%), including six class A hemorrhages and one class B vasovagal reaction. No accidental insertion of the biopsy needle into the aorta or other important organs occurred.

Discussion

In the present study, we evaluated CT fluoroscopy-guided biopsy of abdominal para-aortic lesions and found excellent outcomes in both diagnostic yields and safety. Technical success was obtained in all cases, and diagnostic yield was obtained in 29 of 30 cases (96.7%) without any severe complications.

With imaging alone, it is often difficult to establish a definitive diagnosis for enlarged abdominal para-aortic lesions [4]. Lee et al. reported that in 66 patients with intra-abdominal malignancies, CT is more sensitive than FDG-PET (sensitivity 61.5% vs. 46.2%) for the detection of para-

aortic LN metastases, while FDG-PET is more specific (specificity 84.9% vs. 100%) [4]. Surgical resection or percutaneous needle biopsy of para-aortic lesions should be considered when pathological diagnosis is required for cancer staging or decisions regarding treatment planning.

Conventional CT-guided biopsy has the disadvantage of lacking real-time imaging reconstruction because it requires a few seconds of post-processing time to obtain CT images; operators have to move in and out of the room each time for needle manipulation and CT scanning. Therefore, if a target lesion shifts due to respiratory movement, it may be lost. CT fluoroscopy is a technique that provides rapid reconstruction of CT images and allows for the confirmation of the location of the inserted biopsy needle virtually in real time [19].

For retroperitoneal LNs (including abdominal para-aortic LNs), there are a few reports evaluating results of conventional CT- and/or CT fluoroscopy-guided biopsy [1-3]. The diagnostic yields and safety are generally high. Tomozawa et al. reported that a pathological diagnosis was made in 70 (95%) of 74 retroperitoneal lesions (including 49 para-aortic lesions), with only minor complications in seven patients (five local hematomas and two occurrences of transient pain at the puncture site) [2]. There is a lack of studies focusing specifically on the diagnostic yield and safety of CT fluoroscopy-guided biopsies of abdominal para-aortic lesions.

In this study, a coaxial technique was used in all cases. With this technique, a single puncture is needed for insertion of an external guiding needle to the target lesion, reducing complications including hemorrhage and the time and imaging required for precise needle placement [26]. Babaei Jandaghi et al. reported that a shorter procedural duration (coaxial group, 5 ± 1 min; noncoaxial group, 14 ± 2 min; $p < 0.001$) and a lower complication rate (coaxial group, 10.8%; noncoaxial group, 24.1%; $p = 0.025$) were achieved for a US-guided renal parenchyma biopsy with the coaxial technique [27]. Zhang et al. reported that the diagnostic accuracy of the CT-guided lung biopsy was significantly higher (95.5% vs. 72.7%, $p = 0.023$) for the coaxial group than the noncoaxial group when the tumor was < 1.5 cm and the needle path length was ≥ 4 cm. They also reported that the incidence of pneumothorax was lower (19 versus 43, $p = 0.024$) in the coaxial group [28].

Sone et al. reported that histopathological diagnosis was established in 47 (97.9%) image-guided biopsies with an 18-gauge needle, and the success rate of genomic analysis using next-generation sequencing was 79.2% (38/48). The reason for genomic analysis failure was also reported to be unprocessed for deoxyribonucleic acid (DNA) extraction due to insufficient specimen volume (6/10), insufficient DNA volume (2/10), and deteriorated DNA quality (2/10) [29]. Although our study showed a high diagnostic yield for pathological diagnosis including malignant lymphoma with 18-gauge and 20-gauge needles, 20-gauge needles should not be used for genomic analysis.

This retrospective study has several limitations. The study population was relatively small. Surgical biopsy patients were not considered, which introduces selection bias. In almost all of the cases, the pathological diagnoses were not proven surgically. Moreover, the study was not designed to compare the diagnostic yield, safety, procedure time, or radiation exposure with those in other image-guided biopsies (i.e., conventional CT or US).

In conclusion, CT fluoroscopy-guided biopsy of abdominal para-aortic lesions provides a high diagnostic yield without severe AEs.

Conflict of interest: The authors declare that they have no conflict of interest.

Disclaimer: Takao Hiraki is one of the Editorial Board members of Interventional Radiology. This author was not involved in the peer-review or decision-making process for this paper.

A summary of this study was presented at JSIR2019.

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