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# CT-Guided Percutaneous Needle Biopsy in Patients with Suspected Retroperitoneal Fibrosis: A Retrospective Cohort Study

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**Abstract**
*Purpose* The outcome of CT-guided biopsy in patients with suspected retroperitoneal fibrosis (RF), regarded as technically challenging, remains unclear. This study aimed to evaluate the results of CT-guided biopsy in patients with lesions considered in the differential diagnosis of RF and compare them with results from patients with other retroperitoneal lesions.
*Materials and Methods* Patients who underwent CT-guided biopsy of retroperitoneal lesions between January 2010 and September 2018 were retrospectively reviewed. The study cohort with retroperitoneal lesions surrounding the infra-abdominal aorta, iliac vessels, and/or ureters was divided into two groups: Group *F* included patients with lesions for which RF was considered in the differential diagnosis, and Group *C* comprised patients with a retroperitoneal mass or lymphadenopathy. Lesion size and depth, and biopsy details including technical success, position, procedure time, diagnostic yield, and complications between the two groups were compared.
*Results* Group *F* included 27 patients (mean age 68.5 years ± 11.6, 17 male) and Group *C* 30 patients (mean age 65.0 years ± 11.8, 16 male). The short axis was significantly smaller in Group *F* than in Group *C* (19 mm vs 26 mm, $P = 0.041$), and procedure time was significantly longer in Group *F* than in Group *C* (31.5 min ± 13.2 vs 20.3 min ± 8.4, $P = 0.001$). Technical success rate (93% vs 100%), accuracy (93% vs 93%), and complications (3.7% vs 10%) between Groups *F* and *C* were not significantly different.
*Conclusions* CT-guided biopsy of patients with suspected RF is considered safe and effective.

**Keywords** CT-guided biopsy · Retroperitoneal lesion · Retroperitoneal fibrosis

**Abbreviations**

| | |
|---|---|
| CT | Computed tomography |
| IgG | Immunoglobulin |
| PNB | Percutaneous needle biopsy |
| RF | Retroperitoneal fibrosis |

## Introduction

Retroperitoneal fibrosis (RF) is a rare benign disease characterized by inflammation and fibrosis spreading along the retroperitoneal space, the infrarenal aorta, and the

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ureters [1–4]. Many conditions, such as malignant diseases, postoperative complications, radiotherapy, and some medications (*e.g.* serotonin antagonist, ergot alkaloids), are associated with RF [1–4]. In two-thirds of cases the etiology remains unknown and is defined as idiopathic RF, which may be one expression of immunoglobulin G4 (IgG4)-related disease. A definitive diagnosis of RF cannot be reached without pathological examination [1, 2].

Retroperitoneal biopsy is usually performed via open, laparoscopic, or computed tomography (CT)-guided approaches [4–6]. CT-guided percutaneous needle biopsy (PNB) of the retroperitoneal lesion is less invasive and the preferred choice, but is considered technically challenging by some clinicians because of the extensive depth of the lesions and their proximity to vital structures such as vessels and ureters [2, 6]. According to previous reports, PNB was utilized in only 33–66% of RF cases [2, 4], while some patients with suspected RF underwent initial surgical biopsy without attempt of PNB [2, 4, 5]. However, it remains unclear whether PNB for patients with suspected RF is challenging.

In this study we retrospectively investigated the difference in diagnostic yield and complication rate of CT-guided PNB between lesions for which RF was considered in the differential diagnosis and other retroperitoneal lesions. Our purpose was to demonstrate the results of PNB for patients with suspected RF, our hypothesis being that PNB for patients with suspected RF is safe and effective.

## Materials and Methods

The institutional review board approved this study and waived informed consent. A retrospective review of an interventional radiology database to identify patients who underwent CT-guided PNB of retroperitoneal lesions between January 2010 and September 2018 was conducted using the key words "retroperitoneal" and "biopsy". Under our policy, the preferred approach was CT-guided biopsy when patients were referred to the interventional radiology service for retroperitoneal biopsy. Cases involving PNB of lesions in the kidney, pancreas, adrenal organ, or deep pelvis were excluded because this study focused on patients with retroperitoneal lesions surrounding the infrarenal aorta, iliac vessels, or ureters. The study cohort was divided into two groups based on the preprocedural CT imaging: Group *F* included patients with lesions for which RF was considered in the differential diagnosis, and Group *C* comprised patients with a retroperitoneal mass or lymphadenopathy (Fig. 1).

### Imaging Characteristics

RF was considered in the differential diagnosis if the following findings were present on the preprocedural CT scan: (1) soft-tissue density surrounding infrarenal aorta or iliac vessel; (2) urinary tract involvement; and/or (3) ureteral obstruction [1, 2]. The preprocedural CT scans were independently assessed by two board-certified radiologists who were blinded to the clinical data. Disagreements were resolved by consensus.

Evaluation of the target lesions of the retroperitoneal space was based on cross-sectional CT images obtained before the PNB procedures. The retroperitoneal lesion size was measured at the central slice of the cross-sectional images, taking the long- and short-axis diameter as length; the lesion depth was defined as the distance from the skin surface to the proximal site of the lesion.

### PNB Procedures

PNB procedures were performed with conventional CT guidance and coaxial technique using a 16- or 19-gauge coaxial introducer system and an 18- or 20-gauge cutting needle for core specimens (Quick-Core Biopsy Needle set; Cook Medical, Bloomington, IN, USA). CT guidance was undertaken with a multidetector-row 64-slice CT scanner (Toshiba, Tokyo, Japan) using slices of 3- to 5-mm thickness. The position of the patient was chosen according to the preprocedural CT imaging findings. Preliminary axial images were acquired to determine the puncture site and the needle trajectory. Using a sterile technique, the coaxial introducer needle and the cutting needle were advanced into the lesion. As shown by a previous report [7], the curved needle technique was adopted as appropriate. In accordance with our protocol, needle trajectories did not traverse the small bowel and large bowel. Once the correct position of the cutting needle within the lesion was determined by CT, 2–4 core specimens were obtained. Technical success was defined as completion of the planned biopsy by obtaining core specimens. Complications were classified according to the Society of Interventional Radiology guidelines for needle biopsy [8].

### Pathologic Diagnosis, Follow-Up, and Final Diagnosis

The PNB results were recorded in accord with the pathology reports, and classified as malignant or nonmalignant. The final diagnosis was determined in cases of malignancy. Follow-up analyses including repeat biopsy, open surgery, imaging, and clinical indicators were conducted for nonmalignant cases. "Benign" was defined as no evidence of malignancy during follow-up.

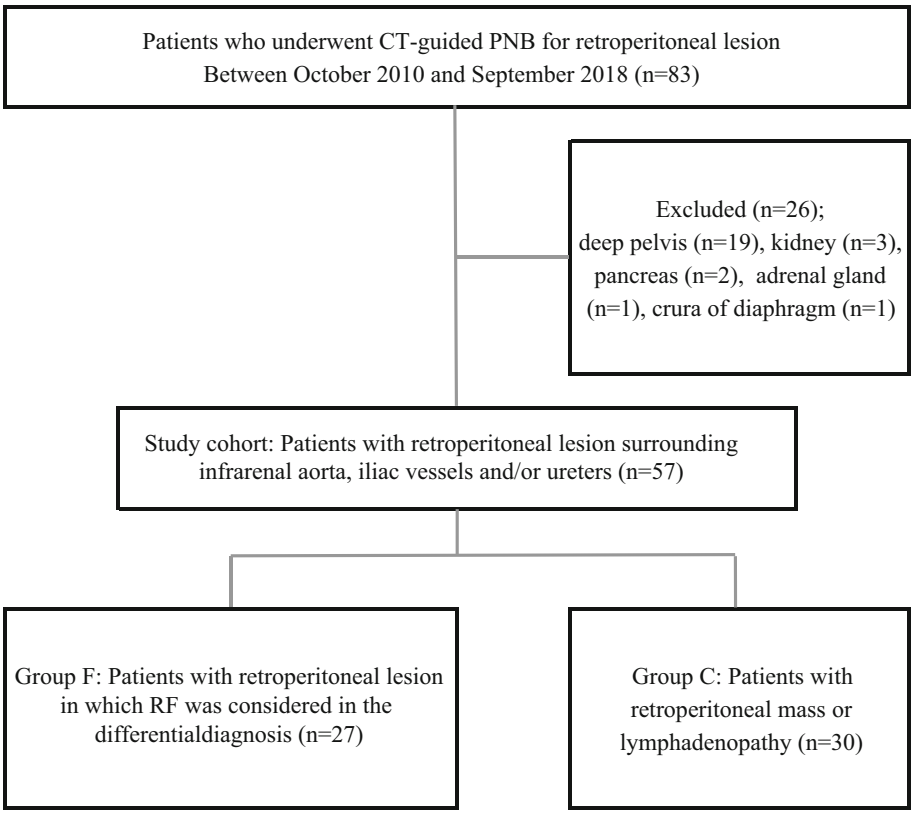


**Fig. 1** Flowchart of the study population. *PNB* percutaneous needle biopsy, *RF* retroperitoneal fibrosis

### Data Analysis

The diagnostic yield was defined in terms of accuracy calculated by (number of true positive + number of true negative) divided by (overall). Interobserver agreements of the radiological diagnosis of RF were analyzed by kappa statistics: kappa values of 0.00–0.20 indicated poor; 0.21–0.40, fair; 0.41–0.60, moderate; 0.61–0.80, substantially perfect; and 0.81–1.00, perfect.

Continuous variables were described as mean (SD). Student's t test was used to compare the means between the two groups. Fisher's exact test was used to compare the nominal variables including sex, technical success, position, accuracy, and complication rate between the two groups. *P* values of less than 0.05 were considered statistically significant. All statistical analyses were performed with EZR (Saitama Medical Center, Jichi Medical University, Saitama, Japan), a graphical user interface for R (The R Foundation for Statistical Computing, Vienna, Austria).

## Results

### Patients and Imaging

A total of 83 patients with retroperitoneal lesions were identified. After exclusion because the lesion was located in the deep pelvis ($n = 19$), kidney ($n = 3$), pancreas ($n = 2$), adrenal gland ($n = 1$), and crura of the diaphragm ($n = 1$), 57 patients with retroperitoneal lesions surrounding the infrarenal aorta, iliac vessels, and/or ureters were included in the study cohort (Fig. 1). The cohort was divided into two groups: Group *F* included 27 patients with a retroperitoneal lesion for which RF was considered in the differential diagnosis, and Group *C* comprised 30 patients with a retroperitoneal mass or lymphadenopathy. The kappa test showed diagnostic concordance rate as "substantially perfect" between the two observers (kappa value = 0.71).

The baseline characteristics of patients are summarized in Table 1. Age and sex did not significantly differ between the two groups. The short axis was significantly smaller in Group *F* than in Group *C* (19 mm vs 26, $P = 0.041$). Although not statistically significant, the long axis of the lesion in Group *F* tended to be smaller than in Group *C* (28 mm vs 33, $P = 0.23$) and the lesions in Group *F* tended to be more deep seated than those in Group *C* (104 mm vs 94, $P = 0.082$).

### Procedure and Complications

The technical success rate of Group *F* and Group *C* was 93% and 100%, respectively. In one case in Group *F*, biopsy was aborted because of pain and lower limb

**Table 1** Comparison between Group *F* and Group *C*

| Factor | Group *F* | Group *C* | *P* value |
|---|---|---|---|
| Patients demographics | | | |
| Number | 27 | 30 | – |
| Mean age (SD) | 68.5 (11.6) | 65 (11.8) | 0.258 |
| Male sex | 17 | 16 | 0.593 |
| Lesion Demographics | | | |
| Long axis, mm, mean (SD) | 27.7 (13.2) | 33.1 (18.7) | 0.233 |
| Short axis, mm, mean (SD) | 18.9 (9.7) | 26.5 (16.5) | 0.004* |
| Depth, mm, mean (SD) | 104 (25.8) | 94 (14.6) | 0.082 |
| PNB procedure | | | |
| Technical success rate | 96% (26/27) | 100% (30/30) | 0.474 |
| Sipine position | 19% (5/27) | 3.3% (1/30) | 0.091 |
| Procedure time, min, mean (SD) | 31.5 (13.2) | 20.3 (8.4) | 0.001* |
| Accuracy | 93% (25/27) | 93% (28/30) | 1 |
| Minor complication | 3.7% (1/27) | 10% (3/30) | 0.613 |

*Statistically significant

numbness caused by the puncture; in all other cases biopsy was successfully completed. The PNB procedure was performed using a posterior approach in the prone position for 22 patients in Group *F* and 29 patients in Group *C* and using a lateral approach in the supine position for 5 patients in Group *F* and 1 patient in Group *C* (Figs. 2, 3, 4). Although not statistically significant, the PNB procedure tended to be more frequently performed in the supine position in Group *F* than Group *C* (5/27 vs 1/30, $P = 0.09$). The procedure time was significantly longer in Group *F* than in Group *C* (31.5 min ± 13.2 vs 20.3 min ± 8.4, $P = 0.001$). Within Group *F*, the procedure time in 5 patients in the supine position tended to be longer than that in 22 patients in the prone position (38.0 min ± 16.8 vs 29.5 min ± 11.8, $P = 0.214$). There were 4 minor complications: 1 patient in Group *F* had minor pain and the procedure was aborted; 2 patients in Group *C* had minor pain; and 1 patient in Group *C* had minor bleeding. No major complications were reported. Fisher's exact test showed no significant difference in complication rate between Groups *F* and *C* (1/27 vs 3/30, $P = 0.61$).

## Pathologic Diagnosis, Follow-Up, and Final Diagnosis

The pathological results of PNB are summarized in Table 2. The 18 patients with non-malignant lesions by PNB were followed up for a median duration of 43 ± 31.9 months after PNB. Repeat PNB provided a definitive diagnosis of "malignant lymphoma" in 1 patient in Group *F* with an initial PNB result of "no specific tissue". Additional surgery provided a definitive diagnosis of "metastatic tumor" in 2 patients in Group *C* with a PNB result of "no specific tissue". These 3 cases were therefore considered false negative. The remaining 15 patients, including all 9 patients pathologically diagnosed as "RF",

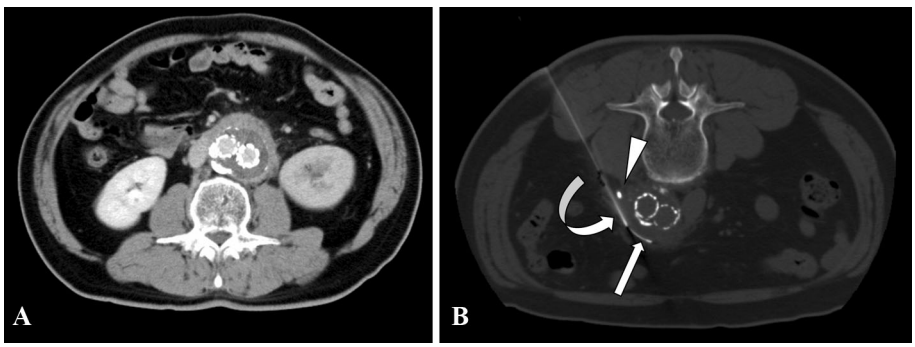


**Fig. 2** CT images of a retroperitoneal lesion in a 63-year-old man with suspected RF (Group *F*). **A** Contrast-enhanced CT image obtained at 24 months after endovascular aneurysmal repair shows soft-tissue density surrounding the infrarenal aorta. **B** CT image during the procedure shows the 20-gauge cutting needle (arrow) manually curved to extend medially from the tip of the 18-gauge coaxial needle (curved arrow) and into the lesion (arrowhead: ureteral stent). The pathological results confirmed "RF"

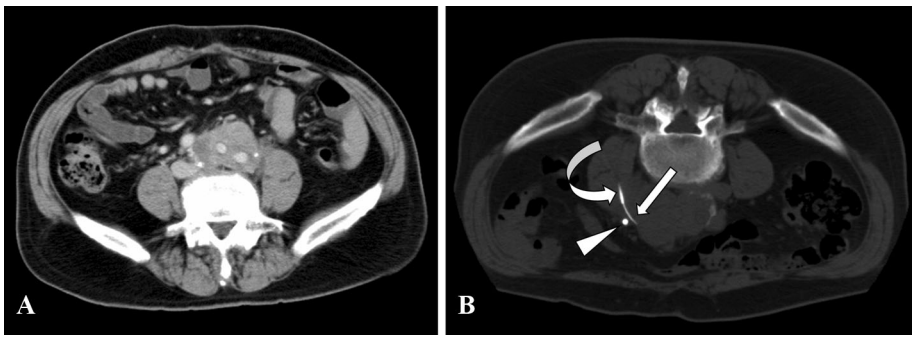


**Fig. 3** CT images of a retroperitoneal lesion in a 69-year-old man with mimicking RF (Group *F*). **A** Contrast-enhanced CT image obtained at 6 months after *Y*-graft repair shows soft-tissue density surrounding the graft. **B** CT image during the procedure shows the 20-gauge cutting needle (arrow) manually curved to extend medially from the tip of the 18-gauge coaxial needle (curved arrow) and into the lesion (arrowhead: ureteral stent). The pathological results confirmed "spindle cell tumor"

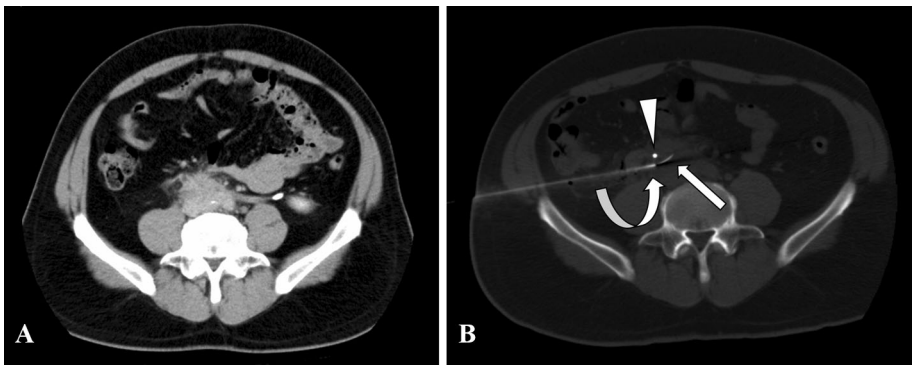


**Fig. 4** CT images of a retroperitoneal lesion in a 40 year-old man with suspected RF (Group *F*). **A** Contrast-enhanced CT image shows a soft-tissue density surrounding the bilateral common iliac arteries. **B** CT image during the procedure in the supine position shows the 20-gauge cutting needle (arrow) manually curved to extend medially from the tip of the 18-gauge coaxial needle (curved arrow) and into the lesion (arrowhead: ureteral stent). The pathological results confirmed the presence of RF

showed no sign of malignancy during follow-up. In addition, a patient in Group *F* in whom biopsy was abandoned underwent additional surgery and was diagnosed as "RF".

The accuracy of biopsies was 93% in both Group *F* (25/27) and Group *C* (28/30), resulting in no statistical difference ($P = 1$).

## Discussion

This study was performed to compare the safety and the diagnostic yield of PNB for retroperitoneal lesions for which RF was considered as a differential diagnosis versus the safety and diagnostic yield of PNB for retroperitoneal masses and lymphadenopathy. The results showed that lesions in Group *F* tended to be smaller in size and deeper than in Group *C*. Although the lesions of Group *F* required a longer procedure time, the diagnostic yield and complication rate of the 2 groups were considered equivalent.

Previous studies have shown a high diagnostic yield for patients with retroperitoneal masses and lymphadenopathy [9, 10]. The technical success rate of 96%, accuracy rate of 93% and minor complication rate of 3.7% in Group *F* were similar to those reported by Shao et al. [9] (99.7%, 92.8%, and 11.3% for retroperitoneal lymphadenopathy, respectively) and Tomozawa et al. [10] (99%, 93%, and 9.5% for retroperitoneal solid lesions, respectively). CT-guided PNB was considered safe and effective for patients with retroperitoneal lesions for which RF was considered as a differential diagnosis.

Unlike previous studies, the present study included retroperitoneal soft tissue lesions with suspected RF. As expected, these lesions were small in size and located at a considerable depth. Surgical biopsy instead of PNB might be indicated for some of these lesions to obtain more conclusive results in the real-world setting. Some evidence shows that PNB is being abandoned in patients with suspected RF; instead, these patients are undergoing surgical biopsy [4]. However, PNB for retroperitoneal lesions with suspected RF is considered safe and effective. We propose that patients with suspected RF should undergo less invasive PNB before surgical biopsy because of the potential for non-malignant lesions.

**Table 2** Details of PNB pathological results, follow-up and final diagnosis

| PNB result | | Follow up | Final diagnosis |
|---|---|---|---|
| Group *F* (*n* = 27) | | | |
| Malignant | 14 | | Malignant 15 |
| Metastatic tumor | 6 | | |
| Malignant lymphoma | 4 | | |
| Primary tumor | 3 | | |
| Local reccurence | 1 | | |
| Non-malignant | 12 | | Benign 12 |
| RF (IgG4-related) | 9 (3) | 9 RF | |
| No specific tissue | 3 | 1 RF | |
| | | 1 No change | |
| | | 1 Malignant lymphoma | |
| Not available | 1 | 1 RF | |
| Group *C* (*n* = 30) | | | |
| Malignant | 24 | | Malignant 26 |
| Metastatic tumor | 12 | | |
| Malignant lymphoma | 10 | | |
| Primary tumor | 2 | | |
| Non-malignant | 6 | | Benign 4 |
| No specific tissue | 4 | 2 No change | |
| | | 2 Metastatic tumor | |
| Granulomatous lymphadenitis | 2 | 2 Granulomatous lymphadenitis | |

*PNB* percutaneojus needle biopsy, *RF* retroperitoneal fibrosis

In the present study, the procedure time was longer for the lesions in Group *F* than those in Group *C*, suggesting that the procedure time depends on the target lesion size and depth. The procedure time of 31 min in Group *F* was similar to that in a previous report by De Filippo et al. [7], who reported an average time of 35 min for small abdominal and retroperitoneal lesions. Additionally, the procedure time of 20 min in Group *C* was similar to that in a previous report by Vadvala et al. [11], who reported a mean time of 17 min for omental and mesenteric lesions. With respect to the position of the patient, the slightly more frequent use of the supine position in Group *F* could be explained by the fact that the lesions were small in size and limited to the surrounding terminal aorta or iliac arteries. The slightly longer procedure time in the supine position than in the prone position in Group *F* was likely associated with the presence of the bowel as an additional obstacle to the needle trajectory. Although the curved needle technique was used as appropriate, other adjunctive maneuvers such as the hydrodissection technique, a transenteric approach, or a transcaval approach could be valid alternatives [9, 11].

This study has some limitations. The study design was retrospective, matched pairing was not utilized, and the sample size was small. Regarding selection bias, this study included only patients who underwent PNB for lesions considered in the differential diagnosis of RF and did not prospectively include patients suspected to have RF. Our policy is that PNB should be attempted when patients are referred to the interventional radiology service for a biopsy, even in cases of small and deep-seated lesions. Moreover, this study lacks the following cases: patients who did not want to undergo PNB, patients without a clinical presentation, patients with contraindications of PNB such as coagulation abnormality, and patients already diagnosed with IgG4-related RF via pathological tissue from other lesions. With regard to measurement bias, this study may have overlooked mild complications that did not require any observation or treatment. Nonetheless, major complications were not encountered in the cohort.

In conclusion, PNB for patients with a lesion for which RF is considered in the differential diagnosis is considered safe and effective. Therefore, we propose that patients with suspected RF should undergo PNB before surgical biopsy.

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**Compliance with Ethical Standards**

**Conflict of interest** The authors have no conflict of interest to disclose.

**Ethical Approval** For this type of study formal consent is not required.

**Informed Consent** This study has obtained IRB approval and the need for informed consent was waived.

**Consent for Publication** Consent for publication was obtained for every individual person's data included in the study.

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