

Urological Oncology

Experience of Ultrasonography-Guided Percutaneous Core Biopsy for Renal Masses

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Purpose: We evaluated the safety and accuracy of ultrasonography-guided percutaneous core biopsy collection in patients with renal masses.

Materials and Methods: From June 2008 to August 2012, 30 percutaneous core biopsies of renal masses were performed. The biopsies obtained were small tumors (< 4 cm) with ambiguous radiologic findings or that met classic renal biopsy indications. The biopsy results were compared with the final pathological results after definitive surgical treatment. Ultrasonography was performed on the day after biopsy collection to rule out any complications.

Results: The mean age of the patients was 57.7 years, and the mean tumor size was 3.39 cm. Twelve of the lesions were in the left kidney, and 18 were in the right kidney. All but one core biopsy contained sufficient material for histopathological analysis. The biopsy results showed 17 renal cell carcinomas (56.7%), 3 angiomyolipomas (10.0%), 2 oncocytomas (6.7%), 1 adenocarcinoma (3.3%), and 7 benign lesions (23.3%). A total of 18 cases underwent surgery, and the pathological results confirmed the initial biopsy diagnosis for 17 of 18 cases (94.4%). The one (5.9%) inaccurate biopsy result was found to be a urothelial carcinoma of the kidney. No needle tract seeding was found in the pathological specimens or on follow-up imaging. A small perinephric hematoma (1-2 cm) was seen in 5 cases (16.7%), but all patients remained hemodynamically stable.

Conclusions: Ultrasonography-guided renal biopsy is a safe, effective, and accurate method for evaluating small renal masses. This procedure may help in selecting treatment modalities for small renal masses.

Keywords: Fine-needle biopsy; Kidney

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INTRODUCTION

Traditionally, most solid renal masses have been managed surgically with radical nephrectomy. However, not all renal masses are malignant, and surgical treatment of all renal masses is not always justified. The widespread use of abdominal imaging studies to investigate variable non-specific abdominal symptoms has led to the increased detection of small incidental renal masses [1]. Recent data suggest that smaller lesions may have a greater chance of being benign than previously recognized [2]. At the same time, the number of treatment options now available for

small renal masses has increased. Furthermore, some renal masses cannot be accurately diagnosed using imaging alone. As a result, identifying the pathological characteristics of these incidentally discovered small renal masses is important in selecting optimal management. For such reasons, percutaneous renal biopsy has been performed [3-5]. We investigated the usefulness of ultrasonography (USG)-guided percutaneous core biopsy of renal masses.

MATERIALS AND METHODS

All renal biopsies performed between June 2008 and June

2012 were retrospectively reviewed; a total of 30 USG-guided biopsies were reviewed. This investigation was conducted in accordance with the Institutional Review Board at our hospital. All lesions appeared predominantly solid, although some had a minor cystic component; none had visible fat; and all were considered suspicious for malignancy based on abdominal computed tomography (CT).

A biopsy was performed by two radiologists (in each hospital) using an 18-gauge core biopsy needle gun. Under local anesthesia, patients were placed in the lateral decubitus position to expose the lesion side. After the lesion was confirmed, the tip of the introducer was placed at the periphery of the renal mass to minimize the possibility of tumor seeding along the needle tract by using USG (Philips Iu22; Philips Medical System, Bothell, WA, Germany) (Fig. 1). One to three cores were obtained per mass (Fig. 2). After the procedure, the patients were advised to rest in bed and to apply a sand bag to the site of biopsy for 6 hours. The next

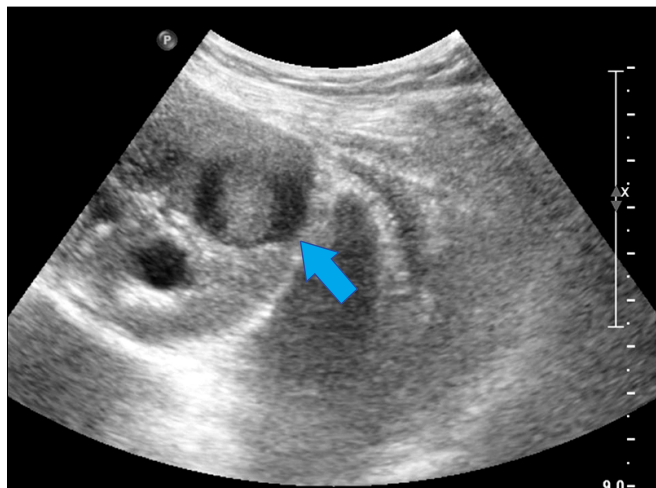


FIG. 1. Targeting the lesion (arrow indicated the mass).



FIG. 2. At the moment of puncture the lesion.

day, imaging evaluation was performed to rule out any complications. All patients returned home at the same time.

All of the patients' charts were reviewed to determine clinical data, such as age, sex, weight, height, tumor size, multifocality, location in the kidney of the tumor, number of iterative biopsies, complications, histopathological post-biopsy findings, and whether the lesions were cystic, solid, or mixed. The effect of the biopsy results on clinical management was used to determine whether follow-up treatment differed from surgical management. The biopsy results correlated with the definitive pathology findings at the time when the patients underwent surgical treatment, whereas the medical records were reviewed for patients who were treated conservatively to obtain information about the renal mass.

Biopsy failure is defined as the inability to obtain sufficient tissue for diagnosis, whereas inaccurate biopsies were categorized as false-negative or false-positive on the basis of the final pathological diagnosis. Biopsy-associated seeding was evaluated for, by CT, during follow-up in patients who did not undergo surgery. In patients who underwent surgery, perirenal and peritumor fat were specifically looked for to detect any tumor tract seeding.

RESULTS

The study population consisted of 16 men and 14 women with a mean age of 57.7 years (range, 41 to 79 years).

In 24 patients, biopsies were selected because the imaging study was unable to predict characteristics of the tumor because of its small size (Tables 1 and 2). Conventional renal biopsy indications such as suspected metastasis, lymphoma, and possible presence of abscess were met for 6 patients [6].

Eighteen of the biopsied masses were located in the right kidney, and 12 were located in the left kidney. The mean size of the biopsied lesions was 3.39 cm (range, 1.4 to 8.7 cm), and 6 tumors were larger than 4 cm. Three masses had mixed solid and cystic or necrotic components that met radiographic criteria for malignancy, as described by Israel and Bosniack [7]. Twenty-seven masses showed predominantly solid components.

TABLE 1. Patient characteristics

| Characteristic | Value |
|-------------------------------|------------------|
| Total no. of patients | 30 |
| Age (y), mean (range) | 57.7 (41.0–79.0) |
| Gender (male/female) | 16/14 |
| Tumor location (left/right) | 12/18 |
| Tumor size (cm), mean (range) | 3.39 (1.10–8.70) |
| Symptom | |
| Incidental | 22 |
| Flank pain | 7 |
| Anemia | 1 |

TABLE 2. Patient data, including tumor characteristics

| No | Age/sex | Tumor size (cm) | Laterality | Location | Biopsy pathology | Operation | Postoperative diagnosis | Cx | Comment |
|----|---------|-----------------|------------|----------|----------------------------------|-----------|------------------------------------|----|---------------------------------------|
| 1 | 52/M | 2.4 | Left | Middle | ccRCC | RNx | ccRCC | - | |
| 2 | 58/M | 2.3 | Right | Middle | ccRCC | PNx | ccRCC | + | |
| 3 | 55/M | 1.5 | Right | Middle | ccRCC | PNx | ccRCC | - | |
| 4 | 66/F | 2.0 | Right | Upper | ccRCC | Nx | Unknown | + | |
| 5 | 67/F | 7.5 | Right | Middle | ccRCC | PNx | ccRCC | - | Acquired single kidney |
| 6 | 71/F | 1.8 | Left | Lower | ccRCC | PNx | ccRCC | + | |
| 7 | 75/M | 3.3 | Right | Upper | R/O oncocytoma | PNx | Oncocytoma | - | Acquired single kidney |
| 8 | 79/M | 3.5 | Left | Middle | ccRCC | - | - | - | On radiation |
| 9 | 51/F | 3.0 | Left | Upper | Hypertrophy of column of Bertin | - | - | - | therapy for rectal cancer |
| 10 | 20/F | 3.7 | Right | Lower | Angiomyolipoma | - | - | - | Acquired single kidney |
| 11 | 46/F | 7.6 | Right | Upper | Angiomyolipoma | - | - | - | Patient want to confirm the pathology |
| 12 | 75/F | 8.0 | Left | Upper | Adenocarcinoma | RNx | Adenocarcinoma | - | R/O metastasis |
| 13 | 75/M | 6.3 | Right | Upper | Tubular atrophy | RNx | TCC | - | R/O renal abscess |
| 14 | 42/F | 4.3 | Right | Lower | Negative for malignant cell | PNx | Chronic granulomatous inflammation | - | |
| 15 | 48/F | 1.4 | Left | Lower | Failure | PNx | Unknown | - | Operation at other hospital |
| 16 | 57/M | 4.5 | Left | Middle | ccRCC | - | | + | Patient want to confirm the pathology |
| 17 | 62/M | 1.2 | Right | Middle | ccRCC | RNx | ccRCC | | |
| 18 | 41/M | 2.0 | Right | Middle | ccRCC | PNx | ccRCC | | |
| 19 | 79/F | 8.7 | Right | Lower | Keratinizing squamous metaplasia | - | | | R/O medical renal disease |
| 20 | 59/M | 3.9 | Left | Upper | ccRCC | - | | | Target therapy |
| 21 | 46/M | 3.6 | Left | Lower | Chronic inflammation | - | | | |
| 22 | 52/F | 1.8 | Right | Lower | Angiomyolipoma | - | | | |
| 23 | F/58 | 2.8 | Left | Middle | Hypertrophy of column of Bertin | - | | | |
| 24 | 57/M | 3.1 | Left | Middle | ccRCC | RNx | ccRCC | | |
| 25 | 44/F | 1.7 | Right | Middle | ccRCC | PNx | ccRCC | | |
| 26 | 48/M | 2.9 | Right | Middle | ccRCC | RNx | ccRCC | | |
| 27 | 55/M | 2.2 | Right | Middle | Oncocytoma | PNx | Oncocytoma | | |
| 28 | 60/M | 1.7 | Right | Middle | ccRCC | PNx | ccRCC | | |
| 29 | 65/F | 1.7 | Left | Upper | ccRCC | - | | | |
| 30 | 67/M | 1.3 | Right | Lower | ccRCC | PNx | ccRCC | + | |

Cx, complication; ccRCC, clear cell renal cell carcinoma; RNx, radical nephrectomy; PNx, partial nephrectomy; Nx, nephrectomy; R/O, rule out; RT, radiation therapy; TCC, transitional cell carcinoma.

In 1 of 30 cases, sufficient material for histopathological analysis was not obtained; thus, the success rate of core biopsy was 96.6%. The biopsy results included 17 renal cell carcinomas (56.7%), 3 angiomyolipomas (10.0%), 2 oncocytomas (6.7%), 1 adenocarcinoma (3.3%), and 7 benign lesions (23.3%).

Clinical treatment was altered in 7 of 29 patients (24.1%) who did not undergo surgery as a result of the biopsy results. In all seven of these patients, the lesions were benign (three patients had AML, two had hypertrophy of the column of Bertin, one had chronic inflammation, and one had keratinizing squamous metaplasia) and surveillance

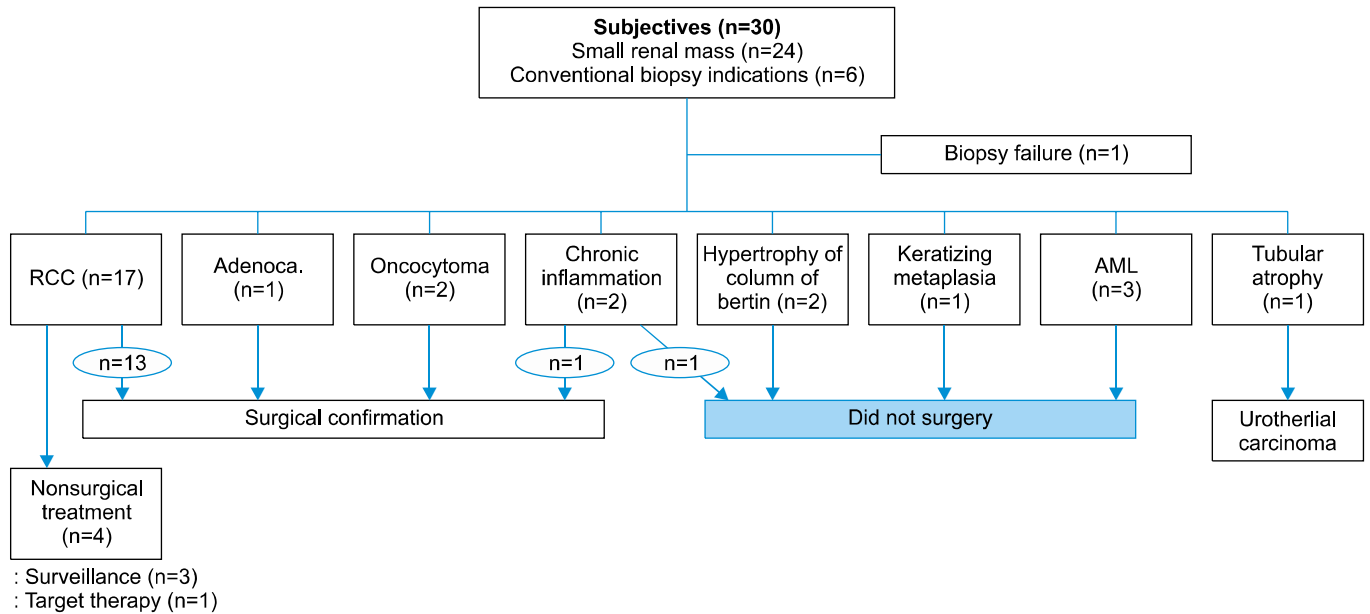


FIG. 3. The flow chart of percutaneous renal biopsy patients. RCC, renal cell carcinoma; AML, angiomyolipoma.



FIG. 4. Small perirenal hematoma formation after biopsy.

was recommended.

After the biopsies were performed, 18 of the 22 lesions were managed surgically; no surgical complexity was observed preoperatively, and no needle tract seeding was found in the pathological specimens or on follow-up imaging. The correlation between histological biopsy and postoperative findings was 94.4% (17 of 18). In the one case in which the biopsy result did not correlate with the surgical histopathologic results, a renal pelvis tumor with renal parenchymal invasion was found (Fig. 3).

A small perinephric hematoma (approximately 2–3 cm) was seen in 5 of 30 cases (16.7%) (Fig. 4). However, all of the patients remained hemodynamically stable throughout the procedure and over the following 24 hours, and none required a blood transfusion. No significant complications

such as fistulas or urinary tract or cutaneous infections were observed. During the 9-month follow-up period, no evidence of tumor track seeding was found in these patients by imaging.

DISCUSSION

Incidental small renal masses account for the largest proportion of newly diagnosed renal tumors, and most of these incidentally detected masses represent low-stage RCC [8]. However, recent data suggest that smaller lesions may have a greater chance of being benign than previously recognized. In a large series, Frank et al. [2] reported that 12.8% of lesions were benign and the remainders were malignant. Of the lesions that were less than 1 cm, 46.3% were benign and 53.7% were malignant.

Although surgical resection remains the standard of care for suspected localized RCC, some patients may not be candidates for excision because of medical comorbidities or an unwillingness to accept the risks inherent to surgery. In addition, older patients may have competing health risks that affect life expectancy more significantly than a small untreated, enhancing renal lesion [9].

Recently, there has been an undeniable paradigm shift in the management of small renal tumors toward nephron-sparing partial nephrectomy and minimally invasive therapies, such as ablative treatments and even watchful waiting. Also, treatment of small renal masses is rarely urgently warranted and need not be radical.

Except for AML, no specific evidence currently exists for an accurate diagnosis of carcinoma by current imaging modalities. The finding of an enhancing solid renal mass without radiographic evidence of fat on contrast-based cross-sectional imaging is considered diagnostic for RCC

and sufficient to recommend intervention. Moreover, when a renal mass is less than 40 mm, malignancies are sometimes doubtful; a large retrospective series reported that up to 15% of nephrectomies performed for these small tumors showed nonmalignancy [10]. Unfortunately, to our knowledge, more specific radiographic characteristics for predicting the biological potential of a tumor do not exist. Thus, identifying the pathologic characteristics of these incidentally discovered masses is important in the selection of optimal management.

Performing percutaneous biopsies for renal tumors remains controversial. In the past, theoretical and practical concerns about renal biopsy and the low negative predictive value in initial clinical studies led to the abandonment of renal biopsy as a diagnostic tool for small renal masses. Sampling error and tumor heterogeneity are major factors that contribute to the inaccuracy of a renal biopsy result [4].

However, recent investigations by Wood et al. [11] and Richter et al. [4] have concluded that percutaneous biopsy of renal masses is safe, accurate, and useful. They reported sensitivities of percutaneous renal biopsy of 76% to 93% for malignancy and false-negative rates ranging from 6% to 21%. In addition, Lane et al. [5] reported that biopsy failures occurred in 8.9% (0–22%) and false-negative histopathological findings occurred in 4.4% of percutaneous renal mass biopsies. Successful biopsies yielded an accurate diagnosis in 80.9% of renal masses suspected to be RCC.

As a guiding method, USG seems to have several advantages. It is generally available, most urologist can perform it, and the device is portable yet provides multiplanar and real-time imaging. Unfortunately, not all small renal tumors can be visualized by USG, and adjacent structures and organs cannot be differentiated as they can be with CT. In addition, gas and bony structures can obscure visibility. However, the needle can be directed to solid components in the mass, and the needle location can be confirmed at the time of biopsy, which allows a more precise placement of the needle and a better core specimen.

In our series, one biopsy failure occurred (an insufficient amount of tissue was obtained). In that case, the tumor was well identified, and there was no problem on targeting. However, the specimen was too small, hard, and movable to obtain enough tissue.

The correlation between histological diagnosis on biopsy and surgical specimens was 90.0% (9 of 10). This high correlation corresponds to findings from previously reported studies in the medical literature [12]. Immunohistochemical staining methods also increase diagnostic precision [13]. Histological analysis did not permit accurate diagnosis of the renal lesions in one biopsied tumor (tubular atrophy). The lesions contained necrosis, which resembled a cystic area on CT. At the time of biopsy by USG, the core biopsy was targeted on a noncystic area, which may have been the reason for the inaccurate result. In the case of an unexpected biopsy result, a repeat percutaneous renal biopsy or surgical treatment should be considered.

Surgery can often be avoided after a benign lesion diagnosis by biopsy. Nevertheless, this approach is not a standard procedure in all cases. Surgical management of oncocytoma continues to be the standard approach when the lesion is voluminous, histopathologically doubtful, or symptomatic. In our series, 4 of 17 biopsies indicated a benign lesion, for which surgery could be avoided.

Morbidity was low in this study. Five cases of subcapsular hematoma and one case of gross hematuria were observed, which resolved without treatment. Hemorrhage after this procedure is common and mild. Leuret et al. [14] reported that hematuria should not be considered a complication. Ralls et al. [15] found that hematomas were observed after 91% of percutaneous renal biopsies. Neuzillet et al. [16] reported low morbidity in their series. All authors considered renal biopsies to be safe and recommended as an outpatient procedure.

Tumor tract seeding should be considered a special issue, and it has been proposed as a negative argument against biopsies. Malignant cell migration along the tunnel tract with dissemination risk was described using a cyto-aspiration fine-needle procedure. Smith [17] reported tract seeding in 0.01% of cases in a large series of abdominal mass cyto-aspirations. Moreover, coaxial systems appear to provide more safety and a lower dissemination risk.

Four patients were found to have RCC by biopsy, but did not undergo surgery. Target therapy was performed in one patient with metastases. One patient died during radiation therapy for rectal cancer, which had been previously diagnosed. Two patients adamantly refused to undergo surgery; therefore, we decided to perform active surveillance. We recommended chest X-ray, blood analysis, and abdominal CT at 3 months following pathological confirmation and then every 6 months if there was no remarkable growth of the tumor.

CONCLUSIONS

Although the number of subjects in this study was small, all biopsies were performed safely. USG-guided renal biopsy is an accurate tool for the pathological evaluation of small solid renal masses with an uncertain diagnosis. This diagnostic modality should be considered selectively for renal lesions with an incomplete diagnosis based on extensive imaging.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

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