Unexpected Discoveries: Uncovering Incidental Tumors in Simple Nephrectomy Specimens

Hallazgos inesperados: descubrimiento de tumores incidentales en muestras de nefrectomía simple


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ABSTRACT

Objectives: We aimed to evaluate the characteristics of patients with incidental kidney tumors detected in the pathological examination performed after simple nephrectomy due to a non-functioning kidney.

Patients and methods: The pathology results of nephrectomy specimens from patients who underwent simple nephrectomy with the diagnosis of non-functioning kidney between January 2012 and March 2021 were retrospectively analyzed. Data regarding demographic information, imaging methods, and clinical and histopathological features of the patients were collected. The number of patients with incidental renal tumors was determined.

Results: A total of 163 patients with nonfunctioning kidneys who underwent simple nephrectomy between January 2012 and March 2021 were included in the study. Sixty-nine (42.3%) patients were male and 94 (57.7%) patients were female. The most common complaint was flank pain (60.7%). The cause of the nonfunctioning kidney was urinary stones in 116 (71.2%) patients and ureteropelvic/ureterovesical junction stenosis in 21 (10.1%) patients. Incidental renal tumors were detected in 21 (12.9%) patients. Papillary adenoma was the most common renal tumor and was detected in 11 patients. Four patients had renal cell carcinoma and 4 patients had urothelial cell carcinoma (UCC). Three of the patients with UCC had high grade invasive UCC with squamous differentiation and 1 patient had low grade papillary UCC.

Conclusion: In non-functioning kidneys, kidney tumors may be overlooked due to radiological and clinical diagnostic difficulties. Therefore, careful macroscopic and microscopic histopathological evaluation is necessary to detect incidental renal tumors.

RESUMEN

Objetivos: Nuestro objetivo fue evaluar las características de los pacientes con tumores renales incidentales detectados en el examen patológico realizado tras nefrectomía simple por riñón no funcionante.

Pacientes y métodos: Se analizaron retrospectivamente los resultados anatomopatológicos de las muestras de nefrectomía de pacientes sometidas a nefrectomía simple con diagnóstico de riñón no funcionante entre enero de 2012 y marzo de 2021. Se recopilaron datos sobre información demográfica, métodos de imagen y características clínicas e histopatológicas de los pacientes. Se determinó el número de pacientes con tumores renales incidentales.

Resultados: Se incluyeron en el estudio un total de 163 pacientes con riñones no funcionantes sometidos a nefrectomía simple...
The non-functioning kidney is diagnosed based on clinical and radiological findings. Several criteria are utilized to define non-functioning kidneys, including paper-thin renal parenchyma (renal parenchymal thickness <5 mm) on urinary ultrasound or computed tomography, non-visualization of collecting duct system on intravenous pyelography (IVP), an exhibition of less than 10% renal function in dimercaptosuccinic acid scan (DMSA) and a glomerular filtration rate of <10 mL/min/1.73 m² in the affected kidney determined by nuclear renography. In the etiology of non-functioning kidneys, there are many causes such as adult polycystic kidney disease, acquired cystic kidney disease, unsuccessful transplantation, urolithiasis, chronic pyelonephritis and end-stage kidney disease due to other causes (diabetes, hypertension, etc). Surgical intervention is not always necessary for a non-functioning kidney. A simple nephrectomy is usually performed in symptomatic patients with chronic infection, pyelonephritis, or obstruction. Despite its name, a simple nephrectomy can be challenging due to widespread inflammation and scar tissue, potentially making it more difficult than radical nephrectomy. The advancement of minimally invasive surgical techniques has introduced simple laparoscopic nephrectomy as a viable alternative to open nephrectomy. Histopathological examination of non-functioning kidneys reveals various findings depending on the underlying etiology. These may include inflammation, glomerular sclerosis, tubular atrophy, thyroidization, nephrocalcinosis, chronic pyelonephritis, xanthogranulomatous pyelonephritis (XP), dysplastic tubules, and cystic structures.

There are several case reports in the literature about incidentally detected tumors of non-functioning kidneys. The preoperative diagnosis of renal lesions in non-functioning kidneys with conditions such as chronic pyelonephritis, XP, and obstructing renal stones can be challenging using imaging modalities. In such cases, the diagnosis is often made through pathological examination. However, only a limited number of studies that investigate incidentally detected renal tumors following a simple nephrectomy exist.

The objective of this study was to assess the characteristics of patients who had incidental kidney tumors identified during pathological examination following a simple nephrectomy for a non-functioning kidney. Additionally, we conducted a retrospective review of the histopathological features of these patients and documented the common findings.

**MATERIAL AND METHODS**

**Patient Data**

Patients who underwent simple nephrectomy with the diagnosis of a non-functioning kidney between January 2012 and March 2021 were included in the study. The pathology reports of all the cases were reviewed, and the histopathological features and the histological types of the cases with kidney tumors were documented. Patients with a significant renal function (split renal function > 15%) or a suspicious lesion diagnosed preoperatively with computed tomography (CT) or magnetic resonance imaging (MRI) and patients <18 years old were excluded from the study.

The diagnosis of a non-functioning kidney in this study was established using DMSA. Those with split renal function less than 10% were considered non-functioning. In patients with a split renal function between 10-15%, if there was a diffuse decrease in the renal parenchymal thickness (<5 mm), diffuse inflammation and scarring on CT or MRI, the kidney was considered non-functioning and simple nephrectomy was performed. This retrospective study was approved by the Medical Ethics Committee of our University (Approval No: 2021-7228).

**Statistical analysis**

Descriptive statistics were used to summarize the data, and the frequencies with percentages were reported for categorical variables. SPSS (IBM Corp. Released 2019. IBM SPSS Statistics for Windows, Version 26.0, Armonk, NY: IBM Corp) software was used for data analysis.

**RESULTS**

A total of 163 patients with non-functioning kidneys who underwent simple nephrectomy between January 2012 and March 2021 were included in the study. Demographic data and clinical features are given in Table 1. The median age of the patients was 48 (38–58) years. Sixty-nine (42.3%) patients were male and 94 (57.7%) patients were female. The most common complaint was flank pain and it was...
reported by 99 (60.7%) patients. Non-functioning kidneys were in- 
cidentally detected in 32 (19.6%) patients. Recurrent urinary tract 
infections and hematuria were reported by 18 (11.1%) and 4 (2.5%) 
patients, respectively. The other 10 patients had various complaints 
like abdominal swelling, urinary incontinence, nausea, and vomiting.

The main cause of non-functioning kidneys was urinary stones, af-
flecting 116 (71.2%) patients, followed by ureteropelvic/ureteroves-
cical junction (UPJ/UVJ) stenosis in 30 (18.4%) cases and vesicoureteral 
reflux (VUR) in 11 (6.8%) patients.

All patients underwent urinary ultrasonography preoperatively. Ad-
ditionally, 100 patients had non-contrast CT, 45 patients had con-
trast-enhanced CT, 8 patients had CT-urography, 1 patient had a 
non-contrast MRI, 4 patients had contrast-enhanced MRI, 2 patients 
had MRI-urography and 3 patients had intravenous pyelography 
(IVP) before the operation.

After pathological examination of nephrectomy specimens, chronic 
pyelonephritis was detected in 121 (74.2%) patients, tumors in 21 
(12.9%) patients, XP in 18 (11.1%) patients, polycystic kidneys in 2 
(1.2%) patients and necrotizing granulomatous pyelonephritis was 
detected in 1 (0.6%) patient (Figure 1, Table 2).

### Table 1. Demographic data and clinical features

<table>
<thead>
<tr>
<th>Number of Patients</th>
<th>163</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median Age, years (IQR)</td>
<td>48 (38–58)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Female, n (%)</td>
<td>94 (57.7)</td>
</tr>
<tr>
<td>Male, n (%)</td>
<td>69 (42.3)</td>
</tr>
<tr>
<td>Laterality</td>
<td></td>
</tr>
<tr>
<td>Right, n (%)</td>
<td>78 (47.9)</td>
</tr>
<tr>
<td>Left, n (%)</td>
<td>85 (52.1)</td>
</tr>
<tr>
<td>Median Split Renal Function, % (IQR)</td>
<td>3 (0–8)</td>
</tr>
<tr>
<td>Main Complaint</td>
<td></td>
</tr>
<tr>
<td>Flank pain, n (%)</td>
<td>99 (60.7)</td>
</tr>
<tr>
<td>Incidental, n (%)</td>
<td>32 (19.6)</td>
</tr>
<tr>
<td>Urinary tract infection, n (%)</td>
<td>18 (11.1)</td>
</tr>
<tr>
<td>Hematuria, n (%)</td>
<td>4 (2.5)</td>
</tr>
<tr>
<td>Others, n (%)</td>
<td>10 (6.1)</td>
</tr>
<tr>
<td>Etiology</td>
<td></td>
</tr>
<tr>
<td>Urolithiasis, n (%)</td>
<td>116 (71.2)</td>
</tr>
<tr>
<td>UPJ/UVJ, n (%)</td>
<td>30 (18.4)</td>
</tr>
<tr>
<td>VUR, n (%)</td>
<td>11 (6.8)</td>
</tr>
<tr>
<td>Renal artery stenosis, n (%)</td>
<td>3 (1.8)</td>
</tr>
<tr>
<td>PKD, n (%)</td>
<td>2 (1.2)</td>
</tr>
<tr>
<td>Urinary TBC, n (%)</td>
<td>1 (0.6)</td>
</tr>
</tbody>
</table>

IQR: Interquartile range. UPJ: Ureteropelvic Junction, UVJ: Ureteroves-
ical Junction, VUR: Vesicoureteral Reflux, PKD: Polycystic Kidney Disease, 
TBC: Tuberculosis

### Table 2. Histopathological characteristics of the patients

| Chronic Pyelonephritis, n (%) | 121 (74.2) |
| Tumor, n (%) | 21 (12.9) |
| Xanthogranulomatous Pyelonephritis, n (%) | 18 (11.1) |
| Polycystic Kidney Disease, n (%) | 2 (1.2) |
| Necrotizing Granulomatous Nephritis, n (%) | 1 (0.6) |

Of the tumors detected histopathologically, 13 (61.9%) were benign 
and 8 (38.1%) were malignant (Table 3). In patients with tumors, 20 
patients had chronic pyelonephritis and one patient had xanthogran-
ulomatous pyelonephritis. The most commonly observed benign tu-
mor was papillary adenoma. Four patients were diagnosed with renal 
cell carcinoma (RCC), and another four patients with urothelial cell car-
cinoma (UCO). Among the UCC cases, three had high-grade invasive 
UC with squamous differentiation, and one had low-grade papillary 
UC (Table 3). The median tumor size of the malignant tumors was 
8.25 (4.5–9.5) cm. In patients with malignant tumors (n=8), the most 
common preoperative complaint was flank pain and it was reported 
by 4 patients (50%). One (12.5%) patient had hematuria and 3 (37.5%) 
patients had no complaints. Further details regarding the characteris-
tics of patients with malignant tumors are shown in table 4.

### DISCUSSION

Thanks to the advances in radiological imaging methods, the diag-
nosis of kidney tumors has become easier with imaging modalities 
like ultrasonography, CT, or MRI in individuals with normally func-
tioning kidneys. However, renal tumors can be missed in patients
with non-functioning kidneys especially in those with severe inflammation, scarring, and urolithiasis. These situations may obscure the presence of a malignant tumor. Simple nephrectomy is the surgical removal of the kidney through Gerota's fascia and is performed in patients with benign diseases of the kidney. Radical nephrectomy is the removal of the kidney with Gerota's fascia and is performed in malignant diseases of the kidney.

Although it is rare, a kidney tumor may be detected after pathological examination of the specimen in patients who underwent simple nephrectomy. There is limited data available in the literature regarding this topic. Zengin et al. conducted a study involving 97 patients who underwent simple nephrectomy for non-functioning kidneys caused by urolithiasis and reported that in 9 (9.3%) patients, a malignant tumor was detected in pathological examination. This rate is almost twice the rate of what we detected. Among these 9 patients, 3 had UCC, 3 had RCC (1 sarcomatoid, 1 papillary, and 1 clear cell), 2 had squamous cell cancer (SCC) and 1 patient had both RCC and UCC. In their series, the most common pathological diagnosis, similar to our study, was chronic pyelonephritis (in 79 patients), followed by XP in 9 patients. They also reported that papillary adenoma was detected in 2 patients with chronic pyelonephritis. The rate of papillary adenoma in our series was higher. They made no comment about the type of preoperative imaging method they used. Lin et al. evaluated the incidence of RCC in non-functioning kidneys in their study. They analyzed 311 nephrectomy specimens obtained from 279 patients with non-functioning kidneys. They found that 73 (23.5%) nephrectomy specimens had RCC and most of these cases had acquired cystic kidney disease or end-stage renal disease. Clear cell RCC was the most common subtype followed by papillary RCC. However, the type of nephrectomy (simple or radical) was not specified in their study, and it included patients who had a preoperative diagnosis of RCC. Additionally, the study did not provide information on other types of renal tumors apart from RCC. Angerri et al. performed simple laparoscopic nephrectomy on 96 patients with urolithiasis and split renal function < 15%. They detected SCC in 1 (1.04%) patient. In our study, we detected renal tumors in 21 (12.9%) patients and 8 (4.9%) were malignant in the whole group. The number of patients who developed a non-functioning kidney due to urolithiasis was 116; in 3 (2.6%) of these patients, malignant tumors were detected through histopathological evaluation. This rate is lower than the value reported by Zengin et al. In the study conducted by Yeh et al., 47 patients with non-functioning kidneys due to urolithiasis were evaluated. They detected renal tumors in 24 patients. In 7 of these patients, tumors were detected preoperatively therefore the detection rate of incidental tumors was 36.2%. This is still a very high rate. They speculated that the inadequacy of USG, IVP and retrograde pyelography in detecting malignant lesions may have led to this result and they recommended performing an MRI before the operation in these patients. It is worth noting that the study by Yeh et al. is from 2007, and advancements in imaging techniques and protocols have

### Table 3. Classification of tumors (n=21)

<table>
<thead>
<tr>
<th></th>
<th>Benign Tumors</th>
<th>Malignant Tumors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Papillary Adenoma, n (%)</td>
<td>11 (52.3)</td>
<td>RCC</td>
</tr>
<tr>
<td>Oncocytosis, n (%)</td>
<td>1 (4.8)</td>
<td>Clear Cell RCC, n (%)</td>
</tr>
<tr>
<td>Renomedullary Interstitial Cell Tumor, n (%)</td>
<td>1 (4.8)</td>
<td>Papillary RCC, n (%)</td>
</tr>
<tr>
<td>UCC</td>
<td>Low grade, n (%)</td>
<td>Chromophobe RCC, n (%)</td>
</tr>
<tr>
<td>High Grade UCC with squamous differentiation, n (%)</td>
<td>3 (14.2)</td>
<td></td>
</tr>
</tbody>
</table>

RCC: Renal Cell Cancer; UCC: Urothelial Cell Carcinoma.

with non-functioning kidneys especially in those with severe inflammation, scarring, and urolithiasis. These situations may obscure the presence of a malignant tumor. Simple nephrectomy is the surgical removal of the kidney through Gerota's fascia and is performed in patients with benign diseases of the kidney. Radical nephrectomy is the removal of the kidney with Gerota's fascia and is performed in malignant diseases of the kidney.

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### Table 4. Characteristics of the patients with malignant tumors (n=8)

<table>
<thead>
<tr>
<th>Case</th>
<th>Age (years)</th>
<th>Gender</th>
<th>Laterality</th>
<th>SRF (%)</th>
<th>Etiology</th>
<th>Preop. Imaging</th>
<th>Diagnosis</th>
<th>Tumor Diameter (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>35</td>
<td>Female</td>
<td>Right</td>
<td>2</td>
<td>UPJ stenosis</td>
<td>Contrast CT</td>
<td>Clear cell RCC</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>31</td>
<td>Female</td>
<td>Left</td>
<td>0</td>
<td>Urolithiasis</td>
<td>Noncontrast CT</td>
<td>Papillary RCC</td>
<td>1.5</td>
</tr>
<tr>
<td>3</td>
<td>60</td>
<td>Male</td>
<td>Right</td>
<td>12</td>
<td>Urolithiasis</td>
<td>Noncontrast CT</td>
<td>UCC with squam. diff.</td>
<td>9.5</td>
</tr>
<tr>
<td>4</td>
<td>43</td>
<td>Female</td>
<td>Left</td>
<td>0</td>
<td>Urolithiasis</td>
<td>Noncontrast CT</td>
<td>Chromophobe RCC</td>
<td>6.5</td>
</tr>
<tr>
<td>5</td>
<td>80</td>
<td>Male</td>
<td>Right</td>
<td>0</td>
<td>UPJ stenosis</td>
<td>Noncontrast CT</td>
<td>UCC low grade</td>
<td>N/A</td>
</tr>
<tr>
<td>6</td>
<td>45</td>
<td>Female</td>
<td>Left</td>
<td>8</td>
<td>VUR</td>
<td>Contrast CT</td>
<td>Clear cell RCC</td>
<td>4.5</td>
</tr>
<tr>
<td>7</td>
<td>72</td>
<td>Female</td>
<td>Left</td>
<td>0</td>
<td>UVJ stricture</td>
<td>Contrast MR</td>
<td>UCC with squam. diff.</td>
<td>N/A</td>
</tr>
<tr>
<td>8</td>
<td>76</td>
<td>Female</td>
<td>Right</td>
<td>0</td>
<td>UPJ stenosis</td>
<td>MR urography</td>
<td>UCC with squam. diff.</td>
<td>10</td>
</tr>
</tbody>
</table>

obtained from case reports. Most of the information on renal SCC is obtained from case reports. Most of the information on renal SCC is obtained from case reports. It is believed that renal SCC is closely related to kidney stones, chronic infection, and inflammation\(^6\). Jain et al. reported a case series of 4 patients with renal SCC who had staghorn calculi and non-functioning kidneys\(^6\). In three of these cases, the diagnosis was established by postoperative pathological examination; there was no evidence of malignancy on preoperative radiological evaluation. Since SCC metastases to the kidney may also occur, it is essential to show the transition from squamous metaplasia areas to the tumor to support the primary diagnosis. In our study, we did not have a case with a diagnosis of squamous cell carcinoma after a simple nephrectomy. However, we had a urothelial carcinoma case with an extensive squamous differentiation in a patient with urolithiasis and 2 cases of UCC with squamous differentiation in patients with ureteropelvic/ureterovesical junction stenosis.

There is no specific follow-up protocol defined for patients with malignant tumors detected after simple nephrectomy. We considered these patients at high risk for recurrence or metastasis and followed them closely, similar to patients who underwent radical nephrectomy, with frequent contrast-enhanced CT or MRI.

A papillary adenoma is an unencapsulated small-sized tumor with papillary or tubular architecture and low nuclear grade\(^10\). They are associated with papillary RCC and the most important distinguishing factor is their size (≤15 mm)\(^15\). Due to their small size, they are not usually detected by imaging methods and are most commonly found incidentally in nephrectomy specimens. Caliò et al. reported the incidence of papillary adenoma as 19% in their autopsy study\(^16\). This incidence increased to 25% in cases >40 years old. Wang et al. evaluated 542 consecutive nephrectomy specimens and detected papillary adenomas in 38 (7%) patients\(^17\).

Papillary adenoma was the most common incidental tumor lesion in our series (6.7%), a rate similar to that reported by Wang et al. The high incidence of papillary adenoma in the study by Caliò et al. may be attributed to the fact that it was an autopsy study\(^16\).

The most common histopathological diagnoses in nephrectomies performed for non-functioning kidneys are chronic pyelonephritis, XP, polycystic kidney, and granulomatous pyelonephritis\(^1,18,19\). In our study, chronic pyelonephritis was found in 71.1% and XP in 9.6%, which is consistent with the literature. Tuberculosis is a granulomatous disease and it is more commonly observed in developing and low-income countries\(^20\). Tuberculosis may affect the entire urinary system and the kidneys are the most frequently affected urogenital organs\(^21,22\). We also had a diagnosis of granulomatous pyelonephritis in one of our cases, and the case was being followed up for tuberculosis.

**Limitations**

This study has several limitations. It is a retrospective study with a limited number of patients. The radiological imaging methods were reviewed by different radiologists which might affect the preoperative diagnosis of suspicious lesions.
CONCLUSION

In non-functioning kidneys, tumors may be overlooked due to radiological and clinical diagnostic difficulties. The possibility of detecting a tumor in histopathological examination after simple nephrectomy is low and most of these tumors are benign. However, rarely, malignant lesions like RCC and UCC can be missed preoperatively by imaging methods in some patients with non-functioning kidneys and detected after the pathological examination. Therefore, the possible presence of a concomitant tumor should be considered when evaluating non-functioning kidneys, and macroscopic and microscopic examinations should be done carefully.

Funding sources
Authors have not received any funding for this research.

Conflicts of interest
All authors declare that they have no conflicts of interest.

Ethical approval
The study was approved by the Ethics Committee of Bezmialem Vakif University with the approval number (2021-7228).

Author Contributions
Drafting of the manuscript: GC, BCT, NS. Critical revision: GC, PY, HT. All authors declare that they have no conflicts of interest.

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