

Original Article

Incidental renal neoplasia following simple nephrectomy of the non-functioning kidney. Is it more common than previously reported?

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Abstract

Background: Simple nephrectomy is a technique of removing the kidney from within the Gerota's fascia and is usually for a non-functioning kidney. While for renal tumors, radical nephrectomy is done, which involves the removal of the kidney with Gerota's fascia along with the ureter. Histopathology of patients who undergo simple nephrectomy sometime reveals renal malignancy. Such patients often need further treatment as simple nephrectomy in such cases is mostly suboptimal. The number of studies reporting tumors in simple nephrectomy specimens is limited. We aim to report single-center pathological findings in nephrectomy specimens from patients treated for non-functioning kidneys due to renal stone disease.

Methodology: The medical record of patients (n=210) who underwent simple nephrectomy between 2014 and 2021 at the Kidney Centre Postgraduate Training Institute due to renal stone disease was reviewed retrospectively.

Results: The total number of patients undergoing simple nephrectomy for non-functioning kidneys due to stone disease was 210. Of those patients, 117 were males, and 93 were females. The mean age was 45.33 ± 17.65 years. The histopathology report of specimens revealed renal malignancy in 10 patients (4.76%), xanthogranulomatous pyelonephritis in 11 patients, tuberculosis of the kidney in 7 patients, and chronic pyelonephritis in 182 patients.

Conclusion: In conclusion, the prevalence of renal malignancy in patients undergoing simple nephrectomy is significantly high.

Keywords

Non-Functioning Kidney, Renal Malignancy, Renal Cell Carcinoma, Chronic Pyelonephritis.



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Introduction

The term simple nephrectomy describes the technique of removing the kidney from within the Gerota's fascia. It is usually performed in the setting of non-neoplastic disease. In contrast to simple nephrectomy, where only the kidney is removed with the proximal part of the ureter, radical nephrectomy involves removing the kidney along with Gerota's fascia, adrenal gland, lymph nodes, and proximal two-thirds ureter¹. Common symptoms of simple nephrectomy include trauma, renal infections (e.g., pyelonephritis and pyonephrosis), and non-functioning kidneys due to stone or obstruction, and congenital disorders.

Renal stone is one of the predisposing factors for causing chronic inflammation in the kidney's collecting system. And chronic inflammation has long been demonstrated as a precursor for different cancers², and the effect of chronic inflammation in causing bladder cancer is well established³. A population-based prospective cohort study in Sweden by WH Chow et al. reported that the most common malignancy associated with renal stone is squamous cell carcinoma because of long-standing infection and chronic irritation of urothelium⁴.

The kidney loses its function when a prolonged obstruction is due to renal stone disease. In a non-functioning kidney, imaging modalities, including intravenous urography and contrast-enhanced computed tomography, do not help diagnose renal neoplasia. Because there is no contrast uptake by the non-functioning kidney unit or there is limited uptake, making it is very difficult to diagnose renal neoplasia. Furthermore, the diagnosis of renal neoplasia can also be challenging because the symptoms may mimic the stone disease. Because of this reason, many patients with renal neoplasia go undiagnosed until the histopathology report reveals after nephrectomy the presence of renal neoplasia. Such a situation requires careful postoperative consideration, as performing a simple nephrectomy in patients with renal neoplasia can be a suboptimal treatment option.

The dilemma with this situation is that if renal neoplasia is known beforehand, the surgery of choice will be radical nephrectomy (radical nephroureterectomy with bladder cuff in case of transitional cell carcinoma) instead of simple nephrectomy to ensure the tumor-free margins and thus increasing the cancer-free survival and overall survival⁵.

The number of studies and case reports reporting tumors in specimens from patients undergoing nephrectomy for non-functioning kidneys due to kidney stones is limited⁶. There is no local data on this subject, and even the international data is very limited.

This study aims to report pathological findings in nephrectomy specimens from patients treated for non-functioning kidneys due to renal stone disease.

Methodology

The medical record of all the patients (n=210) who underwent simple nephrectomy at The Kidney Centre Postgraduate training institute for non-functioning kidneys due to renal stone disease between 2014 to 2021 was reviewed retrospectively. The indications of nephrectomy included the patients with non-functioning kidneys due to stone disease along with either these: severe flank pain, recurrent urinary tract infections (UTI), pyonephrosis, and uncontrolled hypertension because of the non-functioning kidney. The patient's data and pathological reports of the specimens were reviewed retrospectively, and confidentiality was maintained.

All the patients underwent either simple open nephrectomy by flank incision or laparoscopic nephrectomy. The specimens were sent to a histopathologist at study hospital as per routine practice. Patients whose malignancy was detected in the histopathology findings were treated according to the standard of care. Patients with renal cell carcinoma (RCC) and squamous cell carcinoma (SCC) were followed serially with imaging to see if they had local recurrence or metastasis. Only one patient had metastasis which

was dealt with tyrosine kinase inhibitors. Patients with transitional cell carcinoma (TCC) underwent ureterectomy, bladder cuff excision, and cystoscopy immediately after the histopathology results.

The histopathology reports and age and gender were recorded in digital form. Mean and standard deviation was calculated for age, while percentages for gender and histopathology findings. For data entry and analysis, SPSS version 23.0 was used.

Results

Two hundred ten patients underwent simple nephrectomy due to their non-functioning kidneys because of renal stone disease. A non-functioning kidney was diagnosed based on functional nuclear scintigraphy showing split function less than 10% or no contrast uptake in intravenous pyelography. Of the 210 patients, 117 were male, and 93 were female (Table 1). The mean age of patients undergoing nephrectomy was 45.33 ± 17.65 years. The histopathology report of specimens revealed renal malignancy in 10 patients, xanthogranulomatous pyelonephritis in 11 patients, tuberculosis of the kidney in 7 patients, and chronic pyelonephritis in 182 patients.

Amongst the patients with renal malignancy, 7 were males, while 3 were females. Renal cell carcinoma was found in 4 specimens, transitional cell carcinoma in 3 specimens, and squamous cell carcinoma in 3 specimens. The prevalence of overall renal malignancy was 4.76% in our study.

After the histopathology was reported, patients with RCC ($n = 4$) and SCC ($n = 3$) were followed extensively with CT urography serial imaging at 3, 6, and 12 months to see if there was a residual disease or any sign of metastasis. Only one patient with renal cell carcinoma had metastasis reported 6 months after surgery which was dealt with Sunitinib, a tyrosine kinase inhibitor (TKI). The patient died 6 months after initiation of TKI.

Patients whose histopathology revealed transitional cell carcinoma were counseled for subsequent surgery and underwent cystoscopy to rule out TCC bladder and ipsilateral ureterectomy and bladder cuff excision.

All three patients with transitional cell carcinoma, four renal cell carcinoma cases, and 2 cases of squamous cell carcinoma had non-contrast-enhanced computed tomography as part of their diagnostic workup. None of them had preoperative suspicion of renal malignancy based on their imaging findings.

Table 1: Patient's age and the histopathology reports of renal specimens.

Variables	n=210	
Age; years (Mean±SD)	48.31±10.66	
Gender n (%)	Male	117(55.71)
	Female	93(44.28)
Histopathology n (%)	210(100)	
Renal Malignancy	10(4.76)	
	TCC	3(1.42)
	RCC	4(1.94)
	SCC	3(1.42)
Xanthogranulomatous pyelonephritis	11(5.23)	
Tuberculosis of kidney	7(3.33)	
Chronic Pyelonephritis	182(86.66)	

SD-Standard Deviation, RCC-Renal Cell Carcinoma, SCC-Squamous Cell Carcinoma, TCC-Transitional Cell Carcinoma.

Discussion

The prevalence of malignancy within non-functioning kidneys due to renal stone is still unclear. It is, however, known that due to stone disease, the type of malignancy that is most common is squamous cell carcinoma which occurs as a result of chronic inflammation and insult to the renal parenchyma⁷. However, our study noted that renal cell carcinoma (1.94%) was more common than squamous cell carcinoma (1.42%). Therefore, while it may be that chronic inflammation due to stone may have given rise to renal malignancy, there may also have been some undetected tumors that were only detected on histopathology.

Many malignancies remain undetected in patients with renal stone disease because the symptoms of malignancy mimic that of stone diseases, such as hematuria, flank pain, and urinary tract infection⁸. Also, patients with renal stone disease undergo non-contrast-enhanced computed tomography (NCCT) as the standard of care. Even if computed tomography is ordered in patients with suspicion of renal neoplasia (the fact that the non-functioning kidneys), because of their inability to uptake contrast and thus no enhancement of masses, makes it difficult to diagnose the renal malignancy. Also, the CT scan without the aid of contrast cannot differentiate between the necrotic area and the renal mass.

Patients undergoing nephrectomy usually undergo preoperative computed tomography without contrast at our institute. Interestingly, all three patients with transitional cell carcinoma, four renal cell carcinoma cases, and 2 cases of squamous cell carcinoma had non-contrast-enhanced computed tomography as part of their diagnostic workup. None of them had a preoperative diagnosis of renal malignancy based on their imaging findings. The available literature shows that non-contrast-enhanced computed tomography is not very good at picking up renal neoplasia, especially if the tumor size is less than 3 cm. Stacy et al.⁹, in their retrospective study of more than 15000 patients who underwent non-contrast-enhanced computed tomography of the abdomen for reasons other than a diagnosis of renal neoplasia, identified that

over one-third of patients with potential renal neoplasia were missed. But the majority of patients had functioning kidneys instead of non-functioning kidneys. Diagnosis of renal neoplasia without the aid of contrast is difficult in functioning kidneys with normal parenchyma. Still, it is even more difficult in patients with distorted or no parenchyma. Additionally, tumors of transitional cell origin are not detected unless they are T1/T2 and above.

In the case of indeterminant masses of the kidneys on non-contrast-enhanced CT scans, radiologists have employed some principles to identify if that indeterminant mass/cyst is malignant or benign. If mass/cyst is homogenous and has Hounsfield unit (HU) above 70 or below 20, it is considered benign^{10,11}. If HU is between 20 to 70, is heterogenous, contains thick wall or septa, and is considered malignant^{12,13}, further imaging with contrast is warranted. From these literature findings, it is known that the only way non-contrast CT imaging can help identify renal neoplasia is by differences in attenuation between the normal renal parenchyma and the neoplastic area, along with distorted renal parenchyma of the neoplastic region¹⁴. Sadly, these principles cannot be employed in patients with non-functioning kidneys since there is little to no parenchyma. Any parenchyma has areas of necrosis and fibrosis from recurrent infections due to renal stone disease.

In one of the studies by Shah et al., it was reported that at least two cases of untreated staghorn stone were associated directly with renal malignancy¹⁵. In one study from Europe¹⁶, renal carcinoma per 100,000 people is 15.8% for men and 7.1% for women. It is higher than our pathological reporting of the renal masses, which is 4.76%. Therefore, when a patient undergoes a nephrectomy of their non-functioning kidney due to stone disease, he may be counseled about the possibility of renal malignancy, albeit less frequent it is.

In conclusion, renal malignancy in patients undergoing simple nephrectomy is significantly high. Thus, the non-functioning kidneys with the renal stone disease may be treated on priority

because of their potential to harbor renal malignancies. Also, the patients may be counseled about the possibility of renal malignancy on histopathology reporting, thus warrant additional treatment or surveillance. Additionally, imaging protocols may be developed to better identify the patients who harbor malignancy in their non-functioning kidneys.

Conflicts of Interest

The authors have declared that no competing interests exist.

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