ORIGINAL ARTICLE

Vol. 39 (2): 189-194, March - April, 2013
doi: 10.1590/S1677-5538.IBJU.2013.02.06

Comparison of radiographic and pathologic sizes of renal tumors

Wei Chen, Linhui Wang, Qing Yang, Bing Liu, Yinghao Sun

Department of Urology, Changhai Hospital, Second Military Medical University, Shanghai, China

ABSTRACT

Purpose: The determination of the size of a renal tumor is important for staging, prognosis and selection of the appropriate surgical treatment. We investigated the difference of radiographic and pathologic size of renal tumors in a contemporary cohort of patients who underwent nephron sparing surgery and evaluated its clinical implications.

Materials and Methods: The records of 169 patients who received nephron sparing surgery for renal lesions suspicious for malignancy between January 2006 and December 2010 were reviewed retrospectively. Radiographic tumor size, defined as the largest diameter of tumor measured by CT images, and pathologic size, the largest diameter of tumor measured in the surgical specimen, were compared and analyzed.

Results: Among all subjects, mean radiographic and pathologic tumor size were 3.25 ± 1.78 cm and 3.03 ± 1.91 cm, respectively ($P < 0.001$), with a discrepancy of just 0.22 cm. When the patients were categorized according to radiographic tumor size in the 1 cm range, the mean radiographic tumor size was significantly greater than pathologic tumor size in the following groups: 2 to 3 cm ($P < 0.001$), 3 to 4 cm ($P < 0.001$), and 4 to 5 cm ($P = 0.028$). When radiographic and pathologic tumor sizes were compared according to the pathologic tumor subtype, a significant difference was observed only among those with clear cell renal carcinoma ($P < 0.001$).

Conclusions: Renal tumor size was overestimated by radiography as compared with pathology. The difference was just 0.22 cm with little clinical significance, suggesting that CT provides an accurate method to estimate renal tumor size preoperatively.

ARTICLE INFO

Key words:
Nephrons; Surgery; Pathology; Radiography; Carcinoma, Renal Cell

Int Braz J Urol. 2013; 39: 189-94

Submitted for publication:
July 09, 2012

Accepted after revision:
January 10, 2013

INTRODUCTION

The determination of the size of a renal tumor is important for staging, prognosis and selection of the appropriate surgical treatment. Several reports in the literature have concluded that the prognosis of renal tumor, including renal cell carcinoma (RCC), was related to the pathologic size of the tumor (1,2). Meanwhile, the increased use of modern imaging techniques such as computed tomography (CT) has led to an increase in the incidental discovery of smaller renal masses. As a result, nephron sparing surgery (NSS) has been developed and has become a standard surgical treatment for small renal masses. The oncologic outcome is similar to that achieved with radical nephrectomy (RN) (3,4). The decision to perform NSS is mainly determined by the radiographic size, but not the pathologic size, of the renal mass as measured by preoperative CT. Therefore, it is necessary to define the consistency between pathologic and radiographic sizes.

Several previous reports have shown a certain degree of discrepancy between the preopera-

tive size of renal tumors as measured by CT and the pathologic size as determined from surgical specimens (5-7). A difference in tumor size can alter patients' status regarding tumor stage and prognosis. Also, such discrepancy may result in inadvertent exclusion of a significant number of patients from the opportunity to receive NSS. As maximum preservation of kidney function as well as adequate cancer control is important for the management of RCC, such potential discrepancy should be identified. In this study, we compared the radiographic and pathologic renal tumor sizes of patients in our department who received open NSS or laparoscopic NSS. The main aim of our study was to determine if radiographic size is equal to pathologic size among renal tumors and, if not, whether radiography overestimates or underestimates tumor size and by how much.

MATERIALS AND METHODS

Upon securing approval from the institutional review board of our hospital, we reviewed the records of 169 patients who received open NSS or laparoscopic NSS for renal lesions suspected of malignancy from January 2006 to December 2010. Only the patients who underwent preoperative CT scans at our institution less than 4 weeks before undergoing surgery were included.

The size of renal tumors on contrast--enhanced CT scans was measured in three axes including the anterior-to-posterior, superior-to--inferior, and left-to-right axes. The radiographic size was accepted as the largest of these three diameters. Pathologic size was defined as the largest diameter of the tumor as determined by pathologic examination. In patients with multifocal renal tumors, the tumor with the largest diameter was evaluated. The measurement of tumor size by CT scan and pathologic size were performed by one radiologist and one pathologist.

The clinical informations, including each patient's age, gender, tumor side, histologic subtype and primary tumor classification, were recorded. The primary tumor classification was established according to the AJCC 7th edition of RCC TNM-staging system. In our study, patients were categorized according to radiographic tumor size and pathological diagnoses. The mean values of radiographic and pathologic tumor size, along with differences in these sizes, were calculated for each category. The correlation between radiographic and pathologic tumor size was also analyzed. All categorical variables were analyzed by either a two-tailed Fisher's exact test or a Chi-square test, as appropriate. All continuous variables were analyzed by either a two-tailed Student's t test or a one-way analysis of variance, as appropriate. Statistical Package for Social Sciences 17.0 software (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. P values < 0.05 were considered statistically significant.

RESULTS

A total of 169 patients underwent NSS and were included in our study. A summary of the patient demographics is shown in Table-1. The patients included 106 males and 63 females with an overall median age of 48.7 years. The majority pathologic subtypes were clear cell renal cell carcinoma and angiomyolipoma, accounting for 50.3% and 27.2% of all subjects, respectively. Among all the patients, there were about 134 patients with T1a clinical stage and 28 with T1b clinical stage, accounting for 79.3% and 16.6%, respectively. Only 7 patients with T2 clinical stage received NSS. All tumors had no positive margins.

Among all subjects, mean radiographic tumor size and mean pathologic tumor size were 3.25 $\pm$ 1.78 cm and 3.03 $\pm$ 1.91 cm, respectively ($P < 0.001$), which indicated that the mean radiographic tumor size was greater than the mean pathologic size (Table-2). However, the difference between radiographic and pathologic size was just 0.22 cm with little clinical significance. The relationship between both measurements of tumor size is depicted in Figure-1 and indicates the existences of a strong correlation ($r = 0.956$, $P < 0.001$).

When all the patients were categorized according to radiographic tumor size (in 1 cm ranges), mean radiographic tumor size was greater than pathologic tumor size for all ranges of tumor size, except for the ≥ 7 cm range (Table-2). However, mean radiographic tumor size was significantly greater than pathologic tumor size only in the

Table 1 - Patient Characteristics.

Variables	Median or n (%)
No. of total subjects	169
Age (years)	48.7 (16-80)
Gender	
Male	106 (62.7)
Female	63 (37.3)
Tumor side	
Left	82 (48.5)
Right	87 (51.5)
Histology	
Clear cell	85 (50.3)
Papillary	8 (4.7)
Chromophobe	2 (1.2)
RCC other	6 (3.6)
Oncocytoma	5 (3.0)
Angiomyolipoma	46 (27.2)
Benign other	17 (10.0)
Primary tumor classification	
T1a	134 (79.3)
T1b	28 (16.6)
T2a	4 (2.4)
T2b	3 (1.7)

RCC, renal cell carcinoma

ranges of ≥ 2 cm and < 3 cm, ≥ 3 cm and < 4 cm, ≥ 4 cm and < 5 cm.

When radiographic and pathologic tumor sizes were compared according to pathologic tumor subtypes, a significant difference between radiographic and pathologic tumor size was observed only among those with clear cell RCC ($P < 0.001$) (Table-3). Among the 85 patients with clear cell histology, tumor size was overestimated by 0.27 cm on CT. The tumor sizes were underestimated only in those with chromophobic RCC but overestimated in other pathologic subtypes.

DISCUSSION

The discrepancy between radiographic and pathologic renal tumor size has been discussed in previous reports (5-8). To the best of our knowledge, we present the largest comparison of radiographic and pathologic tumor size for patients with a renal mass treated by NSS. Consistent with some previous observations, in our study, radiographic size overestimated the pathologic size when comparing all patients, but the overall difference between radiographic and pathologic sizes was only 0.22 cm. Although it was statistically significant, we do not think this disparity represents a clinically significant result.

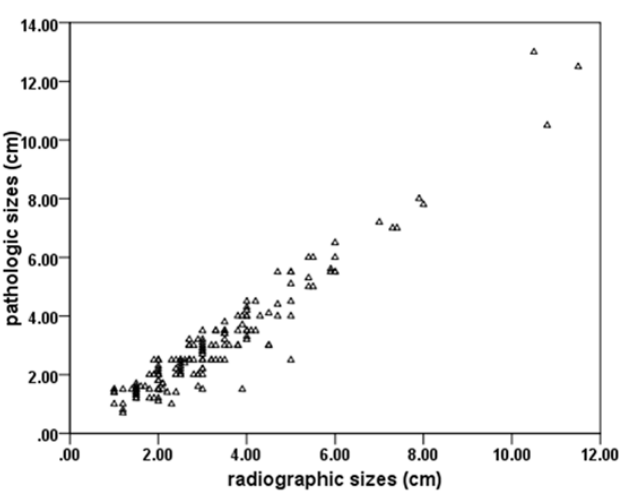
In our series, subgroup analysis showed that the discrepancy between radiographic and pathologic size increased with tumor size in the range of 0 to 4 cm. However, the discrepancy decreased with increased tumor size, when the tumors were larger than 4 cm. The radiographic size overestimated the pathologic size in all groups except the tumors with sizes exceeding 7 cm, but the discrepancy had little significance because only 8 patients were included in this group. The largest gap between the two measurements occurred in tumors of 3 to 4 cm in size, which was different from some previous studies (5-7). When evaluating the subgroups according to 1 cm intervals, Schlomer et al. (5) and Kurta et al. (6) found that the largest differences in size were in patients with tumors of 4 to 5 cm, while Lee et al. (7) considered that the largest differences occurred in patients with tumors of < 1 cm in size.

Tumor size has been widely used when recommending NSS for patients in elective-surgery scenarios (9). Traditionally, a 4 cm cutoff has been recommended, although more recent observations suggested that a threshold of > 4 cm and even 7 cm for appropriately selected patients was safe and effective (10,11). In our study, the tumors with radiographic size less than 4 cm were overestimated by CT, but the discrepancy would not affect the decision between RN and NSS. However, the

Table 2 - The mean radiologic and pathologic tumor size (in the 1-cm radiologic category and clinical stage).

RS range (cm)	n	RS (cm)	PS (cm)	Mean difference (95% CI) (cm)	t	P-value
1 to < 2	31	1.47 ± 0.29	1.45 ± 0.36	0.02 (-0.10,0.13)	0.281	0.781
2 to < 3	54	2.36 ± 0.32	2.12 ± 0.52	0.24 (0.12,0.36)	3.992	< 0.001
3 to < 4	40	3.32 ± 0.32	2.93 ± 0.59	0.39 (0.21,0.56)	4.482	< 0.001
4 to < 5	19	4.23 ± 0.28	3.89 ± 0.62	0.34 (0.04,0.63)	2.395	0.028
5 to < 6	13	5.31 ± 0.34	5.04 ± 0.94	0.27 (-0.23,0.77)	1.164	0.267
6 to < 7	4	6.00 ± 0.00	5.87 ± 0.48	0.13 (-0.64,0.89)	0.522	0.638
≥ 7	8	8.80 ± 1.82	9.13 ± 2.51	-0.33 (-1.15,0.50)	-0.930	0.383
Total	169	3.25 ± 1.78	3.03 ± 1.91	0.22 (0.13,0.30)	5.040	< 0.001

Figure 1 - Relationship between radiologic and pathologic tumor sizes.



situation is different if the size of the tumor was larger than 4 cm. In the group with tumor sizes ranging from 4 to 5 cm, pathologic size was smaller than radiographic size. In some centers, a tumor size of 4 cm is still regarded as the cutoff between RN and NSS. According to our findings, a portion of patients with renal tumors slightly larger than 4 cm measured by CT, with actually pathologic size less than 4 cm, should receive NSS instead of RN. Recent studies have shown that PN for renal tumors provides superior intermediate--term preservation of renal function compared with RN (12,13). In addition, chronic renal failure is more prevalent than previously thought among patients with a renal mass and more than 25% of all patients with a renal mass have at least Grade 3 chronic kidney disease at presentation (14). It is therefore necessary to perform NSS for renal tumors to preserve renal function. Based on our results, we suggest that the threshold of tumor size of 4 cm for NSS should been expanded to some extent, and patients with tumors slightly larger than 4 cm could be offered elective NSS with proper informed consent, which is in agreement with previous studies (5,7). In our study, all tumors had no positive margins. Without doubt, whether tumors were smaller than 4 cm or slightly larger than 4 cm, it is necessary to keep the margin negative. Obviously, preoperative planning for NSS for a renal lesion also requires consideration of its location (exophytic vs. intrarenal, central vs. peripheral, hilar vs. polar) and relation to surrounding structures (main renal vessels, collecting system, colon).

Histological subtype is also an important prognostic indicator for patients with renal tumors. Several studies have showed that there is correlation among tumor size, histology, and

Table 3 - The mean radiologic and pathologic tumor sizes according to histological subtype.

HS	n	RS (cm)	PS (cm)	Mean difference (95% CI) (cm)	t	P-value
Clear cell	85	2.73 ± 0.94	2.46 ± 1.01	0.27 (0.16,0.38)	4.963	< 0.001
Papillary	8	2.91 ± 1.18	2.78 ± 0.87	0.13 (-0.26,0.53)	0.819	0.440
Chromophobe	2	1.90 ± 0.14	2.05 ± 0.07	-0.15 (-0.79,0.49)	-3.000	0.205
RCC other	6	3.02 ± 1.42	2.87 ± 1.29	0.15 (-0.17,0.47)	1.218	0.278
Oncocytoma	5	2.80 ± 1.44	2.40 ± 1.17	0.40 (-0.20,1.00)	1.845	0.139
Angiomyolipoma	46	4.48 ± 2.55	4.29 ± 2.87	0.19 (-0.03,0.41)	1.717	0.093
Benign other	17	3.06 ± 1.46	2.99 ± 1.40	0.07 (-0.13,0.26)	0.720	0.482

HS: histological subtype; **RS:** radiographic size; **PS:** pathologic size; **CI:** confidence interval; **RCC:** renal cell carcinoma

metastatic potential (15,16). Tumors with histology other than clear cell carcinoma appear to have a favorable prognosis and to be suitable for NSS, regardless of tumor size (17). Kurta et al. (6) evaluated the difference between mean CT tumor size and mean pathological size within each histological subgroup, and they found that there were statistically significant differences in the clear cell and papillary types, but the differences were small and unlikely to be clinically significant. Lee et al. (7) found that a significant difference was observed among those with clear cell RCC and papillary RCC, and pathologic tumor size was overestimated in clear cell RCC while underestimated in papillary RCC. In our series, statistically significant differences between radiographic and pathologic tumor size were observed only for clear cell tumors. The difference was small (0.27 cm) with no clinical significance, which was similar to the result obtained by Kurta et al. (6).

The present study has several limitations. Firstly, our study was a retrospective, single-institution analysis of patients. A standardized, prospective study would more definitively characterize the relationship between the radiographic and pathologic size of renal tumors. Secondly, although the time from the CT examination to the operation was limited to 4 weeks, it was not certain that the size of the renal tumor had remained the same throughout this period. Thirdly, the parameters measured in CT scans or specimens may be inaccurate, which would influence the analysis. Much of some potential errors, such as measurement errors, differences in transverse diameter orientation, would have been avoided in a prospective study, where the methods of measurement would have to follow a definite procedure. Finally, formalin fixation may shrink the pathologic specimen to some extent.

CONCLUSIONS

In summary, we found a statistically significant overestimation of renal tumor size when comparing radiographic with pathologic size. Nevertheless, the overall difference was only 0.22 cm. Among the tumors with sizes ranging from 4 to 5 cm, radiographic tumor size was significantly larger than pathologic size. This result may affect decisions to perform NSS in some patients with a radiographic tumor size slightly larger than 4 cm. In spite of slight overestimation of radiographic size compared with pathologic size, and with the expansion of indication for NSS, we believe that CT scans would be appropriate for staging and selection of treatment approaches for renal tumors.

ACKNOWLEDGEMENTS

This study was supported by the Municipal Hospital's Project for Emerging and Frontier Technology of Shanghai China (No. SHDC12010115).

ABBREVIATIONS

RCC = Renal Cell Carcinoma
CT = Computed Tomography
NSS = Nephron Sparing Surgery
RN = Radical Nephrectomy

CONFLICT OF INTEREST

None declared.

REFERENCES

1. Lughezzani G, Jeldres C, Isbarn H, Perrotte P, Shariat SF, Sun M, et al.: Tumor size is a determinant of the rate of stage T1 renal cell cancer synchronous metastasis. J Urol. 2009; 182: 1287-93.
2. Ku JH, Moon KC, Kwak C, Kim HH: Metachronous metastatic potential of small renal cell carcinoma: dependence on tumor size. Urology. 2009; 74: 1271-5.
3. Roos FC, Brenner W, Müller M, Schubert C, Jäger WJ, Thüroff JW, et al.: Oncologic long-term outcome of elective nephron-sparing surgery versus radical nephrectomy in patients with renal cell carcinoma stage pT1b or greater in a matched-pair cohort. Urology. 2011; 77: 803-8.
4. Weight CJ, Lieser G, Larson BT, Gao T, Lane BR, Campbell SC, et al.: Partial nephrectomy is associated with improved overall survival compared to radical nephrectomy in patients with unanticipated benign renal tumours. Eur Urol. 2010; 58: 293-8.
5. Schlomer B, Figenshau RS, Yan Y, Bhayani SB: How does the radiographic size of a renal mass compare with the pathologic size? Urology. 2006; 68: 292-5.
6. Kurta JM, Thompson RH, Kundu S, Kaag M, Manion MT, Herr HW, et al.: Contemporary imaging of patients with a renal mass: does size on computed tomography equal pathological size? BJU Int. 2009; 103: 24-7.
7. Lee SE, Lee WK, Kim DS, Doo SH, Park HZ, Yoon CY, et al.: Comparison of radiographic and pathologic sizes of renal tumors. World J Urol. 2010; 28: 263-7.
8. Herr HW, Lee CT, Sharma S, Hilton S: Radiographic versus pathologic size of renal tumors: implications for partial nephrectomy. Urology. 2001; 58: 157-60.
9. Coffin G, Hupertan V, Taksin L, Vaessen C, Chartier-Kastler E, Bitker MO, et al.: Impact of elective versus imperative indications on oncologic outcomes after open nephron-sparing surgery for the treatment of sporadic renal cell carcinomas. Ann Surg Oncol. 2011; 18: 1151-7.
10. Roos FC, Brenner W, Jäger W, Albert C, Müller M, Thüroff JW, et al.: Perioperative morbidity and renal function in young and elderly patients undergoing elective nephron-sparing surgery or radical nephrectomy for renal tumours larger than 4 cm. BJU Int. 2011; 107: 554-61.
11. Becker F, Roos FC, Janssen M, Brenner W, Hampel C, Siemer S, et al.: Short-term functional and oncologic outcomes of nephron-sparing surgery for renal tumours ≥ 7 cm. Eur Urol. 2011; 59: 931-7.
12. Deklaj T, Lifshitz DA, Shikanov SA, Katz MH, Zorn KC, Shalhav AL: Laparoscopic radical versus laparoscopic partial nephrectomy for clinical T1bN0M0 renal tumors: comparison of perioperative, pathological, and functional outcomes. J Endourol. 2010; 24: 1603-7.
13. Lane BR, Fergany AF, Weight CJ, Campbell SC: Renal functional outcomes after partial nephrectomy with extended ischemic intervals are better than after radical nephrectomy. J Urol. 2010; 184: 1286-90.
14. Huang WC, Levey AS, Serio AM, Snyder M, Vickers AJ, Raj GV, et al.: Chronic kidney disease after nephrectomy in patients with renal cortical tumours: a retrospective cohort study. Lancet Oncol. 2006; 7: 735-40.
15. Remzi M, Ozsoy M, Klingler HC, Susani M, Waldert M, Seitz C, et al.: Are small renal tumors harmless? Analysis of histopathological features according to tumors 4 cm or less in diameter. J Urol. 2006; 176: 896-9.
16. Skolarus TA, Serrano MF, Berger DA, Bullock TL, Yan Y, Humphrey PA, et al.: The distribution of histological subtypes of renal tumors by decade of life using the 2004 WHO classification. J Urol. 2008; 179: 439-43; discussion 443-4.
17. Onishi T, Oishi Y, Yanada S, Abe K, Hasegawa T, Maeda S: Prognostic implications of histological features in patients with chromophobe cell renal carcinoma. BJU Int. 2002; 90: 529-32.

Correspondence address:
Dr. Yinghao Sun
Department of Urology,
Changhai Hospital,
168 Changhai Road,
Shanghai 200433, China.
Fax: + 86 21 3503-0006
E-mail: syhchanghai@126.com