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# Comparison of CT analyses of primary renal cell carcinoma and of metastatic neoplasms of the kidney

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***Background and purpose.*** *We compared the computed tomography (CT) findings in 25 patients, in 10 with pathologically proven metastases in the kidney and in 15 with renal cell carcinoma to establish the difference on CT scan.*

***Patients and methods.*** *All 25 patients with kidney neoplasm were analysed by the conventional contrast-enhanced CT criteria. Imaging initiated 2 min after intravenous contrast injection.*

***Results.*** *The sensitivity of CT to discriminate renal cell carcinoma from renal metastases and to discriminate renal metastases from renal cell carcinoma were 98 % and 70 %, respectively.*

***Conclusions.*** *This study indicates that CT could be useful in clinical practice for distinguishing renal cell carcinoma and metastatic neoplasms of the kidney.*

*Key words: tomography, x-ray computer; carcinoma, renal cell; kidney neoplasm-secondary*

## Introduction

In order to decide on the type of therapy it is necessary to differentiate between renal carcinoma and renal metastases.

If the renal cell carcinoma is diagnosed, nephrectomy is indicated (in more than 95 %), but in the case of renal metastases, nephrectomy is not the best possible therapy.

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The most common origin of kidney metastases is the carcinoma of the lung.[1] Other primary malignancies are the carcinomas of the colon, breast, stomach, ovaria, uterus and prostate.[2-5]

Although CT is more sensitive than ultrasound and urography in the differentiation of the renal metastases from the renal cell carcinoma, there is only one report comparing CT findings of renal cell carcinoma and of renal metastases.[3]

We report here on CT findings of renal metastases and renal cell carcinoma in order to establish the criteria for the differentiation of these two forms of kidney malignancies.

## Patients and methods

CT examination was performed in 25 patients with kidney neoplasms, using a Shimatzu 4500 T with scan times of 2 to 3 seconds. Conventional contrast-enhanced computed tomography studies were perfomed by using intravenous 60 % iodinated contrast medium administered by bolus injection or drip infusion technique. In 15 out of 25 patients (mean age 58 years, range 21-89 years) renal metastases were found. The most common origin of the metastases was the carcinoma of the lung (n = 4), followed by the carcinomas of the colon (n = 3), ovaria, pancreas and a lymphoma, each in one patient. The interval between the initial diagnosis of the primary malignancy and the occurrence of renal metastases was 1 to 5 years (mean 1.9 years).

The diagnoses were pathologically confirmed by surgery in 19 patients (renal cell carcinoma 18, renal metastases 1), by biopsy in 4 patients (renal metastases 4), and by autopsy in 2 patients (renal metastases 2). When multiple tumours existed in one or both kidneys, the largest tumours were chosen for evaluation because they were the most frequently biopsied.

Renal function was normal except in one patient with lymphoma and acute renal failure, successfully treated by haemodialysis.

There were no patients with acquired renal cystic disease or patients with Von Hippel-Lindau disease.

## Results

We retrospectively reviewed 25 cases of kidney neoplasms diagnosed during the past 5 years. Fourteen CT criteria were chosen to characterise the tumours: bilateralism, number, location, size, shape, margin, calcification, involvement of the renal vein, involvement of collecting system, hydronephrosis, perirenal extension, attenuation, thickening of Gerota's fascia and lymphadenopathy. Table 1 presents the result concerning individual predictors of renal cell carcinoma and renal metastasis.

Criterion location included 2 categories: type I - tumour located entirely within the renal parenchyma and capsule, less than 50 % of the tumour has an exophytic pattern; type II - more than 50 % of the tumour demonstrated an exophytic pattern. The largest axis was used as an expression of the tumour size. The lesion's shapes were divided into round or wedge-shaped. The tumour margin was characterised as well or poorly demarcated, and the attenuation (density) as homogenous or inhomogeneous. The lymph nodes were measured by the length of their longest axis and those that were more than 10 mm long were diagnosed as positive. The calcification, renal vein involvement, collecting system involvement, hydronephrosis, perirenal extension and Gerota involvement were descirbed as yes or no. All patients with renal cell carcinoma had solitary tumours (100 %). Five patients (50 %) with renal metastasis had solitary tumours, 3 patients (30 %) 2 unilateral tumours, and 2 (20 %) patients had more than 2 bilateral tumours.

Renal metastases were smaller (mean 3.1 cm) than renal cell carcinoma (mean 8 cm). A round shape was found in 80 % of patients with renal cell carcinoma, and in 70 % of patients with metastases.

Renal cell carcinoma were of exophytic pattern in 60 % of patients, with the size of 6-9 cm in 53 % of patients, well demarcated tumour margin in 66 % of patients, calcification in 33 % of patients, renal vein involvement in 20 % of patients, collecting system involvement in 73 % of patients, with hydronephrosis in 36 % of patients, perirenal extension in 60 % of patients, and lymph node metastasis in 53 % of patients.

Renal metastases were located within the kidney parenchyma in 80 % of patients; their size ranged 0-3 cm in 60 % of patients. The metastases had smooth margins and were without calcification in 80 % of patients; in 10 %

**Table1.** Individual predictors between renal cell carcinoma and renal metastasis in our patients (I part)

| Predictors | | Renal cell carconoma | Renal metastases |
|---|---|---|---|
| Laterally | Unilateral | 15 | 8 |
| | Bilateral | 0 | 2 |
| Number | One | 15 | 6 |
| | Two | 0 | 3 |
| | >=3 | 0 | 1 |
| Location | a) within parenchyma and capsule, less than 50 % of tumour is exophytic | 6 | 8 |
| | b) more than 50 % of tumour is exophytic | 9 | 2 |
| Size | 0-3 cm | 2 | 6 |
| | 3.1-6 cm | 5 | 3 |
| | 6.1-9 cm8 | 1 | |
| | > 9.1 cm | 0 | 0 |

**Table 2.** Individual predictors between renal cell carcinoma and renal metastasis in our patients (II part)

| Predictors | | Renal cell carcinoma | Renal metastases |
|---|---|---|---|
| Shape | round | 12 | 7 |
| | irregular | 3 | 3 |
| Margin | smooth | 10 | 3 |
| | irregular | 5 | 8 |
| Attenuation | inhomogeneous | 6 | 8 |
| | homogenous | 4 | 6 |
| Calcification | no | 10 | 10 |
| | yes | 5 | 0 |
| Renal vein involvement | no | 12 | 0 |
| | yes | 3 | 9 |
| Collecting system involvement | no | 4 | 7 |
| | yes | 11 | 3 |

**Table 3.** Individual predictors between renal cell carcinoma and renal metastasis in our patients (III part)

| Predictors | | Renal cell carcinoma | Renal metastses |
|---|---|---|---|
| Hydronephrosis | no | 10 | 9 |
| | yes | 5 | 1 |
| Perirenal extension | no | 6 | 7 |
| | yes | 9 | 3 |
| Gerota involvement | no | 8 | 8 |
| | yes | 7 | 7 |
| Lymph node metastases | no | 7 | 7 |
| | yes | 8 | 8 |

of patients, renal vein involvement and in 30 % of patients collecting system involvement were observed; 80 % patients had lymph node metastasis.

The stepwise discriminant analysis showed that number (N), laterality (L), location (LO), perirenal involvement (P) and calcifications were the strongest predictors. The primary and secondary scores were calculated according to Honda et al. as follows:

Primary score = (L x 3.63) + (N x 0.85) + + (P x 0.83) + (LO x 4.29) - - 9.65.

Secondary score = (L x 5.01) + (N x 2.67) - (P x 1.27) + (LO x 3.33) - - 11.60.

The radiologic variables were defined as follows:

L = laterality; 0 = unilateral, 1 = bilateral
N = number; actual number of the tumours
P = perirenal involvement; 0 = yes, 1 = no
LO = location: 0 = a, 1 = b.

Using these primary and secondary scores the posterior probabilities (PP) of primary versus secondary tumour were computed as follows:

Posterior probability (primary) =
= exp(primary score) / exp(primary score) + exp(secondary score)

Posterior probability (secondary)=
= exp(secondary score) / exp(primary score) + exp(secondary score)

The PP (primary) + PP (secondary) = 1.
When PP (primary) > PP (secondary) the number can be diagnosed as primary tumour. When PP (primary) < PP (secondary) it can be diagnosed as secondary tumour.

The classification functions detected 98 % of primary renal cell carcinoma and 70 % of metastases.

## Discussion

The kidney is a common site of metastases, with reported incidence of 2 to 20 % at autopsy.[6-9] The tumour that most commonly metastasises to the kidney is the lung carcinoma[1], followed by the tumours of the breast and stomach, melanoma and contralateral renal cell carcinoma.[5]

Most renal metastases are less than 3 cm in diameter, whereas more than 50 % of renal cell carcinomas are more than 6 cm long.[6]

Bilateral, multiple, small lesions without an exophytic appearance may be seen in multiple areas of renal inflammation, renal infarction and multiple renal cysts.[10]

It is well known that renal cell carcinoma can also occur bilaterally or multifocally, especially in the patients with predisposing conditions (i.e. in the patients with acquired renal cystic disease or patients with Von Hippel-Lindau disease).[11,12] This study did not include any patients with acquired renal cystic disease or patients with Von Hippel-Lindau disease.

In recent years, more and more small renal masses have been reported (usually incidentally) due to the widespread use of cross-sectional imaging modalities (especially ultrasound and computed tomography) as well as other reasons.[13,14] Most of these masses are low stage renal cell carcinomas. The problem is that the growth rate of small renal tumours is variable; the tumours that are destined to grow and possibly metastasise do so early. So, bilateral or multifocal involvement doesn't exclude renal cell carcinoma as the diagnosis.[14]

The size "per se" cannot be a strong predictor for the metastases.[15,16] The indication for surgery in renal cell carcinoma is under discussion in the urologic literature.[12] The main problem of nephron-sparing surgery is the multifocality of renal cell carcinoma. Modern double-phase helical CT can distinguish among the subtypes of renal cell carcinoma

(clear, chromophobe, papillary), and correlates with microvessel density or the existence of intratumoral necrosis or haemorrhage. However, it does not differentiate between renal cell carcinoma and other solid tumors.[17]

In the preparation for nephron-sparing surgery of renal cell carcinoma, preoperative routine imaging cannot safely predict multifocal lesions of renal cell carcinoma.[12]

In this study, tumour calcification was a diagnostically strong predictor for the renal cell carcinoma. Calcifications were present in five cases of renal cell carcinoma and in none of the cases of renal metastases. Metastases were more frequently bilateral or multifocal, and smaller than renal cell carcinoma.

Stepwise, discriminant analysis showed that the useful radiologic predictors were the number, laterality, location and perirenal extension. The sensitivity of CT to discriminate renal cell carcinoma from renal metastasis was 98 %, and to discriminate renal metastases from renal cell carcinoma was 70 %. In contrast to the investigation of Honda et al., the margin of the lesion, the involvement of the renal vein and collecting system, existence of hydronephrosis, thickening of Gerota's fascia and lymphadenopathy were not diagnostically strong predictors, like in.[3]

## Conclusions

Using the stepwise discriminant analysis and posterior probabilities of primary versus secondary tumour, computed tomography could be useful to differentiate between non-multifocal renal cell carcinoma and renal metastasis.

In patients with a single, exophytic, large and perirenally extending lesions with calcifications, renal cell carcinoma is more likely than renal metastasis.

In patients with multiple, less exophytic, small renal lesions with or without wedge shaped appearance, the renal metastasis is more likely than the renal cell carcinoma.

The biopsy of tumour lesions is restricted to cases with discrepancy between clinical manifestation and computed tomography findings.

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