Differentiation between clear cell renal cell carcinoma from other renal cell carcinoma subtypes: qualitative and quantitative multiphasic CT analysis

Poster No.:	C-2630
Congress:	ECR 2019
Type:	Scientific Exhibit
Authors:	M. H. Verussa[1], F. M. A. Coelho[2], M. FUKUMOTO[1], B. A. Vento[1], R. Gianordoli[1], S. Horta[1], F. I. Yamauchi[1], P. Viana[1]; [1]São Paulo/BR, [2]São Paulo, São Paulo/BR
Keywords:	Pathology, Neoplasia, Efficacy studies, CT, Urinary Tract / Bladder, Kidney, Abdomen
DOI:	10.26044/ecr2019/C-2630

Aims and objectives

Renal cancer carcinoma (RCC) is the most common cancer of renal parenchyma (1,2). The incidence of RCC has varied significantly over the last two decades worldwide (3,4). There is a higher prevalence of clear cell RCC that has the worst prognosis of all subtypes (5,6). Therefore, the histological classification of RCCs is extremely important and the imaging features are largely studied considering the significant implications of the subtypes in the prognosis (7).

The aim of this study is to determine whether enhancement phases and imaging features at multiphasic computed tomography (CT) can aid differentiate clear cell RCC from papillary RCC and chromophobe RCC.

Methods and materials

Patient selection

A retrospective study of patients followed on Department of Urology, University of Sao Paulo Medical School General Hospital. From January 2011 to December 2017, all patients with renal mass who underwent a partial nephrectomy with previous CT were included in this present cohort.

CT imaging

All examinations were performed using a multidetector CT MDCT with 64 or 128 channels (Brillance, Philips Healthcare or Aquilion CXL, Toshiba). For all patients, the abdominal scan included precontrast and postcontrast phases (corticomedullary, nephrographic and excretory phases).

Imaging evaluation

CT exams were examined by a second-year resident who was blinded to clinical, pathologic, and imaging findings. Subjective and objective criteria were evaluated. The subjective analysis consisted of classifying the renal mass in the followed features: shape (well-defined x ill-defined), necrosis (present or absent), hemorrhage (present or absent), calcification (present or absent), fat component (present or absent), contrast enhancement pattern (hypovascular x hypervascular), washout (present or absent), collateral vessels into the lesion (present or absent) and collateral vessels around the lesion (present or absent). The objective criteria evaluated were the renal mass attenuation on each postcontrast phase. ROIs were placed on the most homogenous site of renal mass (and the most intense enhancement on postcontrast phases) (Figure 1).

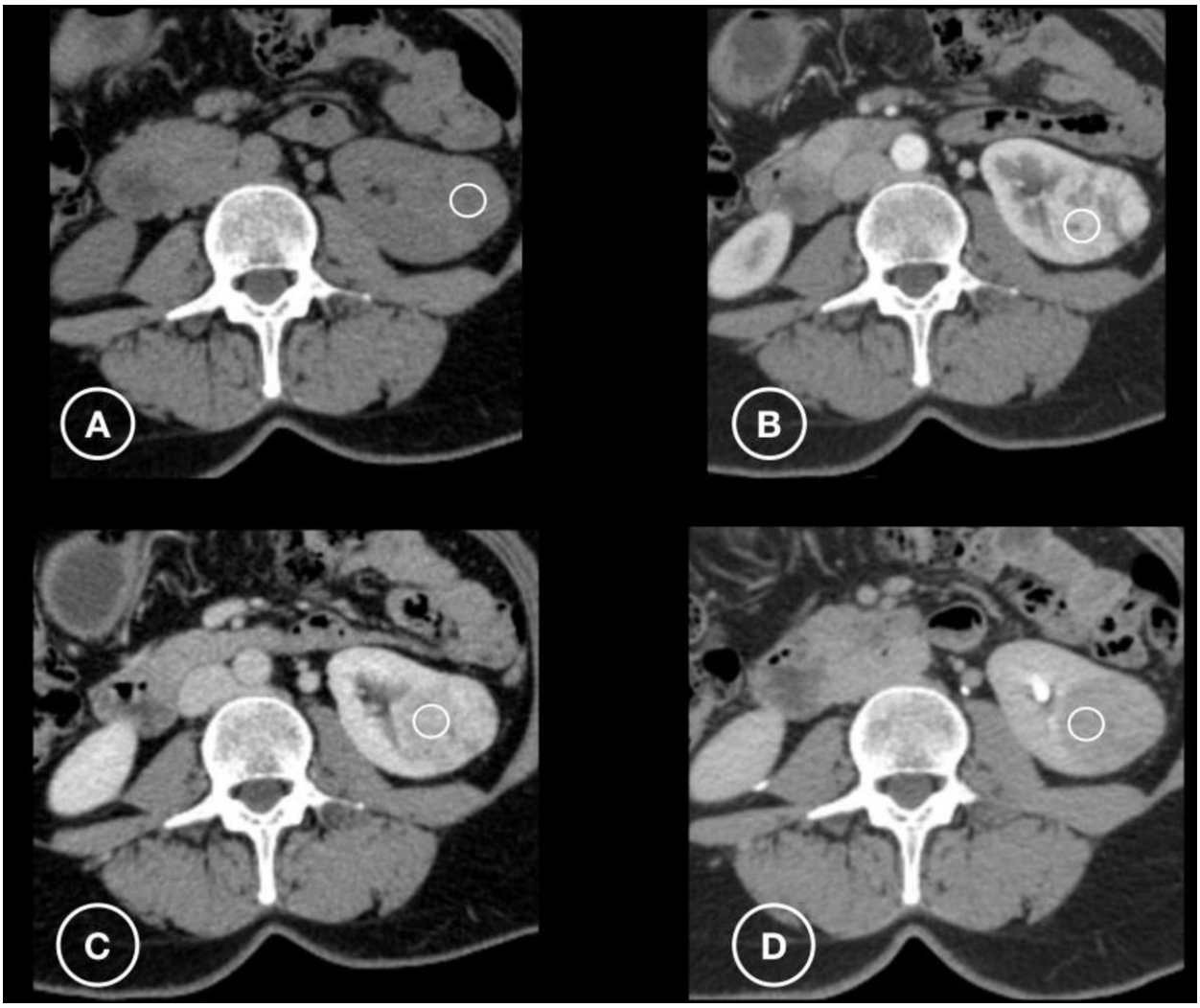
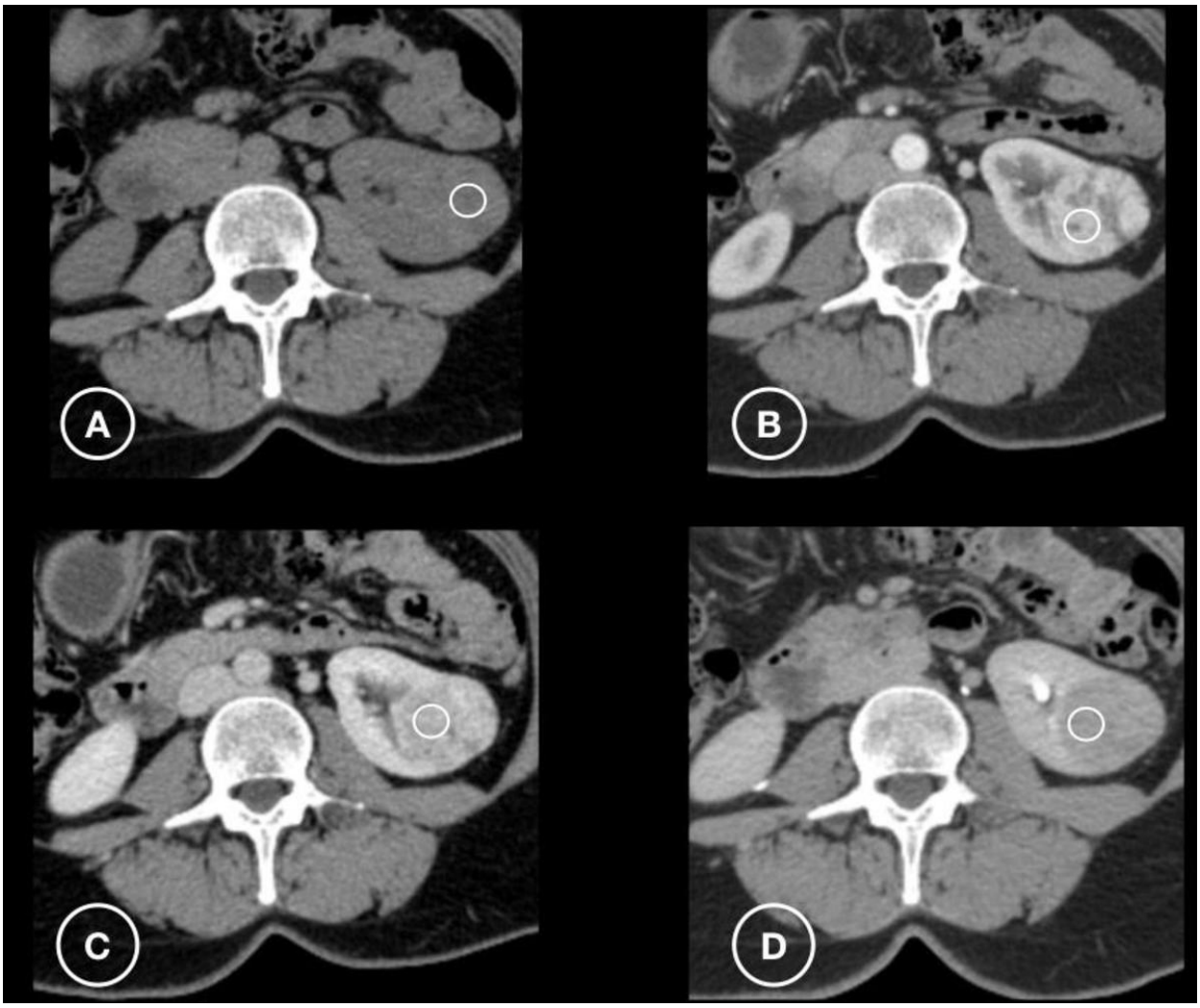


Fig. 1: CT scan on (A) precontrast phase, (B) arterial phase, (C) nephrographic phase and (D) excretory phase. ROIs are placed in the most homogeneous and intensely enhanced area of renal mass.
References: Instituto de Radiologia - InRad, Universidade de São Paulo, Hospital das Clínicas - São Paulo/BR

Statistical analysis:

Quantitative and qualitative analysis were compared by using the Dunnett test and Qui-Square test, respectively $P < .05$ was regarded as indicating statistical significance.

Images for this section:



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Results

In total, 1,100 patients were diagnosed with a renal mass, being 153 included in this sample with a unique lesion. Among these, 108 (70,6 %) were clear cell renal cell RCC, 30 (19,6 %) were papillary RCCs, and 15 (9,8 %) were chromophobe RCCs. The baseline characteristics for each of the groups are demonstrated in Table 1.

		All lesions	Clear Cell RCC	Papillary RCC	Chromophobe RCC
		n = 153 (100%)	n = 108 (62.1%)	n = 30 (17.2%)	n = 15 (8.6%)
Age		57.5 (23 - 79)	57.6 (23 - 79)	58.1 (28 - 74)	56.7 (37 - 73)
Sex					
	Female	62 (40.5%)	42 (38.9%)	10 (33.3%)	10 (66.7%)
	Male	91 (59.5%)	66 (61.1%)	20 (66.7%)	5 (33.3%)
Side					
	Left	63 (41.2%)	49 (45.4%)	8 (26.7%)	6 (40.0%)
	Right	90 (58.8%)	59 (54.6%)	22 (73.3%)	9 (60.0%)
Size (mm)		40.0 (11.0 - 89.0)	40.6 (11.0 - 89.0)	40.1 (13.0 - 76.0)	37.3 (15.0 - 76.0)

- Quantitative data are described by mean with ranges in parentheses.
- Categorical data are described by frequency with percentage in parentheses.

Table 1: Epidemiology characteristics of all lesions and subgroups.
References: Instituto de Radiologia - InRad, Universidade de São Paulo, Hospital das Clínicas - São Paulo/BR

Objective evaluation

The mean attenuation measurements according to each group are listed in Table 2.

Enhancement attenuation	Clear Cell RCC	Papillary RCC	Chromophobe RCC
Precontrast	32.0 (30.4 – 33.6)	30.3 (27.1 – 33.5)	37.3 (31.9 – 42.7)
p-value	-	.688	.063
Corticomedullary attenuation	136.9 (128.9 – 145.0)	59.9 (49.8 – 70.0)	96.2 (81.0 – 111.4)
p-value	-	< .001	< .001
Nephrographic attenuation	117.3 (11.3 – 123.4)	70.4 (59.7 – 81.1)	88.0 (75.7 – 100.3)
p-value	-	< .001	.001
Excretory attenuation	75.2 (71.5 – 78.9)	59.2 (50.8 – 67.6)	60.1 (53.8 – 66.4)
p-value	-	< .001	.015

- Quantitative data are described by mean with 95% confidence intervals in parentheses. P-values were calculated in comparison with clear cells RCCs. P-values are adjusted by Dunnett multiple comparisons test.

Table 2: Attenuation of renal masses on the basis of histologic subtype.
References: Instituto de Radiologia - InRad, Universidade de São Paulo, Hospital das Clínicas - São Paulo/BR

In corticomedullary phase, enhancement of clear cell RCCs was significantly greater than that of papillary RCCs (137 HU vs 60 HU, P = .001), such as greater than that of chromophobe RCCs (137 HU vs 96 HU, P = .001).

In nephrographic phase, the enhancement attenuation of clear cell RCCs was also significantly greater than that of papillary RCCs (117 HU vs 70 HU, P = .001) such as greater than that of chromophobe RCCs nephrographic (117 HU vs 88 HU, P = .001).

Enhancement of clear cell RCCs was significantly greater than that of papillary RCCs in the excretory (75 HU vs 59 HU, P = .001) phase, such as greater than that of chromophobe RCCs (75 HU vs 60 HU, P = .015).

Subjective evaluation

Subjective features are listed in Table 3.

Qualitative features that aid the differentiation between clear cell RCCs and papillary RCCs were necrosis (65/108 vs 5/30, P < .001), contrast enhancement pattern (P < .001) and washout (82/108 vs 1/30, P < .001), and between clear cell RCCs and chromophobe

RCCs were necrosis (65/108 vs 3/15, P = .009), contrast enhancement pattern (P < .001), washout (82/108 vs 6/15, P = .012) and vessels into the lesion (7/108 vs 4/15, P = .03).

Imaging Features	Clear Cell RCC	Papillary RCC	Chromophobe RCC
Shape			
Well-defined	76 (70.4%)	17 (56.7%)	10 (66.7%)
Ill-defined	32 (29.6%)	13 (43.3%)	5 (33.3%)
p-value	-	.471	1.000
Necrosis			
No	43 (39.8%)	25 (83.3%)	12 (80.0%)
Yes	65 (60.2%)	5 (16.7%)	3 (20.0%)
p-value	-	<.001	.009
Hemorrhage			
No	102 (94.4%)	28 (93.3%)	15 (100.0%)
Yes	6 (5.6%)	2 (6.7%)	0 (0.0%)
p-value	-	1.000	1.000
Calcification			
No	96 (88.9%)	25 (83.3%)	10 (66.7%)
Yes	12 (11.1%)	5 (16.7%)	5 (33.3%)
p-value	-	1.000	.057
Fat component			
No	107 (99.1%)	29 (96.7%)	15 (100.0%)
Yes	1 (0.9%)	1 (3.3%)	0 (0.0%)
p-value	-	.987	1.000
Contrast enhancement pattern			
Hypovascular	18 (16.7%)	27 (90.0%)	10 (66.7%)
Hypervascular	90 (83.3%)	3 (10.0%)	5 (33.3%)
p-value	-	<.001	<.001
Washout			
No	26 (24.1%)	29 (96.7%)	9 (60.0%)
Yes	82 (75.9%)	1 (3.3%)	6 (40.0%)
p-value	-	<.001	.012
Collateral vessels into the lesion			
No	101 (93.5%)	29 (96.7%)	11 (73.3%)
Yes	7 (6.5%)	1 (3.3%)	4 (26.7%)
p-value	-	1.000	.030
Collateral Vessels around the lesion			
No	88 (81.5%)	29 (96.7%)	12 (80.0%)
Yes	20 (18.5%)	1 (3.3%)	3 (20.0%)
p-value	-	.123	1.000

- Categorical data are described by frequency with percentage in parentheses. P-values were calculatec in comparison with clear cells RCCs. P-values are adjusted by Qui-Square test with Bonferroni correctio

Table 3: Imaging features of renal masses on the basis of histologic subtype.
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Conclusion

In this study, the renal mass differentiation between clear cell RCCs from other RCC subtypes (papillary and chromophobe) was statistically significant in corticomedullary, nephrographic and excretory phases, same results demonstrated by Zhang et al (8) and Young et al (9). As demonstrated by Zhang et al, some qualitative findings were related to clear cell RCC, such as necrotic and cystic changes, and the presence of the washout pattern.

Despite some overlaps, the multiphasic MDCT imaging features and the degree of enhancement aid in the differentiation of RCC subtypes.

Personal information

Mário Henrique Verussa

Department of Imaging, INRAD. Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo

R. Dr. Ovídio Pires de Campos, 75 - Cerqueira César

CEP 05403-010 - São Paulo/SP, Brazil

E-mail: marioverussa@gmail.com

Fernando Morbeck A. Coelho

Department of Imaging, INRAD. Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo

R. Dr. Ovídio Pires de Campos, 75 - Cerqueira César

CEP 05403-010 - São Paulo/SP, Brazil

dr.fernandomorbeck@gmail.com

References

1 - Jemal A, Siegel R, Xu J, Ward E. Cancer Statistics, 2010. CA: A Cancer J Clin. 2010; 60(5): 277-300.

2 - Protzel C, Maruschke M, Hakenberg OW. Epidemiology, Aetiology, and Pathogenesis of Renal Cell Carcinoma. European Urology Supplements. 2012;11:52-59.

3 - Kim SH, Kim CS, Kim MJ, Cho JY, Cho SH. Differentiation of Clear Cell Renal Cell Carcinoma From Other Subtypes and Fat-Poor Angiomyolipoma by Use of Quantitative Enhancement Measurement During Three-Phase MDCT. AJR 2016 jan; 21-28.

4 - Srigley JR, Delahunt B, Eble JN, Egevad L, Epstein JI, Grignon D, et al. The International Society of Urological Pathology (ISUP) Vancouver Classification of Renal Neoplasia. Am J Surg Pathol. 2013; 37(10):1469-89.

5 - Dall'Oglio MF, Antunes AA, Pompeo AC, Mosconi A, Leite KRM, Srougi M. Prognostic Relevance of the Histological Subtype of Renal Cell Carcinoma. International Braz J Urol. 2008, Jan-Feb; 34(1): 3-8.

6 - Nguyena DP, Vertosickb EA, Corradia RB, Vilasecaa A, Benfantea NE, Touijera KA, el al. Histological subtype of renal cell carcinoma significantly impacts survival in the era of partial nephrectomy. Urol Oncol. 2016 Jun; 34(6): 259e1-259.e8.

7 - Muglia VF, Prando A. Renal cell carcinoma: histological classification and correlation with imaging findings. Radiol Bras. 2015 May/Jun;48(3):166-174.

8 - Zhang J, Lefkowitz RA, Ishill NM, Wang L, Moskowitz CS, Russo P, et al. Solid Renal Cortical Tumors: Differentiation with CT. Radiology [Internet]. 2007;244(2):494-504. Available from: http://pubs.rsna.org/doi/10.1148/radiol.2442060927

9 - Young JR, Margolis D, Sauk S, Pantuck AJ, Sayre J, Raman SS. Clear Cell Renal Cell Carcinoma: Discrimination from Other Renal Cell Carcinoma Subtypes and Oncocytoma at Multiphasic Multidetector CT. Radiology [Internet]. 2013;267(2):444-53. Available from: http://pubs.rsna.org/doi/10.1148/radiol.13112617