The Value of Spiral Computed Tomography in Diagnosis of Renal Mass Lesions

Sahar Basim Ahmed, Saad Hatem Al-Samarrai

ABSTRACT:

BACKGROUND:
This prospective study was done in spiral CT units at Al-Yarmook teaching hospital & Al-Kadhmia teaching hospital , in the period from October 2005 to October 2007, 40 Patients with renal masses were examined

OBJECTIVE:
To evaluate the role of spiral CT in the diagnosis of renal mass lesion. Agreement between spiral CT with histopathology in diagnosis of renal masses by spiral computed tomography.

PATIENTS & METHODS :
Forty patients with renal masses were referred to spiral CT examination , they were referred from urology department . The final diagnosis of most cases was confirmed by surgery and histopathology in (36) cases. The patients ages ranged from (3-79) years. Data collection regarding age, sex, occupation, history of cigarette smoking, history of renal stones, clinical presentation, past history, family history of renal disease, history of trauma and previous history of hospital admission were made.

RESULTS:
The most common age group affected was (50-59) most frequently Presenting symptom was haematuria .
The sensitivity 76.9%, specifity 97%, PPV 78%, NPV 96.4% and accuracy of CT in diagnosis of renal masses was 96%.

CONCLUSION:
This study shows that CT is highly specific and accurate for diagnosis of renal masses and especially the renal cell carcinoma,which is the most common tumor detected in this study.

KEY WORDS: centimeter, computed tomography, hounse field unit, kilovoltage, milliampere **.**

INTRODUCTION:

Computed tomography (CT) is widely accepted as the imaging modality of choice for detection and characterization of renal masses [1]. It can accurately assess pseudomasses and other anatomical abnormalities and can provide attenuation values that can confirm the presence of fluid in cysts or fat as in angiomyolipoma[2]. The primary reason to investigate a renal mass is to exclude a malignant neoplasm.

Renal masses were classified based on pathology (malignant, benign or inflammatory)[3] or based on a radiographic appearance (simple cyst, complex cyst, fatty tumors and others) [4], or can be categorized into cysts, tumors, inflammatory lesions[5]. Spiral computed tomography is accepted as the state of art technology in staging of renal cell carcinoma (RCC) due to its ability to obtain multiple scan through the area of interest with accuracy rate of 90-95% [6] and sensitivity of 94%

in detecting of small tumors [7], also spiral computed tomography provides the high quality CT examination and is prerequisite for characterization of cystic mass lesions.

The Bosniak classification system in which CT features are used to classify cysts in four categories (benign, complicated benign, intermediate, malignant)[1].

Class (I) Lesions are simple benign cysts that require no further evaluation unless signs or symptoms develop. Class (II) Lesions are also benign, these cysts which are minimally complicated by previous infection or hemorrhage, can be followed radio graphically. Class (III) Lesions are indeterminate and have a malignancy rate of 50%, hence surgical exploration of the lesions is warranted in otherwise healthy patients.

Class (IV) cystic lesions and solid masses that enhance with contrast medium are presumed to be malignant[8].

Renal cell carcinoma (RCC):- is the most common primary renal malignant neoplasm in the adult [9]. It accounts for approximately 85% of renal tumors, and 3% of all adult malignancies, It is more

Al – Yarmook Teaching Hospital

common in men than in women (ratio 2.5:1) [10]. It often occurs in patient aged 50-70 years [9]. RCC is seen in about 36% of patient with Von Hippel - Lindau disease. There is also an increased incidence of RCC in patient with long-term haemodialysis [11].
One fourth to one third of patient have metastatic disease at the time of presentation[9], the tumor may be multifocal within the same kidney or bilateral in up to 2% [10].

Renal cystic diseases associated with renal neoplasms include aquired cystic kidney disease , Von Hippel-Lindau disease and tuberous sclerosis Renal tumors are staged according to Robson's staging for RCC.

Stage I	Tumor confined within a kidney
Stage II	Perinephric fat involvement but confined with Gerota's fascia.
Stage IIIA	Renal vein or IVC involvement.
Stage III B	Regional lymph node involvement.
Stage III C	Venous and lymph node involvement.
Stage IVA	Adjacent organs involvement other than ipsilateral adrenal gland
Stage IVB	Distant metastasis[9].

Transitional cell carcinoma (TCC):- this malignancy originates from the transitional epithelium of the renal pelvis, ureters or bladder, and usually present with hematuria, it's most common in the bladder and the least common in the ureter. It forms about 5-10% of renal malignancies [10] and 4%, of all urothelial tumors [12].

Wilms' tumors : it's the most common solid renal tumor of child hood for roughly 5% of childhood cancer. More than 90% of all Wilms' tumor cases are noted before age of 7 years [11].

Lymphoma : primary renal lymphoma is rare involvement of the kidney is usually secondary to extension disease elsewhere in the abdomen[10]. Incidence of renal involvement in patient with lymphoma is 34-62% in several autopsy series. Renal involvement occurs more commonly in Non-Hodgkin lymphoma than Hodgkin lymphoma. Renal lymphoma demonstrate no sex predilection and occur in all age groups. CT scans demonstrate a wide variety of appearance in renal lymphoma, these include multiple renal masses, a solitary mass diffuse renal infiltration [13].

Angiomyolipoma: is a benign tumor consists of varying proportions of angoid, myoid and lipoid tissue, CT demonstrate some fat in over 90% of cases, shown an areas of low density (-20 Hu or less). It has an incidence of about 0.3-3% [14], among population and occur in 80% in adults between 30 and 50 years of age with marked female predominance[10].

Renal abscess : focal parenchymal inflammation may progress to liquefaction and abscess formation[11]. CT scan has improved ability to diagnose renal and perirenal abscess. CT will also show a heterogeneous mass with irregular marginal enhancement containing single or multiple areas of cystic necrosis. In severe cases gas may also be identified [1].

Cystic disease: the cystic disease of kidney can be classified into renal dysplasia. Polycystic disease, cortical cyst, medullary cyst, or can be categorized into simple cyst, parapelvic and peripelvic cyst, complex cyst and a quired cystic disease of dialysis [15].

PATIENTS & METHODS :

Forty patients with renal masses were referred to spiral CT examination , they were referred from urology department . The final diagnosis of most cases was confirmed by surgery and histopathology in (36) cases.The patients ages ranged from (3-79) years. Data collection regarding age, sex, occupation, history of cigarette smoking, history of renal stones, clinical presentation, past history, family history of renal disease, history of trauma and previous history of hospital admission were made.

Scanning technique :-

All spiral CT equipment were performed on a Somatom, plus 4, Siemens.
KV = 120, mA = 200-360 according to body built no preparation was required, patients lying supine holding breath during the scan. Axial sections were

taken in craniocaudal direction. Slice thickness is 8 mm, table feed 12 mm. Pitch 1.5 (pitch is the ratio between table feed per rotation and slice thickness).

The slice thickness was reduced to 5 mm in small size tumor. Pre and post contrast scans were done to all patients using 300 mg/kg body weight of water soluble iodinated contrast media (Omnipaque) given manually within 1-2 minutes intravenously scanning began immediately after the injection.

RESULTS:

Forty patients (21) males & (19) females, clinically labeled as cases of renal masses referred to radiology department for (CT) evaluation.

The mean age of patients was 46 year, for female patient, the mean age was 45 year and for male patient was 47 year. The most common age group affected was (50-59) year forming 27.5% of all patients. (table -1-). The patients presented with variety of symptoms, the most frequently presenting symptom was haematuria 50% followed by palpable mass 36%, Loin pain 25%, fever, malaise and weight loss 19.4%, incident finding on routine (US) examination 8.3%, bone pain 5.5%, clot retention 5.5%, cough, dyspnoea and haemoptysis 2.7%.

The final diagnosis of the renal masses was: 22 patients were diagnosed as RCC, the heighest incidence was noted in age group between (40-70) year, more in males 68.2% compared to 31.8% in females, and the major risk factor was cigarette smoking. four patients with Wilm's tumor (3-5) year, two male patients with Non-Hodgkin lymphoma, two patients with renal abscess had history of immune compromized disease (diabetes mellitus and chronic renal failure), three females with masses diagnosed as angiomyolipoma, two

with complicated cysts, two with Xanthogranulomatous pyelonephritis in which there was history of renal stone and repeated urinary tract infection and another two patients with simple renal cysts (table -2-).

Regarding the side of involvement by the renal mass, the left kidney was involved in (23) cases while the right kidney in (17) cases, the lower pole of the kidney showed higher incidence of affection (19) cases, midpole (13) cases, upper pole (9) cases, whole kidney involvement (2) cases and renal pelvis (1) case.

The size of renal masses detected in this study ranged from (1 cm) up to (15 cm) the renal mass ranged from (1-5) cm in (21) cases, from (6-10) cm in (14) cases, from (11-15) cm in (5) cases.(table -3-).

The smallest renal mass detected by CT was 1cm proved to be angiomyolipoma.

The (CT) features of the renal mass regarding the density was hypodense masses in(15), heterogenous in(14), isodense in(7) and (4) hyperdense masses (table -4-).

Regarding the agreement between spiral CT and histopathology in diagnosis of renal masses, the observed agreement was 83.3% . (table-5-).

The sensitivity 76.9%, specifity 97%, PPV 78%, NPV 96.4% and accuracy of CT in diagnosis of renal masses was 96%.

The sensitivity 90.9%, specifity 85.7%, PPV 90.9%, NPV 85.7% and accuracy in diagnosis of RCC was 88.9%.

The observed agreement between CT and histopathology instaging of RCC was 90%, the rate of under diagnosis by CT (5%) and the rate of over diagnosis by CT was (5%). The accuracy of CT in staging RCC was (90.9%) (table-6-)

Table 1 : Gender distribution by age groups

Groups of age (year)	Gender				Total No.	Total %
	Male No.	%	Female No.	%		
0-9	1	2.5	3	7.5	4	10
10-19	1	2.5	1	2.5	2	5
20-29	0	0.00	1	2.5	1	2.5
30-39	2	5	2	5	4	10
40-49	7	17.5	2	5	9	23.5
50-59	7	17.5	4	10	11	27.5
60-69	2	5	3	7.5	5	12.5
70-79	1	2.5	3	7.5	4	10
Total	21	50	19	50	40	100
Mean	46.9		44.8		45.8	

Table 2 : Frequency distribution of the study sample by final diagnosis

Disease	Male No.	%	Female No.	%	Total No.	Total %
Renal cell carcinoma	15	37.5	7	17.5	22	55
Transitional cell Carcinoma	0	0.00	1	2.5	1	2.5
Wilms' tumour	1	2.5	3	7.5	4	10
Non-Hodgkin lymphoma	2	5	0	0.00	2	5
Angiomyo lipoma	1	2.5	2	5	3	7.5
Renal abscess and perinephric abscess	0	0.00	2	5	2	5
Xanthogranulomatous pyelonephritis	0	0.00	2	5	2	5
Complicated cyst	2	5	0	0.00	2	5
Simple renal cyst	0	0.00	2	5	2	5
Total	21	52.5	19	47.5	40	100

Table 3 : Distribution of renal mass Lesion according to the size of predominate renal Lesion

Final diagnosis	Less 1 cm	1 – .5 cm	6 – 10 cm	11 – 15 cm	Total
Renal Cell Carcinoma	0	10	10	2	22
Transitional Cell Carcinoma	0	1	0	0	1
Wilms' Tumour	0	2	1	1	4
Non – Hodgkin Lymphoma	0	1	1	0	2
Angiomyolipoma	0	3	0	0	3
Renal abscesses and Perinephric abscesses	0	0	1	1	2
Xanthogranulomatous pyelonephritis	0	1	0	1	2
Complicated cyst	0	2	0	0	2
Simple renal cyst	0	1	1	0	2
Total	0	21	14	5	40

Table 4 :CT features of predominate renal mass Lesion

CT Provisional diagnosis	Final Diagnosis										
	R.C.C.	T.C.C	Wilms' Tumor	N.H.L.	Angiomyo-Lipoma	Renal abscess	XGP	Complicated cyst	Simple renal cyst	Adenoma	Total
Renal cell Carcinoma.	20			1				1			22
Trasitional cell Carcinoma		1									1
Wilms' tumor			3								3
Non – Hodgkin Lymphoma			1	1							2
Angiomyolipoma											
Renal abscess and perinephric abscess						2					2
Xanthogranulomat-ous Pyelonphritis XGP							1				1
Complicated cyst	1						1	1			3
Simple renal cyst									1		1
Adenoma	1										1
Total	22	1	4	2		2	2	2	1		36

Table 5 : Agrecment between spiral CT and histopathology in diagnosis of renal mass.

Final diagnosis	Isodense	Hypodense	Heterogenous	Hyperdense	CT enhancementnt	No enhancement	Total
Renal Cell Carcinoma	6	4	10	2	21	1	22
Wilms' Tumour	1	-	2	1	4	-	4
Transitional Cell Carcinoma	-	1	-	-	1	-	1
Non – Hodgkin Lymphoma	-	2	-	-	2	-	2
Angiomyolipoma	-	2	1	-	1	2	3
Renal abscesses Perinephric abscesses	-	2	-	-	2	-	2
Xanthogranulomatous pyelonephntis	-	2	-	-	1	1	2
Complicated cyst	-	-	1	1	1	1	2
Simple renal cyst	-	2	-	-	-	2	2
Total	7	15	14	4	33	7	40

Table 6: Agreement between CT and histopathology in staging of RCC

	Histopathological Staging						Total
	Stage I	Stage II	Stage IIIa	Stage IIIb	Stage IIIc	Stage IV	
CT staging							
Stage – I	6						6
Stage – II		6		1			7
Stage – IIIa			1				1
Stage – IIIb		1		1			2
Stage – IIIc					1		1
Stage IV						3	3
Total	6	7	1	2	1	3	20

The Observed agreement   = 18/20 = 90%
The rate of under diagnosis by CT   = 1/20 = 5%
The rate of over diagnosis by CT   = 1/20 = 5%
The accuracy of CT in staging of RCC   = 90.9%

DISCUSSION:

Spiral CT remains the single most important radiologic test for delineating the nature of a renal mass[16].

In our study, the analysis of age and gender distribution amongst (40) patients showed that the highest percentage (27.5%), (17.5% males and 10% females) were at the age group of (50 – 59) years and the age group (40 – 49) formed (23.5%) of all patients, (17.5% males and 5% females) were the most age groups affected by RCC. Dreicel etal (2004) reported that RCC occurred mostly in 5th and 6th decade of life[12].

Among the clinical presentation of the renal mass lesion, haematuria was the commonest presentation (50%), loin mass 36%, renal pain 25%, fever, weight loss (19.4%), incidental finding by (US) in (8.3%), similar results were also reported [9,17]

Regarding the final diagnosis of a renal mass, we found that (55%)of cases (15 males and 7 females) have RCC, with male predominance over female by aratio 2.1:1, similar results obtained by other studies. [9,10]

Wilms' tumor was found in 4 cases with ages

(3-5)years and this was consistent with finding of Belldegrun etal (2003)[16] who reported the same results.

Angiomyolipoma cases were detected in middle aged females,Vogelzang(1996)[5] reported the same results .

Simple renal cyst increasing frequency with age and are present in (25 – 50%) of subjects over the age 50.[10]

In this study, 3 cases of cystic renal lesions were operated upon because of complications related to these cysts.

CT appears to be the most accurate mean of differentiation between renal cyst and tumor.[12] It also confirms the diagnosis of simple renal cyst.[15]

It is recorded that the tumor occur in equal frequency in both kidneys,[12] in this study (57.2%) of the tumors were in the left kidney and (42.5%) of them were in the right kidney.

Regarding the site of affection, the lower pole was more commonly involved (52.7%), while other studies showed no preference for any pole.[12]

In the majority of cases, the CT features of renal mass lesion were predominatly hypodense masses with heterogenous enhancement after intravenous injection of contrast medium .[10] . The distribution of renal mass lesion according to the size of the renal mass, we found (21) cases measured about (1–5)cm, indicate the ability of CT scan for greater lesion detection and better characterization of small renal masses, and this was also shown by other studies. [18,19,22,24] The accuracy of CT for diagnosis of renal mass lesion in the study was 96% and this is consistent with accuracy reported by Hricak (1990) of about 95%.[20]

For RCC, CT results were accurate in 88.9% comparable to what is reported by Mauzan (1989) of about 89%.[21] Spiral CT is accepted as the state of art technology in staging RCCs due to its ability to obtain multiple scans through the area of interest. Tumor staging has an influence on the surgical approach, radical nephrectomy is considered as standard method of surgical management. The observed agreement was 90% and this matched with Fleyeh (2003)[23,25] and we have one case over staged due to an enlarged lymph node proved pathologically to be reactive hyperplasia, and one case under staged due to microinvasion of normal size lymph node, The accuracy of CT in staging of RCC in our study was 90.9% and this is consistent with accuracy reported by kabala (2003) of about 90%.[10]

CONCLUSION:

CT scan remains the single most important radiologic test for delineating the nature of renal mass.

CT scanning with and without contrast medium administration is necessary to take full advantage of the contrast enhancement characteristics of highly vascular renal parenchyma tumors. In general any renal mass that enhance with intravenous contrast on CT should be considered RCC until proved otherwise.

This study shows that CT is highly specific and accurate for diagnosis of renal masses and especially the renal cell carcinoma, which is the most common tumor detected in this study.

CT is relatively easy, less operator dependant and therefore more reproducible.

REFERENCES:

1. Schreyer HH, Uggowitzer MM, Kohlmager AR. Helical CT of the urinary Organs. Eur. Radiology 2002; 12,575 – 591.
2. Birnbaum RBA, Jacobs JE, Ramch , Mutiphasic renal CT: Comparison of renal mass enhancement during the corticomedullary and nephrographic phase. Radiology 2000, 753 – 758.
3. Schoepf UJ, Becker C, Broning R et al. Computed tomography of the abdomen. Radiology 1999; 39, 652 – 61.
4. Barbaric ZL. Principles of genitourinary Radiology, and ed. New York. Thieme medical publisher 1994; 154.
5. Vogelzang R. Renal arteriography and computed tomography. In Gillenwater JY, Adult and pediatric Urology 3rd ed, St. Louis: Mosby, 1996; 113.
6. Newhose JH. Radiological evaluation of the patient with renal cancer. In: The urologic clinic of the North America. Philadelphia. Saunders 1993, 231 – 246.
7. Schweden FJ, schild HH, Riedmiller H. Renal Tumors in Adults. In: Schild HH, Schweden FJ, Lang EK; (eds). Computed Tomography in Urology New York: Thieme, 1992, 135 – 167.
8. Wolf JS. Evaluation and management of solid and cystic renal masses. Jurology 1998; 159: 1120 – 33. Cited in Higgins JC and Eitzgerald JM. Evaluation of Incidental Renal and Adrenal masses. American family physican 2001,1 – 10.
9. Baumgarten D, Smith JK. Renal cell carcinoma. J urology 2002; 8, 521 – 533.
10. Kabala, J.E., The kidneys and ureters. In: Suttion D; ed. A text book of Raiology and imaging 7th ed. London: Churchill Living stone, 2003, 929 – 987.

11. Rottenberg G, Rankin S. Renal masses. In: Grainger and Allson's diagnostic Radiology. Atextbook of medical imaging, 5th ed. New York: Churchill Livingstone, 2005, 1557 – 1575.

12. Dreicel R., Williams RD. Renal Parenchymal neoplasms. In: Tanagho EA, Mcaninch JW; Eds. Smith's general Urology; 16th ed. California: Appleton and Lange, 2004, 346 – 365.

13. Truong LD, Caaniay N, Ngo T, et al: The diagnostic and therapeutic needle aspiration in renal lymphoma. Am J Clin Pathol 2001; 115 , 18 – 13.

14. Mitchell TL, Pippin JJ, Devers SM: Incidental detection of preclinical renal tumors with beam computed tomography: report of 26 operated patients. J comput. 2000; 24 , 843 – 5.

15. Bosniak MA: the use of the Bosniak classification system for renal cysts and cystic tumors. Jurol. 1997; 147, 1852.

16. Belldegrun A, Dekernion JB. Renal Tumors. In: wa;sh, Retik AB, wein AJ eds. Campbell's urology, 8th ed., Philadelphia: Saunders, 2004; 47, 2283 – 2326.

17. Landis SH, Murray T, Bolden S, Wingo PA: Cancer statstic : 1999. CA Cancer Jclin 1999; 49, 8 – 31.

18. Szolar DH, Kammerhuber F, Altziebler S, et al. Multiphasic Helical CT of the kidney: Increased conspicuity for Detection and characterization of small (< 3 cm) Renal Masses. Radiology 1997; 202, 211 – 217.

19. Cohan RH, Sherman LS, korobkin M, et al. Renal Masses: Assessment of corticomedultary phase and Nephrographic – phase CT scans, Radiology 1995; 196,445 – 451.

20. Hricak H, Thoeni RF, Carroll RR, et al. Detection and staging of renal neoplasms: Are assessment of MR imaging. Radiology 1990; 176,333 – 338.

21. Mauzan JK. Renal masses comparison of US, CT, urography and Renal Anigography. 1989; 1 – 14.

22. Rendon RA., Stanietzky N. Panzrella T., et al. The natural history of small renal masses J urol. 2000; 164, 1143 – 1147.

23. Fleyeh A.G, AL-Beer A, Hussein MM. The value of spiral computed tomograghy in the staging of renal cell carcinoma .The post graduate medical journal 2003; 2,350-353.

24. Derweesh et al ,2004. Derweesh IH , Goel MC , Gill IS ,et al : Predictive value of 3 dimentional volum rendering CT for collecting system entry and tumour size prior to nephron sparying syrgery ,J urol. 2004 ;171 (suppl) ,1655 .

25. Fenton & Wiess ; 2004. Fenton JJ, Wiess NS: Screening Computed Tomography . Will it result in over diagnosis of renal carcinoma ?.2004;100,986-990.

26. Significance of peritumoral vascularity on CT in evaluation of renal cortical tumor. Journal of computer assisted tomography 2007;31,717-23.

27. Dynamic Contrast-Enhanced CT of Renal Cell Carcinoma for Evaluation of Tumor Vascularity: Analysis of Single-Phase or Multiphase Scanning Am. J. Roentgenol., June 1, 2007; 188, W569 - W569.