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Diagnostic accuracy of ultrasound in renal masses taking computed tomography as a gold standard

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***Abstract*---**Objective: To evaluate diagnostic accuracy of ultrasound in renal masses taking computed Tomography as a gold standard. Methodology: A cross-sectional study of 198 study subjects with renal masses was conducted at District Head Quarter Hospital (DHQ) and Allied Hospital, Faisalabad. Patients of age 18 years and above and of both genders with complaints of hematuria and/or palpable mass in the flank region was included. Patients with nephrolithiasis, any other gross renal pathology and patients with any contraindication to the contrast agent, were excluded. Results: Ultrasound had the Sensitivity of 76.67%, Specificity of 100%, positive predictive value of 100%,

negative predictive value of 80.56%, and the diagnostic accuracy of 88.14% respectively for the assessment of renal cell carcinoma. Conclusion: Ultrasound is a reliable tool for the differentiation of renal masses, and other renal pathologies such as simple cysts, complex cysts, and polycystic kidney disease.

Keywords---computed tomography, renal mass, renal cell carcinoma, ultrasound.

Introduction

The increasing incidence and reporting of renal cell carcinoma can be attributed to the development of more efficient methods of diagnosis. Ultrasound and computed tomography (CT) have become more commonly available in recent years[1]. Because of the widespread use of abdominal x-rays in clinical practice in last decade, small renal cell carcinoma has become more widely recognized and discovered [2]. In patients, most tumors are first found during imaging scans performed for purposes other than the management of renal cell carcinoma. During the same period the patient [3.] Additionally, the great majority of cancers found by accident develop slowly or never advance. In order to avoid over treating benign or potentially malignant disorders, it is crucial to identify clinically relevant renal masses that have the potential to progress into life-threatening disease. Avoid becoming sick and spending money [4]. Renal cell carcinomas make up about 2–3% of all adult cancers, according to current estimates. As per the surveys, 209,000 new cases with 102,000 death are reported annually due to RCC [5]

According to the latest data, the increase in the number of cases of this cancer in all stages over the last several years is associated with an increase in the per capita mortality rate. A risk factor for renal cell carcinoma has been established. BMI, or body mass index, is another well-known risk factor for heart disease (BMI).[7] Although studies have shown that fruits and vegetables are protective, no additional specific dietary relationships have been discovered.[8] According to research, high blood pressure medications such as diuretic pills are ineffective in reducing the risk of this cancer. Cell carcinoma compared with the general population. In most cases, the pathogenic mechanisms underlying the aforementioned risk factors are unknown.[9]

Other potentially carcinogenic environmental factors, such as the use of acetaminophen or analgesic medications, as well as asbestos or trichloroethylene exposure, have not been associated to this disease thus far. Between 2% and 3% of the population is thought to be affected by one of the numerous autosomal dominant syndromes, each with its unique genetic background and manifestations.[10] Von Hippel-Lindau syndrome is related with vascular malignancies such as clear cell renal cell carcinoma, central nervous system haemangioblastomas, and pheochromocytoma (a form of blood vessel cancer) (1 in 36 000 births). Von Hippel-Lindau syndrome is a condition in which one allele of the VHL gene is defective in the heart and the other allele is dysfunctional in the kidneys and liver.[11] Renal cell cancers are more prevalent and are more likely to

be multi-located in this syndrome. Patients with von Hippel-Lindau syndrome who develop renal cell carcinoma are treated by continuously monitoring their kidney lesions and attempting to preserve as many functional nephrons as feasible during their disease. In the vast majority of individuals with sporadic (non-inherited) clear cell kidney tumors, the von Hippel-Lindau protein is found to be faulty. Unallocated and late-onset sporadic clear cell carcinoma are the most common types of clear cell cancer.[12]

Renal cell carcinoma is spreading rapidly, which is a major public health concern. Due to lack of effective diagnostic techniques in less developed areas of Pakistan, early detection of renal cell carcinoma is difficult in these areas. Most hospitals do not have or do not have easy access to computerized tomography scanning equipment. An ultrasound can be done quickly and easily in most hospitals, and is often accessible the same day. Because of its accessibility and affordability, ultrasonography is a viable technique in most healthcare settings in our country. We are currently conducting this research to assess that we're conducting this research right now to assess how effectively Ultrasonography performs in terms of detecting and characterizing kidney masses, so that we can develop health programs that are tailored to the resources available to us in our communities for early detection and successful treatment.

Material and Methods

Study Settings: The current study was carried out at District Head Quarter Hospital (DHQ) and Allied Hospital, Faisalabad, Punjab, Pakistan.
Duration of Study: Total duration of research was approximately 09 months i.e. December 20, 2021 to June 30, 2022.
Sample size: 198 individuals fulfilling the inclusion criteria were selected for the current study. The sample size was calculated at a 95% level of significance and 8% precision of accuracy.

Inclusion Criteria

- Patients of age 18 years and above
- Of both genders
- With complaints of hematuria and/or palpable mass in the flank region

Exclusion Criteria

- Patients with nephrolithiasis or any other gross renal pathology
- With any contradiction to contrast agent.
- With pregnancy

Data Collection Procedure

Before the procedure, informed consent was taken from all the participants. All variables for each patient were recorded in the data collection sheet. The study variables are the age of the patients, Gender, and mass size, number, location, Echogenicity, margins, morphology /echotexture, and vascularity. A thorough clinical history was collected and finding were recorded. For Ultrasound TOSHIBA

Machine (Xario) with convex transducer ranging from 3 to 7.5 MHZ was used to assess the Kidneys and focal lesions were evaluated under the features of size, number, location, echogenicity, margins, morphology/echotexture and vascularity. Color Flow in the lesion was determined as present or absent on color Doppler. For computed tomography CT scan TOSHIBA, 64 slice multi-detector CT scan machine was used. The patient's preparation includes 6-8 hours of fasting, monitoring creatinine level, and intravenous line. Volume and flow of contrast are maintained according to the condition of the patients and results during tomography. After the procedure, patients were advised to increase the water intake to remove contrast through the kidney.

Results

198 subjects were included in this study.

Table 1: Age of patients (n=198)

Descriptive Statistics							
	N	Range	Minimum	Maximum	Mean		Std. Deviation
					Statistic	Std. Error	
Age	198	69.0	18.0	87.0	48.37	1.24	17.53

The age of 198 patients from 18-87 years, and the mean and standard deviation of the age was 48.37 ± 17.53 years (Table 1)

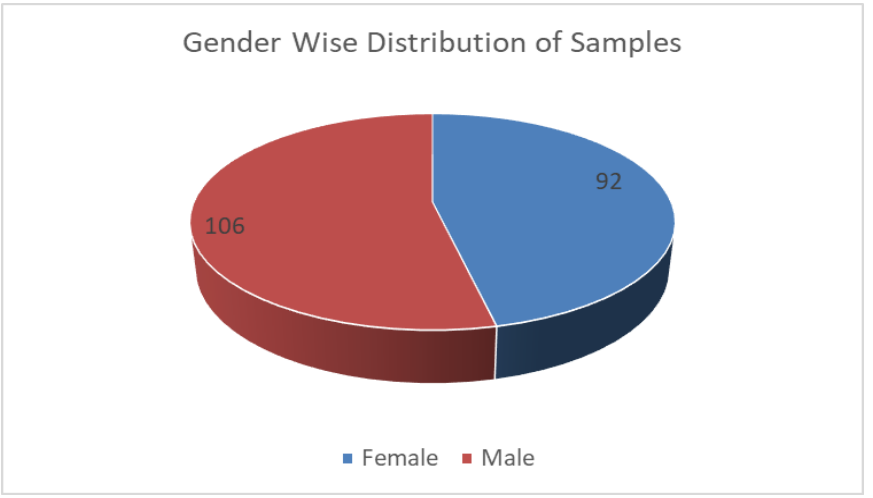

Figure 1: Gender Wise Distribution of Samples

In this study, among the total 198 patients 92 (46.5 %) were female while the remaining 106 (53.5 %) were male (Figure 1)

Table 2: Diagnostic accuracy of US for the assessment of Renal Cell Carcinoma (n=198)

Parameter	Estimate	Lower - Upper 95% CIs
Sensitivity	76.67%	(59.07, 88.21)
Specificity	100%	(88.3, 100)
Positive Predictive Value	100%	(85.69, 100)
Negative Predictive Value	80.56%	(64.97, 90.25)
Diagnostic Accuracy	88.14%	(77.48, 94.13)

Ultrasound had the Sensitivity of 76.67%, Specificity of 100%, positive predictive value of 100%, negative predictive value of 80.56%, and the diagnostic accuracy of 88.14% respectively for the assessment of renal cell carcinoma (Table 2).

Table 3: Diagnostic accuracy of US for simple cyst assessment (n=198)

Parameter	Estimate	Lower - Upper 95% Cis
Sensitivity	86.02%	(77.54, 91.65)
Specificity	96.67%	(83.33, 99.41)
Positive Predictive Value	98.77%	(93.33, 99.78)
Negative Predictive Value	69.05%	(53.97, 80.93)
Diagnostic Accuracy	88.62%	(81.8, 93.1)

In this study ultrasound had the Sensitivity of 86.02%, Specificity of 96.67%, positive predictive value of 98.77%, negative predictive value of 69.05%, and the diagnostic accuracy of 88.62% respectively for the assessment of simple cyst (Table 3)

Table 4: Diagnostic accuracy of US for the assessment of Autosomal dominant polycystic kidney disease (n=198).

Parameter	Estimate	Lower - Upper 95% Cis
Sensitivity	63.16%	(41.04, 80.85[1])
Specificity	100%	(88.3, 100[1])
Positive Predictive Value	100%	(75.75, 100[1])
Negative Predictive Value	80.56%	(64.97, 90.25[1])
Diagnostic Accuracy	85.42%	(72.83, 92.75[1])

For the evaluation of autosomal dominant polycystic kidney disease, ultrasound exhibited a sensitivity of 63.16 percent, a specificity of 100 percent, a positive predictive value of 100 percent, a negative predictive value of 80.56 percent, and a diagnostic accuracy of 85.42 percent. (Table 4).

Table 5: Ultrasonographic assessment of renal pathologies (n=198)

Pathology	Frequency	Percent
Autosomal dominant polycystic kidney disease	12	6.1
complex cyst/cysts	13	6.6
Hydronephrosis	5	2.5
No finding	45	22.7
Renal cell carcinoma	29	14.6
simple cyst/cysts	94	47.4
Total	198	100.0

On US modality 12 (6.1 %) renal pathologies were categorized as autosomal dominant polycystic kidney disease, 3 (1.5 %) were complex cyst/cysts, 5 (2.5 %) were hydronephrosis, 45 (22.7 %with no findings, 29 (14.6 %) were renal cell carcinoma, and 94(47.4%) were simple cyst/cysts (Table 5)

Table 6: Computed Tomographic assessment of Renal pathologies (n=198)

Pathology	Frequency	Percent
Abscess	2	1.0
Angiomyolipoma	3	1.5
Autosomal dominant polycystic kidney disease	19	9.6
Complex cyst/cysts	4	2.0
Hematoma	1	.5
No finding	31	15.7
Pyelonephritis	2	1.0
Renal cell carcinoma	30	15.2
Simple cyst/cysts	104	52.5
Wilm's tumor	2	1.0
Total	198	100.0

On CT modality 2 (1.0 %) renal pathologies were categorized as abscess, 3 (1.5 %) were angiomyolipoma, 19 (9.6 %) were autosomal dominant polycystic kidney disease, 8 (4.0 %) were complex cyst/cysts, 1 (0.5 %) were hematoma, 31 (15.7 %) with no findings, 2 (1.0 %) were pyelonephritis, 30 (15.2 %) Renal cell carcinoma, 104 (52.5 %) were simple cyst/cysts, and 2 (1.0 %) masses were Wilm's tumor. (Table 6)

Discussion

We conducted a comparative study of 198 patients with renal masses of which 92 were female while the remaining 106 were male having a mean and standard deviation of age 48.3737 ± 17.537 years ranging from 18-87 years which is less than 66 ± 13 years, ranging from 32–81 years conducted by Geyer T. et al. [13] We examined the patients with renal masses by using ultrasound and Computed Tomography. We look at the use of ultrasound for the detection of renal disease taking Computed Tomography as a gold standard.

In our study, we classified the renal masses into different pathologies including abscess, angiomyolipoma, autosomal dominant polycystic kidney disease, bosnik cat, complex cyst/cysts, hematoma, pyelonephritis, renal cell carcinoma, simple cyst/cysts, and Wilm's tumor disease based on both ultrasound and Computed Tomography modalities. In another study by Xu Z. F. et al., they also identified the histopathological characteristics of renal pathologies and differentiated between angiomyolipoma and renal cell carcinoma. [14] In another study by Ascenti G. et al., histopathological type concerning angiomyolipoma masses were observed by using ultrasound modality with contrast agent and it was seen that enhanced use of contrast did not enhance the diagnostic accuracy. [15]

For the evaluation of autosomal dominant polycystic kidney disease, ultrasound exhibited a sensitivity of 63.16 percent, a specificity of 100 percent, a positive predictive value of 100 percent, a negative predictive value of 80.56 percent, and a diagnostic accuracy of 85.42 percent. The results of the current investigation support those of Sun M. et al., who found that ultrasound had an 87.1% sensitivity and an 80.0% specificity for the diagnosis of small cysts. 16 Our results are consistent with those of Chen Y. et al., who found that contrast-enhanced ultrasonography (CEUS) had sensitivity, specificity, and overall accuracy of 97.2%, 71.4%, and 84.5% when evaluating masses. 17 These findings are likewise consistent with those of Barr R. G. et al., who found that ultrasound had a 100% sensitivity and a 96.6% specificity for classifying ambiguous renal tumours. 18

According to the results of this investigation, ultrasonography exhibited a sensitivity of 76.67% and a specificity of 100% for detecting renal cell cancer. The results of the current study also support those of Chang E. H. et al., who found that renal cell carcinoma could be detected by CEUS with a 90% sensitivity and a 55% specificity. 19 These findings are at odds with those of Zhang F. et al., who reported that CEUS's sensitivity and specificity for detecting renal cancer were 0.96 and 0.82, respectively [20]. This research agrees with the work of Rossi S. et al., who reported a sensitivity and specificity for renal cell carcinoma of 82.8 and 99.0 percent, respectively (RCC) [21].

According to the findings of this investigation, ultrasound had diagnostic accuracy of 85.42% (95% CI: 72.83%, 92.75%), specificity of 100% (95% CI: 88.3%, 100%), and sensitivity of 63.16% (95% CI: 41.04%, 80.85%) for the evaluation of autosomal dominant polycystic kidney disease. These results differ from those of Kalatharan V. et al., who showed a sensitivity of 33.7% [95% confidence interval (CI) 30.0-37.7] and a specificity of 86.2% [95% CI 75.7-92.5] for the detection of autosomal dominant polycystic kidney disease (ADPKD). 22 These results are consistent with those of Nicolau C. et al., who found that the US had a 97% sensitivity, 100% specificity, and 98% accuracy. 23 These results are consistent with those of Pei Y. et al., who demonstrated the conventional ultrasonography's (US) sensitivity (about 97% versus roughly 82%) and specificity (around 98% against 100%) in the diagnosis of autosomal dominant polycystic kidney disease. 24

Limitations

- This was a cross-sectional study directed in a single center, and only one experienced radiology technologist scanned all study subjects.
- Histopathology finding were not considered to confirmed CT findings.

Conclusion

Ultrasound is an effective method for distinguishing between different types of renal cysts and other renal diseases such simple cysts, complex cysts, and polycystic kidney disease. Our findings indicate that ultrasound has a good diagnostic accuracy for determining whether kidney tumours are benign or malignant.

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