ORIGINAL ARTICLE

Diagnostic Accuracy of Ultrasonography Versus Computed Tomography in Patients of Acute Renal Colic

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ABSTRACT

Background: CT scan is considered as gold standard imaging modality for diagnosis of nephrolithiasis but its utility is limited due to harmful radiation especially in children and pregnant females.
Aim: To evaluate the diagnostic accuracy of ultrasonography for detection of calculi in acute renal colic patients taking computed tomography as gold standard.
Methods: This was a cross-sectional study conducted at Govt. Said Mitha Teaching Hospital, Lahore. 102 patients of nephrolethiasis were selected using non-probability convenient sampling. Adult male and female patients of all ages fulfilling the inclusion criteria were included in the study. Ultrasonography and computed tomography of all patients were done and findings were noted. The data was entered and analyzed using SPSS
Results: Taking CT scan as gold standard, the sensitivity, specificity, positive predictive & negative predictive values and diagnostic accuracy of ultrasonography in detecting renal calculi was 74.47%, 96.36%, 94.59%, 81.54% and 86.27% respectively. While sensitivity, specificity, positive & negative predictive values and diagnostic accuracy of u/s in detecting ureteric calculi was 12.0%, 92.59%, 81.82%, 27.47% and 33.33% respectively.
Conclusion: Despite limited value in diagnosing urinary stones, ultrasonography may be used as an initial assessment tool in patients presenting with acute renal colic. Sensitivity and specificity of ultrasonography for detection of renal and ureteric calculi and hydronephrosis is variable and is influenced by stone size, type and location of the stone in urinary tract.
Keywords: Trasonography, CT, renal colic

INTRODUCTION

Acute renal colic is extremely painful condition and is the typical presentation of renal stones. The colicky pain is often episodic in nature with each episode lasting from twenty to sixty minutes. Urinary stones may affect from 5% to 15% of the population at some point and 50% of those may report recurrent episodes of colicky pain. Whenever the stone moves down the urinary tract, there are chances of blockage in urinary flow and hydronephrosis[1]. Prevalence of nephrolithiasis is on rise across the globe and highest increase in incidence is observed in 15 – 19 years age group in the last decade[2]. Regional and geographical variability has been reported in stone prevalence. The prevalence of nephrolithiasis is highly variable among various regions of Pakistan with highest reported prevalence of 12% from Dera Ghazi Khan[3].

The diagnosis of renal calculi is made on the basis of history, physical examination, presenting complaints, blood biochemistry and imaging profile. X-ray KUB, Ultrasonography and CT scan are commonly used imaging modalities for detection of stones[4]. There is no consensus on use of optimal initial imaging modality in suspected nephrolithiasis patients between European Association of Urology (EAU), American College of Radiology (ACR) and American Urological Association (AUA)[5]. Although CT scan is considered as the gold standard in diagnosing nephrolithiasis[6] but due to its unavailability at primary healthcare centers, ionizing radiations, contradiction in pregnant females and children and high operative and maintenance cost makes it less suitable to be used as initial diagnostic imaging modality[7].

Ultrasonography is very accurate for detection of hydro-nephrosis in stone patients. Renal stones exhibiting posterior acoustic shadowing and stones of size >5mm can be detected on USG reliably[8]. Ultrasonography has also advantages of lower cumulative radiation exposure, easy to use, cost effectiveness, non-invasive and availability at lower-level healthcare facilities.

Acute renal colic is the typical presentation of renal stones. Nephrolithiasis is a prevalent condition and its prevalence is rising across the globe. Patient may remain asymptomatic and diagnosed during routine health examination. In other cases, patient may present with typical colicky pain or atypical symptoms of nausea, vomiting, abdominal pain, frequency and urgency of urination .The colicky pain is often episodic in nature with each episode lasting from 20 to 60 minutes.

Urinary stones are classified into renal, ureteric, uretheral and bladder stones on the basis of location of the stone. Chemically, stones are classified into calcium and non-calcium stones. Calcium stones are the most prevalent form of stones and have metabolic levels due to various pathologies. The percentage of calcium stones ranges from 75% to 85% in various population. Uric acid (UA) stones are less prevalent form and makes approximately 10% of the all kidney stones. UA stones are frequently observed in men than women and in patients

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with gout and genetic causes. Less commonly, these are produced in patients with increased serum calcium.

The diagnosis of renal calculi is based on history, physical examination, presenting complaints, blood biochemistry and imaging profile. CT scan is considered as the gold standard for the diagnosis of nephrolithiasis. Urinalysis is simple and reliable marker for identification of renal stones but it do not provide information regarding size and location of the stone. Moreover, it is significantly affected by dietary habits, hydration status, environmental factors, various kidney diseases and systemic metabolic diseases.

- Various imaging modalities have been used for diagnosis of acute renal colic however, their sensitivity and specificity is variable. Moreover, there is no consensus on the use of initial imaging modality in suspected nephrolithiasis patients between European Association of Urology, American College of radiology and American Urological Association. Variable sensitivity and specificity of ultrasonography for detection of nephrolithiasis has been reported from various regions. Only a few studies have compared diagnostic accuracy of computed tomography and USG for nephrolithiasis. The pooled sensitivity and specificity of ultrasonography in literature for renal calculi is 45% and 88% and 45% and 94% for ureteric calculi respectively.
- The objective of this study was to evaluate diagnostic accuracy of ultrasonography (USG) for revealing of stones in patients with acute renal colic taking computed tomography as gold standard.

MATERIALS AND METHODS

The proposed study was undertaken at radiology department, Govt. Said Mitha Teaching Hospital, Lahore from March 2018 to February 2019. The approval of the study was taken from ethical review board of University of Lahore. All the adult male and females coming to emergency department with symptoms of acute renal colicky pain were included in the study. Patients not willing to participate, non-cooperative patients, pregnant females and patients with renal failure were excluded from the study.

Ultrasound of the patients presenting with symptoms of acute renal colic was performed by consultant radiologist using Ecoste mylab 7 color doppler machine furnished with 3.5, 5 and 7.5 MHz probes. Facility of Doppler was used for assessment of kidneys, ureter and urinary bladder in multiple anatomical planes to visualize stone and to measure the size of the stone.

CT scan of the patients was performed on Siemens CT Somatom Sensation sixty four observing following protocol. Patient with full of urinary bladder was in supine position on CT examination table and scan was performed from the upper abdominal region to the pubis symphysis with images constructed at the distance of five mm gap. No any intravenous or 88 oral contrast was given. Any hyper dense foci in the urethra, urinary bladder, ureter and kidney were taken as calculus.

Data was noted on a proforma and entered and analyzed using SPSS version 24. Specificity Sensitivity, negative predictive and positive predictive values and diagnostic accuracy was calculated for ultrasonography (USG) keeping computed tomography scan (CT scan) as gold standard.

RESULTS

Mean age value of the subjects in the present study was 36.43±10.34 years. Most of the patients (39; 38.24) were younger than 30 years of age. 34 (33.33%) were between 31-40 years of age, followed by 18(17.65%) in 41 – 50 years and 10.78% in 51-60 years of age (Table 1)(Fig. 1). 49% of the patients belonged to lower-middle class, followed by 33.3% and 17.6% in middle and lower socio-economic strata (Table 2).

Ultrasonography helped detection of 35 renal calculi in 35 out of 102 patients indicating a sensitivity and specificity of 74.47%, 96.36% respectively. The diagnostic accuracy was 86.27% while negative and positive predictive values were 81.54% and 94.59% respectively (Table 3).

Sensitivity and specificity of ultrasonography for detection of ureteric calculi was 12.0%, 92.59% respectively. The negative and positive predictive values using CT scan as gold standard were 27.47% and 81.82% while the diagnostic accuracy was only 33.33% (Table 4).

Figure 1: Age groups

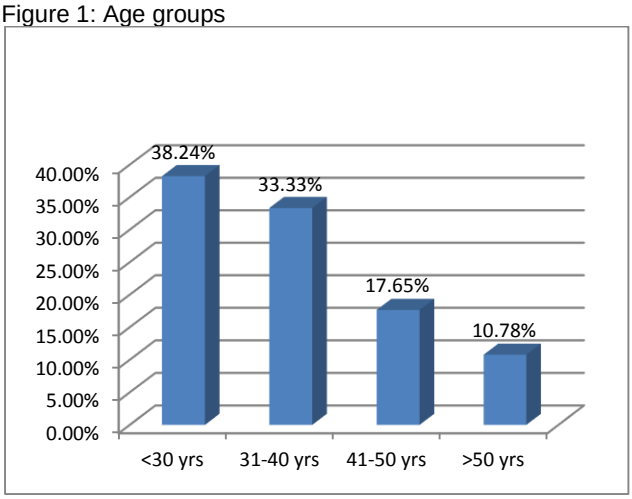

Table 1: Percentages among different age groups

Age groups	Percentages
<30 years	**38.24%**
31-40 years	**33.33%**
41-50 years	**17.65%**
>50 years	**10.78%**

Table 2: Socio-economic stratification of the study subjects

Socio Economic Status	Frequency	%	Valid%	Cumulative%
Lower Class	18	17.6	17.6	17.6
Lower Middle Class	50	49	49.0	66.7
Middle Class	34	33.3	33.3	100
Total	102	100.0	100.0	

Table 3: Renal Calculi single table analysis

	Ureteric Calculi on scan		Total
	Present	Absent	
Present	35	2	37
Absent	12	53	65
Total	47	55	102

Sensitivity = 74.47%
Specificity = 96.36%
Positive Predictive Value = 94.59%
Negative Predictive Value = 81.54%
Diagnostic accuracy = 86.27%

Table 4:Ureteric Calculi single table analysis

	Ureteric Calculi on scan		Total
	Present	Absent	
Present	9	2	11
Absent	66	25	91
Total	75	27	102

Sensitivity = 12.00%
Specificity = 92.59%
Positive Predictive Value = 81.82%
Negative Predictive Value = 27.47%
Diagnostic accuracy = 33.33%

DISCUSSION

Renal colic is the clinical presentation of flank pain radiating towards groin. Its prevalence is highly variable across various geographical regions and between races and is influenced by socio-economic and environmental factors. CT scan is the gold standard for diagnosis of urolithiasis but its use is limited due to ionizing radiation and unavailability at low level health care facilities in resource limited countries like Pakistan. On the other hand, ultrasonography is easily accessible, cost effective and easy to operate imaging modality for identification of renal stones.

In the present study, sensitivity, specificity, positive & negative predictive values and diagnostic accuracy of ultrasonography in detecting renal calculi was 74.47%, 96.36%, 94.59%, 81.54% and 86.27% respectively. While sensitivity, specificity, positive & negative predictive values and diagnostic accuracy of ultrasonography in detecting ureteric calculi was 12.0%, 92.59%, 81.82%, 27.47% and 33.33% respectively.

A study from US indicated 66.7% sensitivity and 97.4% specificity for detecting renal stones in pediatric population while NPV and PPV were 79.2% and 95.2% respectively[9]. Another study from USA reported a sensitive.ity and of 91% and 54% respectively for detection of renal calculi on ultrasonography[10]. The specificity and sensitivity of USG from Jordan was reported to be 91% and 58% respectively for diagnosing renal stone disease[11]. Results from a study from Nawaz Sharif Social Security Hospital, Lahore reported 93% sensitivity and 95% specificity of ultrasonography for diagnosing urolithiasis. While sensitivity and specificity of CT scan was 91% and 95% respectively in the same study[12].

Another study from Iran reported an overall sensitivity and specificity of 75.4% and 16.75 for detecting urinary calculi on ultrasonography[13]. The pooled sensitivity and specificity of ultrasonography in literature for renal calculi is 45% and 88% and 45% and 94% for ureteric calculi respectively[14]. Various factors affect sensitivity, specificity and diagnostic accuracy of the ultrasonography. Review of literature shows that diagnostic accuracy of ultrasonography in urolithiasis is directly associated with degree of hydronephrosis[15]. Moreover, increasing stone size also increases detection rate of renal stone[16]..

Pain in lumber region was the most frequently observed symptom in these patients followed by heaviness , burning sensation , swelling and pain in iliac region .The symptoms of urolithiasis are related to the location and size of the stone. Stones usually remain asymptomatic in the early phase. Mostly reported symptoms include renal colic, flank pain, hematuria, obstructive uropathy, hydronephrosis and blockage of urine .

49% of the patients belonged to lower-middle class, followed by 33.3% and 17.6% in middle and lower socio-economic strata. Similar results are reported by Prakash from Tamil Nadu, India. In the study, the highest incidence of 70% was reported in middle class, followed by 20% and 10% in good and low socio-economic status. Other studies have associated high incidence of upper ureteric stones with level of prosperity. The bladder stones are more common in low socio-economic group. Many studies have reported higher prevalence of urolithiasis in high income group. The probable reason is the higher prevalence of chronic metabolic diseases in this strata which are pre-disposing conditions for nephrolithiasis. A study from US also reported increased risk of kidney stone disease in people of lower income group than high income group. Difference in frequency of type, size and chemical composition of stones in various studies may partly explain this difference. Lastly, under–reporting, lack of diagnostic facilities and illiteracy in low socio-economic group may be a major factor for this difference.

Various factors affect sensitivity, specificity and diagnostic accuracy of the ultrasonography. Review of literature shows that diagnostic accuracy of ultrasonography in urolithiasis is directly associated with degree of hydronephrosis. Moreover, increasing stone size also increases detection rate of renal stone.. Non-visualization of stone directly on ultrasonography may be due to small stone size, low attenuation values and overlying bowel over most part of the ureter. Furthermore, the variability in literature may be due to variable sample size, environmental, ethnic and gender variation, different age groups, availability of imaging modality and expertise of the radiologist. In-experienced sonologist working at ideal setting with latest machine may not be able to balance the transducer power and focal length.

Although CT scan is gold standard for diagnosis of nephrolithiasis but using ultrasonography as an initial investigation toil is of utmost importance. Availability, easy handling and less radiation exposure with sufficient sensitivity and specificity for detecting stone makes it ideal imaging modality in resource limited settings. Moreover, use of ultrasonography is safe in children and pregnant females.

CONCLUSION

The high diagnostic accuracy of ultrasonography for renal stones makes it suitable as a first line diagnostic approach in emergency settings. Contrary to this, lower diagnostic

accuracy for ureteric stones makes it less suitable. However, due to easy accessibility, less side effects, no contraindications and cost effectiveness supports this as an initial diagnostic modality. CT scan should be used only when ultrasonography is in-conclusive.

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