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Comparison Study of USG with CT in Identifying Ureteric Calculi In Acute Ureteric Colic

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Abstract
Aim:*To assessing sensitivity, specificity, positive predictive value and negative value of Ultrasound (US) over Computerized Tomography (CT) in diagnosis ureteric calculi in patients with ureteric colic.*
Methods:*A descriptive study involving 101 patients with acute ureteric colic referred to the Radiology department in Sree Balaji Medical College and Hospital, for US and CT imaging evaluation. Patients in the age groups of 20 – 70 years and of both men and women referred from emergency department for radiological evaluation of low backache were included. Pregnant women are excluded. USG was performed for all the patients following which proceeded with CT imaging. CT imaging of Kidney, ureter and Bladder. CT images are acquired in supine position and thin sections of ~ 2.5mm in axial plane following which reconstructed in coronal and sagittal planes.*
Results:*Of 101 patients included in this study calculus was found in 63 patients by USG and in 79 patients by CT. This shows about 16 (20%) patients with calculi were missed on USG. On comparison of location of calculus by USG and CT we find that majority of the calculi missed by USG were located in the distal ureter and were in females, but in females ~ 50 % of mid ureteric calculi were missed by USG.*
Conclusion: *USG is freely available, rapid and easy to perform and also absence of radiation hazard make it a safe and effective technique for screening of patients with suspected renal colic. Major drawback is it has poor sensitivity for detecting mid ureteric calculi, because the area is obscured by the bowel gas. CT has high sensitivity and specificity for detecting urolithiasis, Unenhanced CT is a valuable technique for examining patients with acute flank pain in whom a clinical diagnosis is uncertain. It can accurately determine the presence or absence of ureteral stones as well as extra urinary causes of acute flank pain.*

Keywords: *Ureteric calculi, Computerized tomography, acute ureteric colic, ultrasound*

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I. Introduction

Most renal stones become symptomatic when they fall into the ureter causing pain called as ureteric colic.(1) In case of ureteric calculi, establishment of early diagnosis and prompt treatment is essential. Treatment options range from conservative approach to surgical exploration of ureter which will depend upon the size and location of the stone in ureter.(2)Radiological evaluation of patients with acute abdominal pain is done by plain radiography (Abdomen erect), followed by ultrasonography (US) and non-enhanced plain computed tomography of the abdomen. Magnetic resonance imaging and diagnostic laparoscopy can also be done, but they are used far less frequently in first line of diagnostic work-up. (3)When a ureteric colic is suspected (acute flank pain) patient may undergo intravenous urography (IVU) as a screening told in pre-ultrasound era but with advent ultrasound and easy availability it is used as the first line of radiological investigation because IVU has its own sets of risks and complications involved due to contrast, ionizing radiation, and duration of study whereas ultrasound is safe and fast as a tool of diagnosis .(4)With widespread availability of computed tomography (CT), it is the investigation of choice for ureteric colic but when compared to US it bombards the patient with ionizing eradiation and thus a risk of radiation induced cancer arises but there is no such risk in US. (5)

Thus this study aims in assessing sensitivity, specificity, positive predictive value and negative value of US over CT in diagnosis ureteric calculi in patients with ureteric colic.

II. Materials And Methods

A descriptive study involving 100 patients with acute ureteric colic referred to the Radiology department in Sree Balaji Medical College and Hospital, for US and CT imaging evaluation over a period between March 2016 and April 2017. 101 consecutive patients presenting with acute severe ureteric colic and fulfilling the inclusion and exclusion criteria were enrolled for the study. Ethical committee of the hospital was obtained prior to conducting the study. An informed written consent was obtained from every patient.USG was done while patient is in supine position and by using curved phased-array transducers (2–5 MHz) and hardcopies of images were obtained. The kidneys were assessed in real time imaging in both longitudinal plane and in transverse planes .If there is any abnormality, additional images were obtained.USG findings were noted for the presence or absence of hyperechoic shadows in the ureteric area.All the patients underwent CT to confirm the USG findings. The CT images were taken with a helical CT scanner without any contrast (I/V or oral). Imaging started from the upper part of the abdomen (this includes entire kidneys and adrenal glands) up till pubic symphysis while patient is in supine position. The slice thickness and interval were same of 5 mm. Images were taken with a 0.8-second gantry rotation by using 140 kVp and 160–180 mAs. If required, then additional scanning or reconstruction of sagittal or coronal images were done.

III. Results

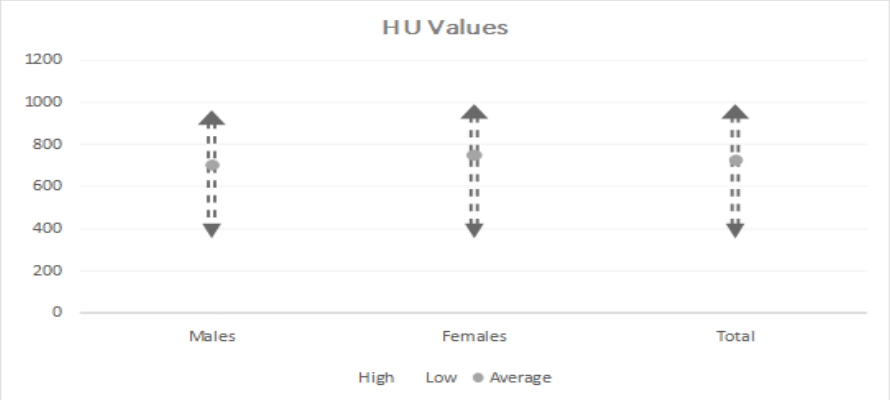
The total number of patients included in this study were 101, of these 52 were males and 49 were females with mean age of both sexes was 42.6 years. All the 101 patients included in the study were assessed based on the presenting complaint of ureteric colic, of these 62 patients (62%) presented with complaints of pain on the right side and 39 patients (38%) presented with complaints of pain on the left side. Other clinical features included macroscopic hematuria. Of 101 patients 42 patients (42%) had macroscopic hematuria, of these 23 were female patients and 19 were male patients. Of the 101 patients included in this study calculus was found in 63 patients by USG and in 79 patients by CT. This shows about 16 (20%) patients with calculi were missed on USG. Calculus was identified in 63 patients by USG, of which majority were in the proximal ureter (51%) followed by distal ureter (31%) and the least were in the mid ureter (18%). Of 52 males calculus was found in 33 patients and of 49 females calculus was found in 30 patients. Calculus was identified in 79 patients by CT, of which majority were in the proximal ureter (40%) followed by distal ureter (37%) and the least were in the mid ureter (23%). Of 52 males calculus was found in 40 patients and of 49 female calculus was found in 39 patients.
On comparison of location of calculus by USG and CT we find that majority of the calculi missed by USG were located in the distal ureter and were in females, but in females ~ 50 % of mid ureteric calculi were missed by USG.

Table 1: Calculus Location – CT vs USG

	USG			CT		
Sex	Proximal	Mid	Distal	Proximal	Mid	Distal
Male	14	9	10	14	12	14
Female	17	3	10	18	6	15
Total	31	12	20	32	18	29

Associated features of urolithiasis included calyceal dilatation, ureteric dilatation, nephromegaly and perinephric fluid collection on both USG and CT. Periureteric fat stranding can be visualized only by CT was found in 73 patients.
The density of calculi ranged from 351 – 994 HU on CT. Mean HU value of calculus in males was 700 HU and 746 HU in females

Fig. 1: Mean HU values



Of 101 patients included in this study with presenting complaints of ureteric colic, only 79 had ureteric calculi rest of the 22 patients presented with symptoms of ureteric colic but had no calculi. Of the 22 patients 8 patients had appendicitis followed by 4 cases of each gynecological disorders and diverticulitis, 3 case of cholelithiasis/choledocholithiasis and 2 cases of ileocecal tuberculosis.

IV. Discussion

This study involves one hundred and one patients who underwent both ultra sonographic and plain computed tomographic assessment of the kidney, ureter, and bladder over a period of 19 months from March 2016 to September 2017. The majority of referrals were from the emergency department (86 patients – 86%), followed by nephrology department (14 patients – 13%) and the rest were from other departments (1 patients – 1%). Most of these were outpatient referrals (95 patients – 95%) and the rest were inpatient referrals (6 patients – 5%).

V. Demographics

Ureteric colic pain was seen in both sexes with almost equal distribution showing no sexual preference and was most commonly seen in middle aged persons. Patients presenting with colicky symptoms had pain mostly on the right side (61%). In a meta-analysis done by Hesse et al (6) they also found no sexual predilection in patients with urolithiasis and also showing increased prevalence of urolithiasis in people above 50 years of age also evidenced in our study.

VI. Hematuria

In a study done by Passerotti et al (7) 24% patients presented with history of hematuria as the presenting complaints whereas in our study 41% of the patients had hematuria along with colicky pain.

VII. Calculus

In various studies the sensitivity of ultrasound in detecting calculus ranges from 44% to 90% (12, 8,9,10), the specificity of ultrasound was 100% (7). In our study we found that sensitivity was 83.16% which falls in the wide range of sensitivity of other studies, and the specificity was 88% (Table 2) which is less than the specificity compared to other studies probably due to poor patient preparation or echogenic shadows close to the ureter.

Table 2: Sensitivity, Specificity, PPV and NPV values of USG

Parameters	Percentage	95% Confidence Interval
Sensitivity	83.16%	74.10% to 90.06%
Specificity	88.0%	68.78% to 97.45%
Positive Predictive Value	96.34%	90.07% to 98.71%
Negative Predictive Value	56.89 %	46.23% to 68.74%

Majority of the calculus in our study was located in the proximal ureter as per both ultrasonography (51%) and CT (40%), followed by distal ureter – 31% on ultrasonography and 37% on CT and the least were in the mid ureter, whereas in a study done by Patlas et al (2), the majority of calculus were located in the distal ureter (77%), followed proximal ureter (13%) and mid ureter (10%) by plain CT of the abdomen. About 16 calculi were missed on USG of which 9 (56%) were located in the distal ureter, followed by 6 (37%) were located in the mid ureter and 1 (7%) was located in the proximal ureter, showing most of the missed calculi were located in the distal ureter, whereas in other studies (4, 12, 6, 7) the maximum of the missed calculi were in the mid ureter. Average size of the missed calculi on USG were ~ 5mm but in other studies (7) the average missed size was ~ 2.3 mm. Probably because this included the renal calculi as well which are usually smaller compared to the ureteric calculi.

8.1 Secondary findings

Some calculus though not visualized directly or clearly can be diagnosed based on the secondary imaging findings like calyceal dilatation, ureteric dilatation, periureteric fat stranding, nephromegaly, perinephric fat stranding and etc., like these various were noted in our study too, with calyceal and ureteric dilatation being most commonly associated with calculi followed by periureteric fat stranding on plain CT and nephromegaly on both USG and CT, least common was the perinephric fluid collection as evidenced by both USG and CT. In other studies (12) ureteral dilatation was easily appreciated on plain CT than USG but in our study ureteral dilatation was appreciated well on both USG and CT.

8.2 Calculus Density

The density of calculus ranged from 351 – 994 HU. Most of the calculus missed on USG were of high density showing poor detection of calculus with high density as they may be confused with echogenic gas shadow. Other studies (13) also showed calculus in the similar HU range.

8.3 Alternate pathologies

Of 101 patients included in this study with presenting complaints of ureteric colic, only 79 had ureteric calculi. Hence 22 patients presented with symptoms of ureteric colic but had no calculi. Of these 22 patients 8 patients had appendicitis followed by 4 cases of each gynecological disorders and diverticulitis. In a study done by Passerotti et al (7) they found no other causes of ureteric colicky pain, and in a study done by Patlas et al (4) he found one. Patient with appendicitis, cholelithiasis, cholecystitis and adnexal mass each.

VIII. Conclusion

Ultrasound has high sensitivity, specificity and positive predictive value (Table 2) in diagnosing ureteric calculus with plain CT as the gold standard. Even other pathologies which present with similar complaints can be assessed and diagnosed using USG.Ultrasound is a safe modality as there is no ionizing radiation exposure to patients and thus has a preferential role in pregnant patients and children to diagnose ureteric calculus.As ultrasonography provides comparable results to that of computed tomography in diagnosis of ureteric calculi it should be used as a first line of investigation in patients with complaints of acute ureteric colic as it is cheaper and free of radiation compared to Computed tomography.

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