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ULTRASONOGRAPHY IN DIAGNOSING ACUTE URETERIC COLIC

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ABSTRACT

The Doppler Effect principle is used in US imaging in evaluation of the blood flow, direction, velocity and hemodynamic within the blood vessels. Renal or ureteral stones appear as bright echogenic foci within the ureter that cast a distal acoustic shadow and shows twinkling artifact on Colour Doppler. Patients presenting to the Urology OPD or Emergency department at our hospital, who clinically have acute colicky flank pain, routinely undergo USG abdomen evaluation, among them suspected cases of ureterolithiasis were selected for initial evaluation by USG KUB evaluation and plain KUB radiograph, NCCT KUB done depending on clinical scenario. We detected 139 calculi in 145 patients with sonography 130 patients had ureterolithiasis, 8 calculi identified in the urinary bladder, 1 calculus in the urethera. Twenty one patients without evidence of ureterolithiasis on sonography underwent non-contrast-enhanced CT (n=6), pre and post contrast CT (n=15), IVU (n=3) and radiographic work up Xray KUB (n=15). Sonography has high diagnostic efficacy in diagnosing in urteric colic conditions.

INTRODUCTION

Urolithiasis is a universal problem, affecting patients across geographical, cultural and racial boundaries. The prevalence of urinary stones has progressively increased in the industrialized nations and a similar trend is being observed in developing countries due to changing social and economic conditions and hovers between 4% and 20% and the annual incidence of hospitalization for calculosis ranges from 0.03 to 0.1%. In addition, many Patients will be affected by multiple stones throughout their lifetime [1].

In India upper and lower urinary tract stones occur frequently but the incidence shows wide regional variation. The incidence of renal calculi is comparatively low in the Southern part of country compared to other parts. The prevalence of urolithiasis is as high as 7.6% in Satpura part of Maharashtra.

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Pendse et al had reported a high and progressively increasing incidence of urolithiasis in Udaipur and some other parts of Rajasthan, in the western part of India. The rising prevalence of urinary stone disease has had a significant impact on the health care system due to the direct costs involved and the morbidity associated with complications such as infection and chronic renal failure.

The renal calculi occasionally pass through the ureter and cause obstruction at sites of narrowing of normal ureter leading to acute colicky flank pain of radiating type with or without hematuria. Rarely stones can be formed within the ureter and gradually increase in size to cause obstruction.

The use of ultrasound in medicine began during and shortly after the 2nd World War in various centers around the world. The work of Dr. Karl Theodore Dussik in Austria in 1942 on transmission ultrasound investigation of the brain provides the first published work on medical ultrasonics. There was gradual improvement in the device and electronics in the US from 1958 when

Professor Ian Donald published the usefulness of US in abdominal masses evaluation. By 1990 US was widely accepted as the modality of choice in imaging of abdominal Emergencies including Ureterolithiasis.

Ultrasound applications are based on the detection and display of the acoustic energy reflected from the interfaces within the body. These interactions provide information needed to generate high resolution, grey scale images of the body. The basic components of the Ultrasound unit are transmitter, transducer, receiver and image display and storage [2]

The transmitter transmits brief bursts of acoustic energy into the body and also controls the rate of pulses emitted by the transmitter or the pulse repetition frequency [2]. Transducer is a device that converts one form of energy to another. It converts the electrical energy to acoustic pulses and also acts as a receiver of the reflected echoes, converting weak pressure changes into electrical signals for processing. Ultrasound transducers use the principle of piezoelectricity discovered by Pierre Curie in 1880. Different transducer arrays available are linear, curvilinear, phased, two-dimensional arrays [2].

Receiver receives the returning echoes and amplifies the weak signals. Image display and storage: Images can be displayed in A mode, M mode and the real time B mode. With real time ultrasound, user feedback is immediate and is provided by the video display. Storage of the images can be in the form of transparencies printed on the film by optical or laser cameras and printers, videotape, or through use of picture archiving and communicating systems [3].

The Doppler principle is the change in frequency of a wave for an observer moving relative to the source of the wave, was presented in 1892 by Christian Andres Doppler and tested experimentally in 1843 by Christoph Buy's Ballot.

The Doppler Effect principle is used in US imaging in evaluation of the blood flow, direction, velocity and hemodynamic within the blood vessels [4].Renal or ureteral stones appear as bright echogenic foci within the ureter that cast a distal acoustic shadow and shows twinkling artifact on Colour Doppler.

The colour Doppler twinkling sign improves the detection and confidence of diagnosis for renal and ureteral stones with minimal loss of specificity.

Hydroureteronephrosis (HDUN) can be seen depending on the degree and level of obstruction [3-5]. Colour Doppler US of the bladder considering ureteral jets as abnormal when they were unilaterally absent or diminished suggestive of a ureteral calculus [3]. Direct assessment of hemodynamic response in intrarenal arteries using Duplex Doppler Ultrasonography, has increased the possibility of early detection of obstruction. As, the obstruction causes increase in renal vascular resistance leading to drop in diastolic flow. This change is measured and expressed as RI (Resistive Index). Intrarenal resistance index is elevated in significant renal obstruction and is more than 0.7026. But, ancillary findings of US cannot definitively depict the location of the obstructing lesion. Further, the finding of normal ureteral jets/absent HDUN/normal RI cannot be used to exclude a diagnosis of ureterolithiasis, instead to be used in combination in suspected cases (which has higher sensitivity) before further imaging evaluation [6].

METHODOLOGY

Patients presenting to the Urology OPD or Emergency department at our hospital, who clinically have acute colicky flank pain, routinely undergo USG abdomen evaluation, among them suspected cases of ureterolithiasis were selected for initial evaluation by USG KUB evaluation and plain KUB radiograph, NCCT KUB done depending on clinical scenario.

Study procedure:

1. Study sample size consists of 160 patients.
2. The study period was of 18 months
3. Patients are enrolled into the study based on:

History and clinical evaluation:

All patients presented with acute, severe, colicky, unilateral or bilateral flank pain, radiating from the front of the abdomen to the groin or to the testicles ipsilaterally, with or without hematuria

Clinical Evaluation Scoring

- Unilateral ureteric colic 1
- Bilateral ureteric colic 2
- Haematuria absent 0
- Haematuria present 1

Protocols:

Of 160 patients, all of them underwent USG KUB as the initial diagnostic imaging modality, depending on the clinical scenario they were subjected to Plain KUB radiograph and or NCCT KUB. Of 160 patients, 15 patients underwent KUB radiograph and NCCT KUB, 3 patients underwent IVU as additional imaging tool.

The Ultrasonography (US) protocol:

The USG KUB was performed using the technologically advanced GE LOGIC E9 and GE LOGIC 9 machines (color1) under adequate room light circumstances,using curved phased array transducer probe of (3-5MHz) in all patients ,selecting brightness gain and transducer frequencies to optimize imaging of Kidneys, Ureter and Urinary Bladder. Each patient underwent standard renal US, including evaluation of the kidneys, ureters, and bladder, with soft-copy images obtained. The kidneys were evaluated completely in the longitudinal and transverse projections at real-time imaging. For the kidney, UPJ, and proximal ureter, a lateral approach, anterior approach, or both approaches were applied. To trace the entire proximal ureter, an anterior approach that progressed through the window of the linea semilunaris

between the rectus abdominis muscle and 3 layers of abdominal muscles was useful. This window was not only the thinnest portion of the abdominal wall but also avoided any colonic gas. We normally able to trace the UPJ and entire proximal ureter extending to the point where it crossed the iliac vessels by using the sonographic window described above.

A lateral approach for the proximal ureter could be achieved with a window posterior to the ascending and descending colon, especially in cases involving a thick body habitus or an associated paralytic ileus. For the distal ureter and UVJ, an anterior approach through the window of the filled urinary bladder was routine. For optimal resolution of the ureter by sonography, compression techniques are usually required to decrease the distance between the transducer and the ureter; therefore, we applied the maximum amount of compression that patients could tolerate while scanning the ureter. For direct demonstration of ureteral calculi, the B-mode gain settings including the focal zone, depth, and time-gain compensation curve were dynamically controlled.

We defined the presence of a calculus as a constantly echogenic lesion clearly located within the ureter, urinary bladder, or urethra [1]. The bladder was evaluated at real-time imaging when it is adequately distended, with a directed attempt to image the ureterovesical junction bilaterally. Longitudinal and transverse images of the bladder were obtained. Up to 5 minutes of transverse color Doppler US of the bladder was performed to evaluate the presence of ureteral jets. Ureteral jets were considered abnormal when they are unilaterally absent or diminished. The routine screening of abdomen was done to rule out other pathologies.

KUB ultrasound interpretation:

Identification of calculus: Calculus appeared as highly echogenic focus with posterior acoustic shadowing within the collecting system/ureter. Identification of hydronephrosis(HDN)/HDUN: The dilatation of pelvi-calyceal system appeared as hypo echoic area within the pelvi-calyceal fat. The dilated ureter appeared as hypo-echoic tubular structure.

Our criteria for diagnosis of ureterolithiasis on sonography only included calcific echogenicity that appeared to be within the ureter lumen associated with or without Hydronephrosis.

USG scoring

Hydronephrosis present 1
Hydronephrosis absent 0
Ureteric calculus identified 1
Ureteric calculus not identified 0

KUB radiograph protocol:

Plain KUB radiographs were obtained using either of the Siemens and GE X-Ray Machines,patient lying supine on the bucky table.The film focus distance of 110 cms used to avoid geometric enlargement of kidneys. The exposure factors varied from 65-75 kVp and 70-80 mAs, in an average at 400 mA station, depending on size of the patient, using 43 X 35 cm (17 X 14 inches) CR cassettes.

KUB radiograph interpretation:

Well defined radio-opacities in the region of KUB were measured, recorded and scored. The opacities were differentiated from normal structures that calcify and abnormal structures that contain calcium and other intra-abdominal calcifications based on location, size, shape and degree of opacification. Pelvic phleboliths, are differentiated by their typical appearance i.e., small, smooth, round, white opacity with central lucency [3].

NCCT KUB protocol:

All images were obtained using GE Light Speed VCT: Sixty four slice helical CT scanner without intravenous or oral administration of contrast medium. Images were acquired extending from the upper part of the abdomen (including the entire kidneys and adrenal glands) through the pubic symphysis, with the patient in the supine position. The section thickness and interval was 3-5 mm, with a pitch of 1-1.5:1. Images were obtained with a 0.8-second gantry rotation by using 110-140 kVp and 160–180 mAs. The CT images were reviewed from each examination before the patient was discharged from the CT suite. Additional scanning or reconstructions of images were done when needed.

NCCT interpretation:

All images are evaluated in abdominal window (WC 40 and WW 300) and bony window (WC 400 and WW 2000).The number, size, location of calculi are recorded. The degree of hydronephrosis, hydroureteronephrosis and perinephric ,periureteric fat stranding if any also noted. The routine screening of abdomen was done to rule out other pathologies.

RESULTS

We detected 139 calculi in 145 patients with sonography 130 patients had ureterolithiasis,8 calculi identified in the urinary bladder,1 calculus in the urethera.

Twenty one patients without evidence of ureterolithiasis on sonography underwent non-contrast-enhanced CT (n=6), pre and post contrast CT (n=15), IVU (n=3),and radiographic work up Xray KUB (n=15) . In the cases of non-visualization of ureteric calculi by sonograpghy, urolithiasis was confirmed on NCCT KUB (n=6). Computed tomography showed the absence of ureterolithiasis in 15 cases. Three cases were diagnosed with adnexal pathology,one case of ectopic pregnancy on right side,two cases of acute appendicitis, one case of gallbladder calculi, rest 8 cases no pathology could be detected for acute pain abdomen. One case of Pelvi Ureteric junction Obstruction confirmed on IVU.

Locations of Calculi:

The 139 calculi identified in 145 patients on sonography included 02 in the renal,07 in the UPJ,37 in the proximal ureter,64 in the distal ureter,22 in the UVJ,08 in the urinary bladder,01 in the urethra.

Dimension of Calculi:

The diameter of the ureteral calculi ranged from 2mm to 25 mm. The details of diameter as provided in the graph.

Figure 1. Number of Persons

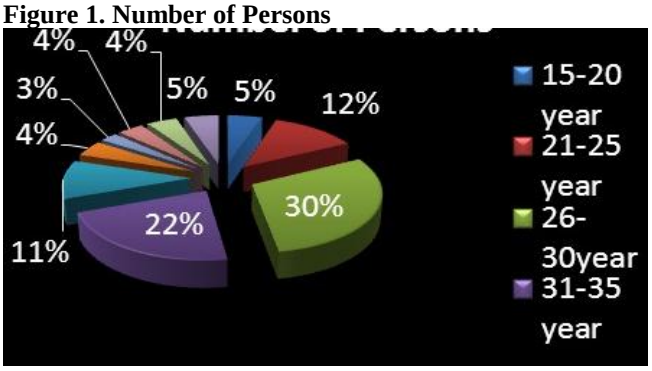


Figure 1. Location of Calculi

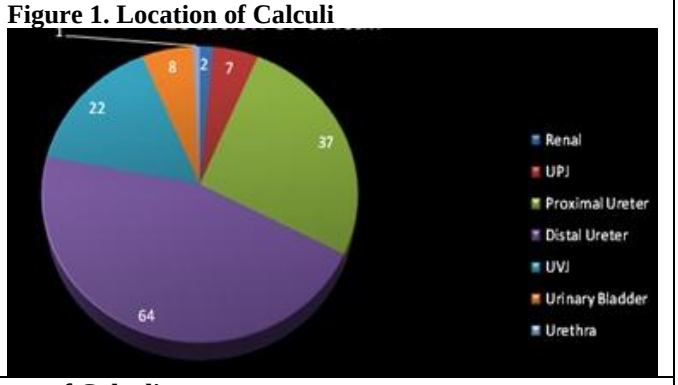
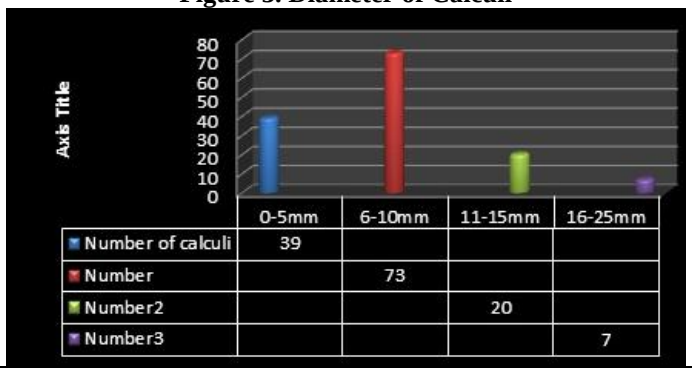


Figure 3. Diameter of Calculi



DISCUSSION

In our study, the overall diagnostic sensitivity, specificity, and accuracy of sonography were 95.86%, 85.7%, and 95.4%, respectively. Previous articles reported sensitivity rates of sonography for detecting lithiasis of 12% to 93%, [7-11]. and a recently published article reported that the sensitivity and specificity of sonography for lithiasis were 78.6% and 100%, which were better than in previous reports, and those for obstruction were both 100% [4] .Several studies have been performed with low-dose CT protocols to detect ureteral stones using a tube charge current of 20 to 50 mA; the sensitivity was reported to be 89.5% to 97%, and the specificity was found to be 94.7% to 100%. Consequently, the diagnostic efficacy of sonography in our study is comparable with that of low dose CT but did not reach the sensitivity of normal-dose CT. Although low-dose CT has many advantages, including simple preparation, objective information, and easy application. Sonography also has great advantages; it is radiation free, universally available, easily applicable, and inexpensive compared with CT, and it allows for repeated follow-up examinations. The higher sensitivity and accuracy of sonography for detecting lithiasis might have been due to the development of new sonographic equipment, appropriate preparation for tracing the entire ureter, and the relatively thinner body habitus of Asian patients [12].

CONCLUSION

Sonography is radiation free, relatively inexpensive, universally available, and easily applicable, and it has high diagnostic efficacy.

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CONFLICT OF INTEREST:

The authors declare that they have no conflict of interest.

STATEMENT OF HUMAN AND ANIMAL RIGHTS

All procedures performed in human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

REFERENCES

1. Avinash R. Kambadakone, Brian H. Eisner, Onofrio Antonio Catalano, Dushyant V. Sahani (2010). New and Evolving Concepts in the Imaging and Management of Urolithiasis: *Urologists' Perspective. Radio Graphics*, 30, 603–623.
2. Nicholas J. Hangiandreou (2003). B-mode US: Basic Concepts and New Technology. *Radio Graphics*, 23, 1019–1033.
3. Douglas H. Sheafor, Barbara S. Hertzberg, Kelly S. Freed, Nelson, et al (2000). Nonenhanced Helical CT and US in the Emergency Evaluation of Patients with Renal Colic: Prospective Comparison. *Radiology*, 217, 792-797.
4. Joseph Woo. A short History of the development of Ultrasound in Obstetrics and Gynecology. http://www.ob-ultrasound.net/history3.html.
5. Z. Ashraf, T. Mansoor, M. Ashai, I. Ahmad and W. Lateef (2009). Duplex Doppler Ultrasonography: An Excellent Initial Investigation in Obstructive Uropathy. *The Internet Journal of Surgery*, 20, 1.
6. C. Sandhu, K. M. Anson and U. Patel (2003). Urinary Tract Stones—Part I: Role of Radiological Imaging in Diagnosis and Treatment Planning. *Clinical Radiology*, 58, 415-421.
7. Gray's Anatomy, Lea and Febinger (1918), Philadelphia, USA.
8. Robert C. Smith and Michael Varanelli (2000). Diagnosis and Management of Acute Ureterolithiasis: CT Is Truth. AJR, 175:3-6
9. Stefan Silbernagl, Agamemnon Despopoulos (2006). Color Atlas of Physiology. 6th edition, 148.
10. Narmada P. Gupta, Mohd S. Ansari, Pawan Kesarvani, Annu Kapoor and Seema Mukhopadhyay (2005). Role of computed tomography with no contrast medium enhancement in predicting the outcome of extracorporeal shock wave lithotripsy for urinary calculi. *B J U International*, 95, 1285–1288.
11. J. Brian Fowlkes, Christy K. Holland (2011). Biological effects and safety. *Diagnostic Ultrasound*, 1, 34-52.
12. Seong Jin Park, MD, PhD, Boem Ha Yi, MD, Hae Kyung Lee, MD, et al (2008).Evaluation of Patients With Suspected Ureteral Calculi Using Sonography as an Initial Diagnostic Tool. *J Ultrasound Med*, 27, 1441–1450