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ROLE OF ULTRASONOGRAPHY IN URINARY TRACT

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ABSTRACT

BACKGROUND-The urinary tract cases are the common cases found, which are likely to found more in male then female. Ultrasonography (US) is an important modality for imaging these cases. Ultrasonography (US) is fast and painless imaging modality for the rapid diagnosis of urinary tract diseases.

OBJECTIVES-To determine the sensitivity and specificity of ultrasonography in evaluation of urinary tract diseases.To determine the localization and the common age group exposed to urinary tract diseases.

METHODS- A retrospective cross-sectional study was conducted reviewing 100 patients request and reports that had USG abdomen scan with a period of 3 months from February to April 2019. The information obtained was recorded on a self-designed data capture sheet. Data was analyzed using Microsoft Excel 2010.

RESULTS-A total of one hundred (100) patients of the age range of 18-80 were referred for USG scan of the abdomen to the department of radio diagnosis with a clinical suspicion of urinary tract diseases. Fifty four (55) of the patients were males while Fourty five (45) were females .Majority of the patients that fall within the age group with the highest patients i.e. 18 -30 years.

Out of 100 patients 33 patients declared normal, 39 patients diagnosed with single disease, 16 patients were diagnosed with two diseases and 12 patients were diagnosed with multiple diseases in urinary tract.

CONCLUSION-Renal ultrasonography (US) is a versatile and useful examination. Ultrasonography (US) is an accessible, inexpensive and fast aid for decision-making in patients with urinary or renal symptoms and for guidance in renal intervention. However, renal ultrasonography (US) has certain limitations, should always be considered as supplementary imaging modalities in the assessment of renal or urinary tract disease.

KEY WORDS : Urinary Tract, Ultrasonography, Usg Abdomen Scan, Renal Ultrasonography

INTRODUCTION

The urinary system consists of the kidneys, ureters, urinary bladder, and urethra. The urinary tract is a system that removes urine from the body, which ismade of wastes and extra fluid. For normal urination, all body parts need to work together in the correct manner.The urinary tract is a group of organs in the body concerned with filtration out excess fluid and other substances from the bloodstream. The substances are filtered out from the body in the form of urine, urine is a liquid product produced by the kidneys. The urine is collected in the bladder and excreted through the urethra. Urine is used to extract excess minerals as well as blood corpuscles from the body. The urinary system works with the other systems of the body to help maintain water and electrolyte homeostasis .The kidneys are main organs of homeostasis because they maintain the acid base balance of the blood.[1].

Kidneys:

The kidneys are two bean-shaped organs, found along the posterior wall of the abdominal cavity. The size of kidney is about the size of a fist. The left kidney is located slightly higher than the right kidney because of large portion of liver is located in right side. Unlike other organs of the abdominal cavity, kidneys are located posterior of the peritoneum and touch the muscles of the back. The layer of adipose surrounds the kidneys that holds them in the place and protects them from physical damage.The kidneys filter about 180 liters of fluid are filtered by the kidney each day.[1]

Ureters: Ureters are a pair of tubes that carry urine from the kidney to the bladder. In the adult; the ureters are usually 25-30cm (10-12 in) long and around 3-4mm (0.12-0.16in) in diameter. The upper half of the ureter lies in the abdomen and lower half is lies in the pelvis region. The ureter has thick walls composed of fibrous, a muscular, and a mucus coat, which are able to contract.Length: 25-30 cm,Diameter: 3-4 mm

PARTS OF URETER: There are basically three parts of ureter.

1. Pelvis of ureter.
2. Abdominal part of ureter.
3. Pelvic part of ureter.[2]

4. **Bladder:** Urinary bladder is a muscular bag which acts as a reservoir of urine. The urinary bladder is a sac-like hallow organ used for the storage of the urine.Bladder emptying is known as urination.The bladder stores urine until the person finds an appropriate time and place to urinate.

5. **Position**: Bladder, lies in the pelvis in adults, in children's it liesabdomino-pelvic organ.

6. **Shape:** Ovoid when distended, tetrahedral when empty.

7. **Capacity** Anatomical capacity: 1000 ml Physiological capacity: 450 ml.

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8. **Urethra:** The urethra is a tube through which urine passes from the bladder to the exterior of the body. It is the distal most part of the urinary system that helps to conduct urine from the bladder to the exterior.

9. **Male urethra:** In males it is 8-10 inches long and extends from bladder neck to tip of penis**.** The urethra is also an organ of the male reproductive system. It is S-shaped in flaccid penis while J-shaped in erected penis.

Parts of Male Urethra:

1. Prostatic part(3.0 cm long).
2. Membranous part(1.5-2.0 cm long)
3. Penile part (15 cm long)

Female urethra:

The female urethra is around 2 inches long and ends inferior to the clitoris and superior to the vaginal opening.It is embedded in anterior wall of vagina. Internally, the mucosa of urethra is folded extensively and contains numerous mucus glands.The kidneys are two bean-shaped organs, found along the posterior wall of the abdominal cavity. The kidney filters metabolic wastes, excess ions, and chemical from the blood to form urine. The thin pair of tubes that carry the urine from the kidneys to the bladder are known as ureters. A renal ultrasound is a safe, painless, and effective test that uses sound waves to generate images of the organs like kidneys, ureters, and bladder. During the examination, an ultrasound machine generates sound waves and sends to the kidney area and images are formed and recorded on a computer. The black-and-white images display on monitor show the internal structure of the organs. Ultrasound (US) is a common examination, which has been performed fromyears.[3]A linear array transducer is using for (B mode imaging) assessment of renal anatomy is easily performed, and US is also used as image guidance for renal interventions. Moreover, applications in renal US have been introduced with contrast-enhanced ultrasound (CEUS) and fusion imaging. In this review, I will highlight the most common findings in urinary tractultrasound (US).[4] Abdominal pain, acute flank pain, with hematuria is relatively common presenting complaints in the radiology department. Although urinary obstruction, kidney stoneand cystitis are likely diagnosis in such patients, the differential diagnosis includes life-threatening disease processes, most importantly chronic kidney disease (CKD) and rupture. Emergency bedside solography is a tool that can rapidly confirm the diagnosis of acute urinary obstruction.[5] It is important to know the common medical terms used to describe the pathophysiology. The structural impediment to the flow of urine is termed obstructive uropathy.[6] Unless this obstruction develops slowly it is typically painful, which is called renal colic. The kidney stone dislodged into the ureter is known as ureterolithiasis. Urine flow is blocked by the stone leading to back-up and dilation of the proximal ureter (hydroureter). As the obstruction progresses, more proximal structures like the renal collecting system (renal pelvis and calyces) becomes dilated, termed hydronephrosis. If the hydronephrosis is severe, the renal parenchyma becomes compressed and can cause loss of renal function.[7] As mentioned above, the common cause of renal colic and hydronephrosis is ureterolithiasis. But anything obstruct the inner lumen of the collecting system can block urinary flow and lead to renal colic. Bedside renal solography in the emergency department is also useful in the patient presenting with decreased urinary output or anuria, acute renal failure or pyelonephritis.[8] Similar to the renal colic patient it allows the doctor to narrow the differential diagnosis by evaluating the retroperitoneal anatomical structures for abnormalities but gives only some limited clues for the functional status of the urinary system.[9]

Following are the indications of sonography for urinary system:-

- Presence or absence of kidney
- Location - Ectopic kidney
- Calculus
- Hydronephrosis
- Renal cysts.
- Renal cystic disease
- Renal solid masses
- Non-functioning kidney on IVP
- Renal failure - i. chronic; ii. acute
- Renal hypertension
- Renal transplant
- Post-surgical complication
- Localizing calculus during lithotripsy and post lithotripsy follow-up.
- Post DJ stent follow-up
- Renal trauma
- Perinephric abscess/hematoma
- Residual volume
- Diverticuli
- Bladder calculi
- Chronic interstitial cystitis with diminished bladder capacity
- Bladder tumor and invasion into bladder wall
- Vesico-ureteric reflux
- Ureterocoele
- Post-operative complications
- Neurogenic bladder

AIMS AND OBJECTIVE

- To determine the sensitivity and specificity of USG in evaluation of urinary tract diseases.
- To evaluate the various pathological findings in the urinary tract.
- To differentiate various urinary tract disorders using the USG.

MATERIAL AND METHODS

STUDY DESIGN

- A retrospective cross-sectional design wills be used.

SOURCE OF DATA

- A secondary source of data will used for the study. It will be obtained from the radiology record book of the ultrasonography (USG) unit, radiology department at NIMS Hospital jaipur.

STUDY POPULATION

- All records with requests for renal scan with an indication of urinary tract diseases.
- A population study will be conducted.

INCLUSION CRITERIA

- The inclusion criteria were: (1) case-control or cohort studies involving participants
- 18 years or older; (2) provided the multivariate-adjusted odds ratio (OR), risk ratio (RR),
- Hazard ratio (HR), or standardized incidence ratio (SIR) with 95% confidence interval
- (CI), or sufficient information to calculate these; and (3) a comparison group made up of
- Participants without kidney stones history were used.

EXCLUSION CRITERIA

- The exclusion criteria were: non-human studies, reviews, comments, editorials, case reports and cross-sectional studies. If a cohort study was reported in more than one publication, we chose the latest article.

INSTRUMENT OF DATA COLLECTION

- Ultrasound machine of the department of radio-diagnosis and imaging

METHOD OF DATA COLLECTION

- A data capture sheet will be used.

- Data collected will be analyzed thus:
- Subjects were classified according to age group and sex
- Data will be presented in charts tables.
- Data will be analyzed using descriptive statistical tools; frequencies, mean and percentages.

ETHICAL CONSIDERATIONS

- Ethical clearance will be obtained from the ethical clearance committee of the hospital. The Helsinki declaration as regards confidentiality will be adhered to.

STANDARD IMAGING PROTOCOL

- Scanning Technique, Normal Findings and Common Variants
- A 3.5-7 MHz probe is typically used to scan the Urinary tract.

OBSERVATIONS AND RESULTS

A total of one hundred (100) patients within the age range of 18-80 were referred for USG scan of the abdomen and pelvis to the department of radio-diagnosis with a clinical suspicion of a urinary tract disease. Fourty Five (45) of the patients were females while fifty five (55) were males.

A total number of patients scanned during ultrasonography were 100 out of which 33 patients were declared normal, 39 patients were diagnosed with single disease, 16 patients were diagnosed with two diseases and 12 patients were diagnosed with three diseases. The study shows that males are more susceptible to urinary tract diseases as compared females. (Table 1)

TABLE 1: PATIENTS DIAGNOISED DURING USG SCAN OF URINARY TRACT DISORDER

DIAGNISIS	NUMBER OF PATIENTS	MALE	FEMALE
NORMAL	33	08	25
PATIENTS DIAGNOSIS WITH SINGLE DISEASE	39	23	16
PATIENTS DIAGNOSIS WITH TWO DISEASES	16	14	02
PATIENTS DIAGNOSIS WITH THREE DISEASES	12	10	02
TOTAL	100	55	45

The common diseases found in patients were renal calculus, hydronephrosis, ureteric calculus, renal cyst, prostatomegaly, cystitis, UB mass, ectopic kidney, horseshoe kidney, urinary bladder obstruction, Staghorn calculus, pyelonephritis, increased kidney echogenicity and residual urine.

A total of 33 (33%) patients fall within the age group of 18-30 years,11 (11%) patients were within age group of 31-40 years,22 (22%) patients fall within the age group of 41-50 years ,11 (11%) patients fall within the age group of 51-60 years,12 (12%) patients fall within the age group of 61-70 years and 11 (11%) patients fall within the 71-80 years. (Figure 16)

Majority of the patients that fall within the age group of 18-30 years and the least number of patients that fall within age group of 51-60 years. (Table 1)

Figure1: GENDER DISTRIBUTION OF PATIENTS OF URINARY TRACT

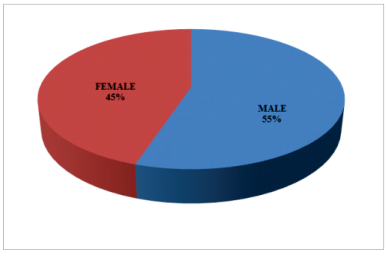
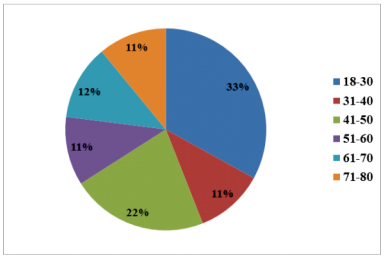


Figure 2: AGE DISTRIBUTION OF PATIENTS WITH URINARY TRACT DISORDER



DISCUSSION

Ultrasonography (USG) is an important modality for imaging of urinary tract. The study was undertaken with the objectives of determining the urinary tract disorders affecting the urinary tract and to correlate the USG findings. Urinary tract diseases are the common cases, where 30% of cases does not show any symptoms .Before the discovery of ultrasound scan physician were mainly dependent on history, physical examination etc. But accurate diagnosis was not 100%.Study have proved that ultrasound scan is helpful in evaluation of different diseases related to urinary tract.

In our study, the common cause of acute abdomen and flank pain are urolithiasis and hydronephrosis, which could be attributed to the ultrasound in warm climate of Rajasthan where the study took place .Whereas, urolithiasis proved to be a less cause of acute abdomen in the study done by Van Randen *et al* [10]. This could be attributed to the colder environmental conditions of Netherlands.

Several studies in the past (Evans K *et al.* 2005,[11] Briskowski *et al*[12]. in 2008) have also suggested association of higher prevalence of stone formation with higher temperature.

In our study, we found that the ultrasound imaging of the urinary tract for prostatomegaly is accurate and fast diagnoses, a similar study was conducted by Micheal Mitterberger *et al*[13] 2010 and showed that Ultrasound is a widely used imaging modality for evaluation of the prostate. The main topic of diagnostic imaging is an improvement of prostate cancer diagnosis. The current available systematic prostate biopsy is performed only under ultrasound guidance, but new imaging techniques allow prostate cancer visualization and therefore improved detection. Evolving methods such as contrast-enhanced colour Doppler imaging, contrast-specific ultrasound techniques and elastography may dramatically change the role of ultrasound for prostate cancer diagnosis. The purpose of this review is to provide an overview of ultrasound and its different techniques for imaging of the prostate and to discuss current trends and future directions.

Our study shows the maximum patients that have renal cyst was diagnosed in ultrasound and most of them have complaints of flank pain. A similar study was published in British Medical Journalby Thoms Sherwood [14] 1995 and showed that among the first 111 patients with renal masses examined by ultrasound most renal cysts (980) and carcinomas (860/%) were correctly detected. Diagnostic accuracy was high when ultrasound predicted a renal cyst (97%), but renal carcinoma accounted for only 600 of the complex echo masses found. Ultrasound was used as the primary, non-invasive test for the selection of outpatients with simple renal cysts for diagnostic puncture and for the selection of those with complex renal masses for more elaborate and expensive inpatient investigation. Ultrasound is not infallible but a safe diagnostic pathway may be drawn up in which ultrasound errors are not allowed to lead to diagnostic disasters. This approach reduced the use of arteriography for renal masses by two-thirds. With care the diagnosis of the common chance finding of a renal mass can be made simpler, safer, and cheaper.

A study was conducted by Ki Choon Sin *etal*[15] 2017 and showed that Ultrasonography is a useful tool for the diagnosis of acute flank pain.

Renal calculus appears as a focal area of echogenicity with acoustic shadowing on ultrasonography (USG). In acute pyelonephritis (APN), the kidneys may be enlarged in size and have a hypo-echoic parenchyma with loss of the normal corticomedullary junction. However, clinical and laboratory correlations are essential for the diagnosis of renal stones and acute pyelonephritis (APN) through imaging studies. This review describes the typical ultrasonography features of renal stones and acute pyelonephritis (APN). More over cross-sectional imaging is essential and widely used to confirm renal calculus and acute pyelonephritis (APN) and to differentiate them from other diseases causing flank pain. Other diseases causing acute flank pain are renal stones, ureteric calculus hydronephrosis, cyst, and mass and other diseases.

A study was conducted by Szabo V*et al* [16] 1977 and showed that Ultrasonic testing and other methods of testing is claimed to furnish reliable results in the diagnosis of renal disease. A total of 177 cases with radiologically confirmed urologic renal disease were tested by means of the ultrasonic method. Of the cases 128, [72.3%] were renal tumors and cysts. The echo-tests involve no risk, can be performed on outpatients, and repeated whenever necessary without special preparation.

In our study of 100 patients, we found that 33 patients are diagnosed normal with no abnormality, 39 patients are diagnosed with single disease out of which, most patients (22) shows calculus followed by the prostatomegaly showed by 5 patients. Our study also shows patients diagnosed with two and more than two diseases. The number patients that are suffered from two diseases are 16 and the patients that are suffered with more than two diseases are 12 in number.

Our study also shows than the females are less prominent to urinary tract diseases than males. The only 20 females are diagnosed with urinary tract diseases out of 45, in which only 4 patients are diagnosed with two or more that two diseases. While in male the number is very high in 55 patients only 08 patients arte normal and 47 patients are diagnoses with urinary tract disease. Out of which 24 patients have diagnosed with two or more than two diseases.

CONCLUSIONS

Renal ultrasound (US) is a versatile and useful examination technique. Ultrasound is an accessible, inexpensive, and fast aid for decision making in patients with urinary symptoms and for guidance in the further intervention. Ultrasonography plays important roles in the early diagnosis of anomalies of the urinary system.

In the present study, overall, the patients diagnosed with single disease are 39, with two diseases are 16 and with more than two diseases are 12. The most common disease among these patients was renal calculus, followed by the renal cyst, and hydronephrosis.

The present study also shows that the females are less susceptible to urinary tract diseases as compared to males.

However, renal ultrasonography (US) has certain limitations, should always be considered as supplementary imaging modalities in the assessment of renal or urinary tract disease.Overall we can say that ultrasound is most important and first line preference for urinary tract imaging. The accuracy of the ultrasound in evaluation of urinary tract is 96%.

RECOMMENDATION

There is always a scope of improvement and change in time to come ahead. Thus every study leaves back scopes for other researchers to do something more advanced and varied in order to touch the height of perfection. This study is not an exception as it only examined 100 subjects.

- The study can be expanded by including more number of subjects so as to make generalization of the results and practice.
- A study with a larger sample size and in multiple centers can also be carried out.

LIMITATIONS

The ultrasonography (USG) of urinary tract has got following limitations

a) It is operator dependent technique requires expertization.
b) Respiratory movement makes it difficult to examine.
c) Difficult to perform in non-cooperative patients.
d) Bowel gas may obscure the kidneys and make it difficult to perform.
e) In obese patients also it is difficult to perform.

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