EVALUATION OF URINARY TRACT CALCULI BY SONOLOGICAL AND PLAIN ABDOMINAL RADIOGRAPHY- AN OBSERVATIONAL STUDY

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ABSTRACT

BACKGROUND

Urolithiasis is very common, affecting 12% of the population at some point of time in their life. The most common type of stone is calcium oxalate (60-80%). X-ray & ultrasound were most commonly used to diagnostic tools to pinpoint the urinary tract calculi & decrease the incidences of false diagnosis.

METHODS

Plain x-ray and ultrasound evaluation in the diagnosis of urinary tract calculi was conducted between September 2006 to August 2008. This study was conducted at Adichunchanagiri Institute of Medical Sciences, B.G. Nagar, Mandya. 35 patients included in the study were subjected to plain x-ray & ultrasound.

RESULTS

Total number of patients was 35, out of which 19 were female (54.28%) & 16 patients were male (45.71%) respectively. Age of the patients varied from 13 to 77 yrs. Out of 35 patients, 16 had ureteric calculi (35%), 11 had renal with ureteric calculi (31.4%), 4 had vesical calculus (11.4%) and 4 had calculus in PUJ (11.4%). 74.2% cases were diagnosed as urinary tract calculi by x-ray & 82.8% cases were diagnosed by ultrasound respectively.

CONCLUSIONS

Ultrasonography has more accuracy than plain x-ray in diagnosing urinary tract calculi. When both investigations were combined, accuracy rate further increased.

KEYWORDS

Ultrasonography, X-Ray, Urinary Tract Calculi

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BACKGROUND

Renal stones are very common, affecting 12% of the population at some point of time in their life.[1,2] The most common type of stone is calcium oxalate (60-80%).[3] The aetiology of formation is largely unknown. Urinary tract calculi is an acute abdominal condition. In earlier part twentieth century, plain x-ray of abdomen was the only such investigation which was introduced as a diagnostic tool in clinical practice, even though x-ray or shadows and not the true images. It turned out plain x-ray was useful in diagnosis of 40% of acute abdominal cases. We are grateful to our father of x-ray Sir. W.C. Roentgen as even after 100 year of detection of x-ray by him no other modality of investigation is able to show the G.I. perforation as plain x-ray of abdomen can.

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As there is tremendous advancement in scientific fields, more and more diagnostic facilities. Like ultrasonography, endoscopy, MRI, CT scan, radionuclide scan and other sophisticated investigations have developed which can give more information, than the plain x-ray. Investigation such as CT scan, MRI and radionuclide scan are very costly and require special training. Ultrasound is a small machine, which does not require many accessories, and trained staff is easily available all over the world. It can be installed easily and less space occupying. Portable one can also be taken to the places where required. Another most important thing is that ultrasound is a non-invasive procedure its safe in pregnancy and paediatric age for calculi detection.[4] This technique has gained acceptance as a major diagnostic tool largely because of the technological development of real time units and M and B mode sector scanners, with high resolution value to visualise intra-abdominal structure has led to its usefulness, one of the major imaging technique in most acute abdominal condition, except in few where bowels, are largely distended.

As air is a bad conductor of sound waves, the pathology can be missed in such conditions, which can still be picked up by plain x-ray abdomen where ultrasound has failed to detect the lesion. So, with this view, a study was

planned to analyse the findings of plain x-ray and ultra sound in urinary tract calculi, to evaluate the urinary tract calculi by using plain x-ray and ultrasound.

Aims and Objectives

1. To study the radiological findings associated with urinary tract calculi.
2. To study the ultrasonographic findings associated with urinary tract calculi.
3. To analyse the efficacy of plain x-ray and ultrasonography in the diagnosis of urinary tract calculi and to compare their individual merits and their superiority in the diagnosis. Both plain x-ray and ultrasonographic findings were correlated with final diagnosis, which was done either by other mode of investigation, clinical correlation.
4. To reduce the investigation time and to facilitate early management of the Patient. To reduce the morbidity and mortality associated with urinary tract calculi condition.

METHODS

This study, plain x-ray and ultra sound evaluation in the diagnosis of urinary tract calculi was conducted between September 2006 to August 2008. This study was conducted at Adichunchanagiri Institute of Medical Sciences, B.G. Nagar, Mandya. 35 patients who presented to us with acute abdomen were admitted to the hospital in the above-mentioned period and were subjected to plain x-ray abdomen or ultrasonography of abdomen subject to the availability of the latter patients were admitted in various wards like general wards, special wards.

All patient included in the study were examined thoroughly, and history, Physical examination, and investigation findings were recorded as per proforma. After history taking and physical examination, all patients underwent plain x-ray abdomen or ultrasonography abdomen. Plain x-ray abdomen, AP view with horizontal beam in upright position were taken. This film included both domes of diaphragm and pelvis up to the symphysis pubis. On certain occasion plain x-ray abdomen AP view in supine position and plain x-ray abdomen left lateral decubitus were taken as clinical condition warranted.

Finally, effort was made to study the sensitivity of plain x-ray and ultrasonographic finding to final diagnosis: efficacies of both were analysed.

Procedure and Technique of X-Ray Abdomen

The patients selected for the study presented with pain, dyspepsia, hematuria, fever and so on. Only those patients evaluated and followed up personally were included in the study. Initially after complete history taking and physical examination, a provisional diagnosis was made, and radiological investigation was done at the earliest patients. The technical factors for taking x-ray films vary from centre. We have employed following standard technique for taking plain x-ray in acute abdomen.

a. Appropriate size of the film was used so that it includes both dome of diaphragm and pelvis. For adults usually '14x17' size film were used.
b. Film focusing distance: 90 cms. for both AP and lateral views.
c. Kilo volt peak (kvp): approximately 70-80 kvp was used for both AP and lateral views.
d. Bucky films were taken where ever required.

Ultrasonography of Abdomen

Wherever possible patients were asked to be nil by mouth for 6-8 hours prior to the ultrasonographic examination. Patients in whom gall bladder disease was suspected were asked to avoid fat containing foods for 12 hours prior to the procedure. Prior to the commencement of scanning the history and physical findings were reviewed once again.

Real time ultrasound scanning was done with a 3.5 Mhz sector probe. Patients were examined either in supine or prone position or both as required. In individual where the pancreas was to be scanned in detail. They were asked to drink 2 glasses of water (which would produce acoustic window suitable for visualisation of pancreas) and additional examination was done in sitting position also.

An organ-oriented examination was the procedure followed even if the pathology was localised to one organ. As a routine, all other abdominal viscera were scanned prior to the completion of the procedure and arriving at a diagnosis. Many of the patients required surgical intervention. The surgery of each patient was observed to know operative findings and diagnosis was made after discussion who operated. Finally, operative finding diagnosis, and surgery performed were recorded in proforma Patients who were not subjected to surgery have been subjected to other modes of investigations such as ultra sound guided aspiration, intravenous urogram (IVU) etc. and their finding were noted.in proforma. Both x-ray and ultrasonographic findings were recorded. A final diagnosis was analysed with findings of plain x-ray and ultrasonography.

Both x-ray and ultra-sonographic findings were classified into 3 categories-

1. Diagnostic: plain x-ray /ultrasonographic findings were diagnostic that means in confirmation with final diagnosis.
2. Suggestive of diagnosis: one or more plain x ray/ ultrasonographic signs suggestive of diagnosis but were not pathognomonic of final diagnosis.
3. Not suggestive of diagnosis: plain x ray/ ultrasonographic were not pathognomonic or suggestive of final diagnosis.

RESULTS

Total no patients were 35 out of which 19 were female (54.28%) & 16 patients were male (45.71%) respectively as shown in figure 1. The age of the patient varied from 13 to 77yrs. Out of 35 patients, 16 were ureteric calculi (35%), 11 were renal with ureteric calculi (31.4%), 3 was vesical calculus (11.4%) and 4 were calculus in PUJ (11.4%) respectively showed in table 1.

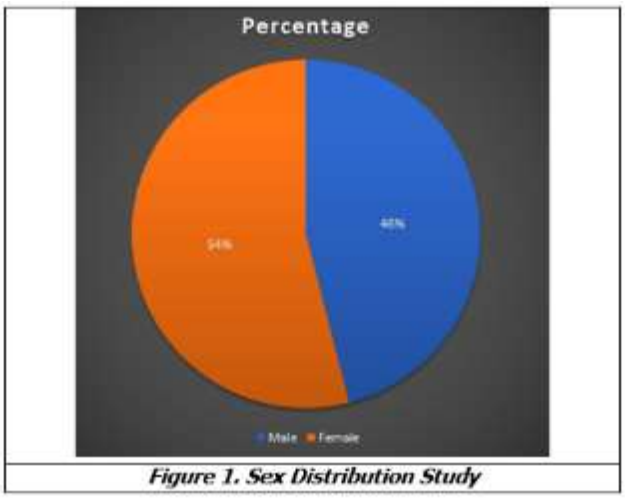

Figure 1. Sex Distribution Study

Sl. No.	Causes	No. of Causes	Percentage
1.	Ureteric calculi	16	35%
2.	Renal with ureteric calculi	11	31.4%
3.	Vesical calculus	4	11.4%
4.	Calculus in PUJ	4	11.4%
	Total	**35**	**100**

Table 1. Acute Ureteric/Vesical/Renal Calculi

Plain x-ray picked up stones in 26 cases (74.2%) seen as radio opaque shadow in the region K.U.B. and it was missed in 9 cases among which 3 cases were picked up by ultrasonography and were confirmed by I.V.U. Plain x-ray failed to diagnose a case of pyonephrosis which was picked by ultrasonography showed a left mid-ureteric calculi (table 2).

In all 29 cases (82.8%) ultrasonography picked up stones in the kidney/ureter/urinary bladder. In 6 cases mild to moderate back pressure changes were seen. Bladder stones was demonstrated as mobile echogenic intraluminal structure with acoustic shadow. Hydronephrotic changes were seen as dilatation of pelvicalyceal system with anechoic urine collection. In severe cases thinning of renal parenchyma was noted. A case of pyonephrosis showed echogenic debris in dilated pelvicalyceal system with mid-ureteric calculus (table 2).

DISCUSSION

In the last decade real time ultrasonography has become a choice of investigation for clinical problem within the abdomen. It is non-invasive, safe, easy to carryout, convenient for the patients, and is showing increasing accuracy and specificity when compared to plain x-ray abdomen. However, in few abdominal conditions in which bowels are largely distended ultrasound has failed to detect abdominal lesions, in such case as air is a bad conductor of sound wave. However, merits and demerits of ultrasonography and pain x-ray abdomen is discussed here in each system and effort has been made to know the efficiency of both in the diagnosis of urinary tract calculi. 90% of stones in urogenital system are radio opaque and 10% are radiolucent.

There is 10% chance that stones can be missed on plain x ray abdomen. Ultrasound can pick such radiolucent stones. In our series, one patient plain x-ray has failed to detect ureteric stones, whereas ultrasonography has picked up the stone, which was confirmed by I.V.U.

As ultrasonography is a 2-dimensional picture it is difficult to measure the exact size of the stones. Stone especially in the middle third of the ureter are difficult to visualise because there is significant overlaps of intestinal coils in that area. The ultrasonography it may not be possible to visualise the stones in all cases, but hydro ureter, back pressure changes in the kidney may suggest obstructive lesion.

In one case plain x-ray K.U.B. region showed a radio opaque shadow opposite to L4 vertebra suggestive of right ureteric stone. Ultrasonography done in that case showed absent kidney or right side in its normal position and was found in pelvis with hydronephrotic changes and stone in pelvi-ureteric junction. In the urinary disease especially urolithiasis USG and plain x-ray are complementary to each other. However, I.V.U may be required to establish the final diagnosis.

Middleton et al[5] demonstrated that sonography has 96% sensitivity for renal stone detection. Which was slightly inferior to a combination of plain radiography with tomography. They also found stones greater than 5 mm in size were detected with 100% sensitivity sonographically. On sonography, renal calculi were seen as echogenic foci with sharp distal acoustic shadowing, small stones in the urinary tract may be hard to find if they have a weak posterior acoustic shadow.

Lee et al[6] have demonstrated that most urinary tract stones (83%) show colour and power Doppler twinkling artefacts. In equivocal cases, this appears to be a helpful ancillary finding.

Smith et al[7] have demonstrated that annular array transducers are able to demonstrate stone shadowing to better advantage than mechanical sector transducers. Harmonic imaging may also help, and this technique should be employed when assessing for the presence or absence of urinary tract stones. Certain entities may mimic renal calculi sonographically including,

1. Intracranial gas;
2. Renal artery calcification;
3. Calcified sloughed papilla;
4. Calcified transitional cell tumour;
5. Alkaline encrusted prelates ;and
6. Encrusted calcification of the ends of a ureteric stent.

Patlas et al[8] suggested a 93% sensitivity and 95% specificity for the sonographic diagnosis of urethral stones. They suggest that because of lack of ionising radiation and lower cost, this test should be employed initially before CT. If sonography is unavailable or is non diagnostic, then CT could be performed. On sonography the search for ureteral calculi can be difficult of overlying bowel gas and the deep retroperitoneal location of the ureter. However, transvaginal or trans perineal scanning may be an optimal way to detect and demonstrate distal ureteral calculi that are not seen with transabdominal suprapubic approach.

Geavlete et al[9] found if there was an intravesical ureteric jet on the renal colic side associated with resistive index (RI) values less than or equal to 0.7 and delta RI less than not equal 0.06, spontaneous passage of the stone occurred 71% of the time.

Ather MH et al[10] and ULUSAN S, et al[11] report the sensitivity and specificity of ultrasound for detecting renal stones as 24-81 % and 83-100% respectively.

CONCLUSIONS

Plain x-ray was helpful in 26 patients (74.2%). Ultrasonography was helpful in 29 patients (82.8%). When combined with pain x-ray, accuracy increased. Plain x-ray was really helpful in diagnosing ureteric/renal/vesicle calculi. Ultrasonography in the diagnosis of acute abdomen, was found to be an excellent diagnostic tool for the diagnosis of acute ureteric/renal/vesical calculus. In acute renal/ ureteric/vesical calculus, it has distinct advantage over plain x-ray radiography because it not only shows the level of obstruction, but also helps in knowing the back-pressure changes and corticomedullary differentiation. This study shows that ultrasonography has higher accuracy than plain x-ray in diagnosing urinary tract calculi. When both investigations were combined, accuracy further increased.

Sl. No.	Age (yr)	Sex (M/F)	Ultrasound	X-Ray	Final Diagnosis
1	13	M	+	+	Left Upper ureteric calculus
2	30	M	+	+	Multiple renal calculi with calculus in right distal end ureter
3	31	M	+	+	Right lower ureteric calculi
4	54	M	+	-	Ureteric calculi
5	77	F	+	+	Right sided hydronephrosis with calculus in pelvis ureteric junction
6	42	F	+	+	Left sided hydronephrosis with calculus in middle 1/3rd of left ureter
7	18	F	+	-	Multiple right renal calculus in distal ureter
8	50	F	+	+	Vesicle calculus
9	30	F	+	-	Left pyonephrosis with ureteric calculus
10	30	F	+	-	Right sided hydroureter due to a calculus in the distal end of right ureter with cystitis
11	70	M	+	+	Left sided hydronephrosis due to a calculus in the mid ureter
12	30	M	+	+	Left renal calculi with upper ureteric calculi
13	30	F	+	-	Left upper ureteric calculi
14	30	M	+	-	Right renal calculus with middle 1/3rd ureteric calculi
15	30	F	+	-	Left upper ureteric calculi
16	25	F	+	-	Left sided hydronephrosis due to a calculus in the mid-ureter
17	25	M	+	_	Vesical calculi
18	35	F	+	+	Right renal calculi
19	32	M	+	+	Left renal calculi
20	38	F	_	+	Right mid ureteric calculi
21	45	M	+	+	Left PUJ calculi
22	50	F	_	+	Right mid ureteric calculi
23	48	M	+	_	Left renal calculi
24	55	F	_	+	PUJ calculi
25	58	M	+	+	Right renal calculi
26	53	F	+	-	Left lower ureteric calculi
27	42	F	_	+	Left mid ureteric calculi
28	59	M	_	+	Right mid ureteric calculi
29	63	M	+	+	Vesical calculi
30	46	M	+	_	Left renal calculi
31	48	M	+	+	Vesical calculi
32	62	F	_	+	Right mid ureteric calculi
33	32	F	+	+	Right renal calculi
34	39	F	+	+	PUJ calculi
35	45	F	+	_	Right renal calculi

Table 2. Results of Ultrasound & X-Ray of Urinary Tract Calculi

Figure 2. RT Calyceal Calculi

Figure 3. Vesical Calculi

Figure 4. Bilateral Renal Calculi with Left Uretero Vesical Junction Calculi

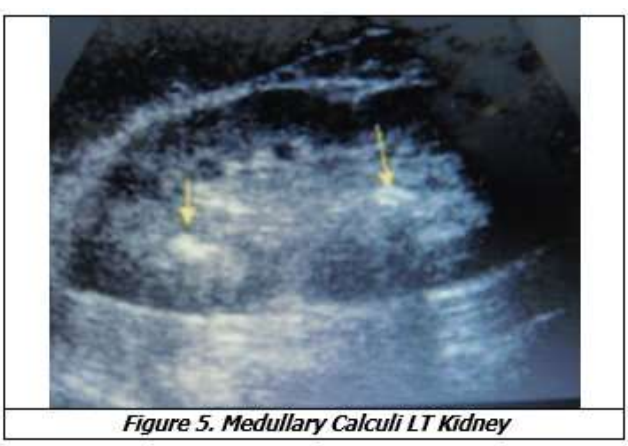

Figure 5. Medullary Calculi LT Kidney

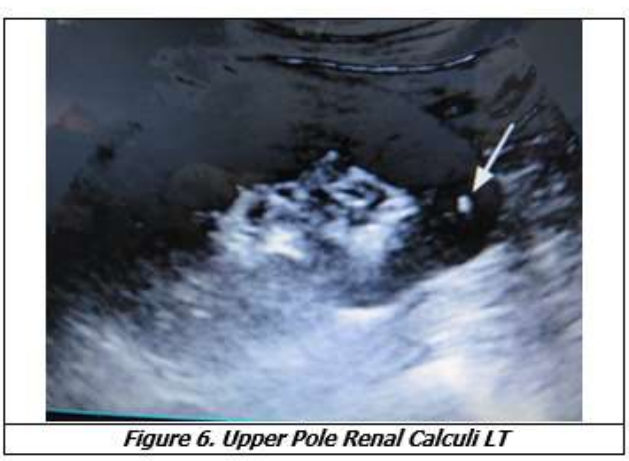

Figure 6. Upper Pole Renal Calculi LT

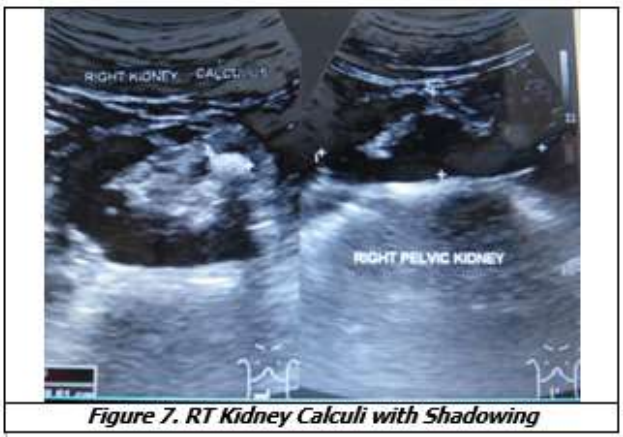

Figure 7. RT Kidney Calculi with Shadowing

Figure 8. RT renal calculi

Figure 9. LT Renal Calculi Lower Pole

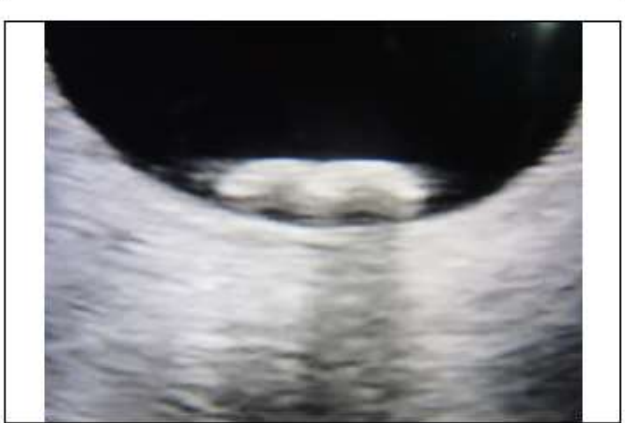

Figure 10. Vesical Calculi with Shadowing

Figure 11. PUJ Calculi with Shadowing

Figure 12. Ureteric Calculi

Figure 13. Vesical Calculi

Figure 14. Stag Horn Calculi

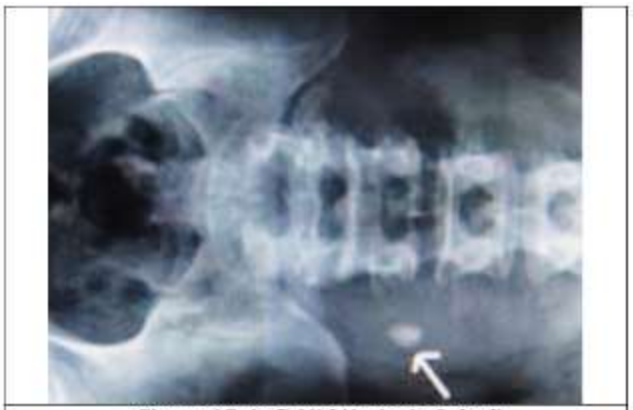

Figure 15. Left Mid Ureteric Calculi

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