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ROLE OF ULTRASOUND AND INTRAVENOUS UROGRAPHY IN PATIENTS WITH RENAL COLIC

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ABSTRACT

Objective: To determine the accuracy of Ultrasound along with x-ray KUB and IVU in detecting renal / ureteric calculi in patients with renal colic.

Study Design: Validation study

Place and Duration of Study: Department of Radiology POF Hospital Wah cantt from 15-06-09 to 15-12-09.

Materials and Methods: One hundred and eleven consecutive patients with clinically suspected urinary tract calculi were selected for study. At first they underwent sonography along with x-ray KUB and then IVU. We evaluated the sensitivity, specificity, negative /positive predictive values and accuracy of US X-ray KUB combination and IVU for detecting renal / ureteric calculi while final diagnosis (gold standard) obtained from the results of clinical course/urological procedures.

Results: Out of 111 consecutive patients 46 (41 %) were normal and 65 (59 %) patients had KUB calculi. US along with x-ray KUB detected 59 patients and missed 6 patients and likewise IVU detected 61 patients out of 65 patients. Sensitivity, specificity, and accuracy of both these modalities are almost similar with IVU having slightly upper edge.

Conclusion: IVU remains an important investigation in the assessment of calculus and other causes of urinary tract obstruction. Ultrasound in combination with x-ray KUB is an excellent modality having almost similar diagnostic capability as IVU in detecting KUB calculi along with many more significant advantages, as it has less radiation dose, relatively inexpensive, universally available, easily applicable and high diagnostic efficacy.

Keywords: Colic, hydronephrosis, pyelonephritis, Ultrasound.

INTRODUCTION

Acute flank pain is the most common urological presentation in the emergency room. The diagnostic workup requires comprehensive history-taking, physical examination and radiological investigation. Flank pain is a nonspecific symptom therefore, imaging evaluation is recommended at the initial presentation. The ureteric calculi commonly become lodged at the ureteropelvic junction, the iliac vessels level, and the ureterovesical junction. The probability of spontaneous passage of a ureteral calculus measuring 5 mm or less is very high. A 10 mm calculus is very unlikely to pass spontaneously. The treating physician wants to know the size of the calculus, location and effect of calculus on renal function. Renal colic has traditionally been evaluated with x-ray KUB (kidneys ureters & bladder) and IVU (intravenous urography). More recently, ultrasound (US), computerized tomography (CT) and megnetic resonance imaging/urography (MRI/MRU) are being used. Plain KUB may be a valuable part of the IVU or US evaluation of flank pain. It has a very limited role when used alone[1]. Spiral non contrast CT (NCT) has high sensitivity and specificity for ureterolithiasis. Coronal reconstruction of CT scans accurately predicts stone size in the craniocaudal direction. The likelihood of stone passage correlates inversely with the degree of perinephric stranding on NCT. The stranding may take 8 hours after the onset of pain to become maximal[2]. NCT is equal to the IVU in diagnosing obstruction and more reliable in diagnosing nephrolithiasis. NCT can also diagnose other causes of flank pain such as appendicitis and torsed ovarian masses. NCT is safer than the IVU since it uses no contrast media and is rapid with the entire procedure taking minutes. When CT is available, it is the study of choice in the non-pregnant adult

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presenting with flank pain[3]. IVU is still the best investigation if NCT is not available. It provides information regarding site and degree of obstruction, size of stone, and effects on renal excretion. Relative contraindications include renal insufficiency, past reaction to contrast agents, and pregnancy. It may take several hours for excretion to occur in acute obstruction. Another disadvantage is the inability of the IVU to identify alternative diagnoses. US is a safe and noninvasive imaging modality to study the urinary tract effectively. The offending calculus is identified along with concomitant hydronephrosis and hydroureter. It takes many hours for pelvicaliectasis and ureterectasis to develop therefore US will miss 30% of acute obstructions caused by a ureteral stone if patients are not specifically hydrated. The renal Doppler US detects early obstruction by showing elevated resistive index[4]. KUB is superior to US in detecting ureteral calculi, therefore a combination of KUB and US is recommended[5]. US is used to detect uretero-caliectasis and then to trace the dilated ureter to a shadowing stone. US can also evaluate the ureteral jet. With obstruction the jets are absent or diminished in frequency. Negative predictive value of the KUB/US combination is 95%, indicating that IVU is not likely to be helpful if the KUB/US tests are negative. Due to lack of ionizing radiation US is better for evaluating stones in pregnant women. Its disadvantages include the need for skilled personnel, its inability to accurately measure the size of the calculus and its inability to differentiate dilatation without obstruction from true obstruction[6]. Magnetic resonance urography (MRU) shows perirenal fluid in obstructed kidneys. Stones are seen as signal voids against a background of bright urine on T2-weighted images. MRU has been successfully used in pregnant patients with flank pain[7].

In this study we evaluated IVU as a reliable invasive modality and US along with x-ray KUB as safe and reliable non invasive modality in detecting renal / ureteric calculi as most of us in developing countries have no access to NCT.

PATIENTS AND METHOD

All patients with acute flank pain who visited the emergency department of POF Wah hospital or outpatient urology clinic from 15-6-09 to 15-12-9 underwent a physical examination and urinalysis. Among these, 111 consecutive patients with clinically suspected urinary tract calculi were included for study. They underwent sonography along with X-ray KUB and then IVU in department of Radiology POF Hospital Wah cantt. Inclusion criteria were as follows: (1) acute flank pain, (2) costovertebral angle tenderness on physical examination, and (3) hematuria on urinalysis. Patients with fever, who were clinically suspected of having acute pyelonephritis, were excluded. The patient's ages ranged from 10 to 76 years (mean, 42 years). No pregnant patients were selected. A definitive diagnosis (gold standard) of urolithiasis was made when the patient passed a stone either naturally or after extracorporeal shock wave lithotripsy, when a stone was extracted by urologic procedures including ureteroscopic lithotripsy and percutaneous nephroscopic lithotripsy, or when a stone was clearly seen within a markedly dilated ureter on sonography.

Data Analysis: Data was analyzed using SPSS version 15. Descriptive statistics was used to describe the data. Sensitivity, specificity, accuracy, positive predictive value and negative predictive value were calculated of x-ray US combination and IVU.

RESULTS

A total of 111 consecutive patients with clinically suspected urinary tract calculi at first underwent X-ray KUB in combination with US and then IVU. The patients age ranged from 10-76 years (mean 42 years). Out of these 46 were normal and 65 patients have KUB calculi. From 65 patients US along with x-ray KUB detected 59 patients and missed 6 patients and likewise IVU detected 61 patients out of 65 patients (Table I). Sensitivity, specificity, Negative/positive predictive values and accuracy of plain X-ray KUB US combination and IVU are shown in table 2.

Table-1: Description of positive and negative cases of both the screening tests along with gold standard.

Gold standard (clinical course/ urologic procedures)		
	+	-
US along with X-ray KUB		
+	59	4
-	6	42
IVU		
+	61	2
-	4	44

Table-2: Diagnostic measures of both the screening methods

Diagnostic measures	US along with X-ray KUB	IVU
Sensitivity	90.7%	93.6%
Specificity	91.3%	95.6%
PPV	93.6%	96.8%
NPV	87.5%	91.6%
Accuracy	90.9%	94.5%

DISSCUSSION

The IVU imaging sequence is designed to optimize depiction of specific portions of the urinary tract during maximal contrast material opacification. A tailored urographic study may provide diagnostic detail beyond the current capabilities of other imaging modalities. This can be accomplished only with good technique and adherence to basic rules of interpretation. The ability to relate urographic findings to other imaging modalities will remain an important skill until the ideal urinary tract imaging technique emerges[8].

IVU is the most accurate imaging modality for visualizing the urothelium-lined surfaces and evaluating potential abnormalities like transitional cell carcinoma. According to this study IVU is slightly better than X-ray KUB and US combination having sensitivity of 93.6%, specificity of 95.6 %, negative predictive value of 91.6%, positive predictive value of 96.8% and accuracy of 94.5%. On IVU, early and mild obstruction is indicated by subtle rounding of the forniceal margins. More severe and prolonged obstruction causes progressive loss of the papillary impression and eventual clubbing of calices. Larger parenchymal collections of contrast material may reflect an inflammatory process such as tuberculosis or neoplastic excavation related to transitional cell carcinoma. Filling defects within the calices or collecting system can be produced by benign or malignant processes. An absolute ureteral diameter exceeding 8 mm represents dilatation[9].

IVU is considered the best first investigation in patients with suspected ureteric colic, but recently US, combined with KUB, has been suggested as an alternative for patients with deranged renal function tests. In the hydrated patient the combination of KUB plus US is a sensitive screening test. Because of the high negative predictive value (87.5%) of this combination that is very close to NPV for IVU. Urography is not likely to be helpful when x-ray KUB plus US combination is negative. Urography is indicated only if x-ray KUB plus US findings are equivocal. If x-ray KUB and US are used as the first test urography is not needed in approximately 60 % of cases.[5] Results of this study showed that US along with KUB x-ray has Sensitivity of 90.7%, specificity of 91.3% negative predictive value of 87.5%, positive predictive value of 93.6% and accuracy of 90.9%. These are very interesting results as values of x-ray KUB and US are very close to IVU with difference of only 4% in negative predictive values.

Keeping in view above mentioned results X-ray KUB with US combination is safer than IVU and can be used as alternative modality for initial investigation when other modalities are not available or contraindicated. When using x-ray KUB and US in combination there is a saving in cost and time. US have specific advantages over IVU in the assessment of the lower urinary tract, including assessment of any pelvic pathology, measure of post-void urine volume and size of the prostate. IVU remains an important investigation in the assessment of renal obstruction, and any abnormalities seen on plain film and US. Due to the hazards of ionizing radiation and contrast media, US and x-ray KUB should be the initial investigations of choice.

CONCLUSION

In clinical practice, the choice of the most appropriate diagnostic imaging is critical. Despite increasingly sophisticated advances in CT technology like multi detector CT, it is likely that urologists will continue to request an IVU especially in our setup. Ultrasound in combination with x-ray KUB is an excellent imaging modality having almost similar diagnostic capability as IVU in detecting KUB calculi with many more significant advantages, as it has less radiation dose, relatively inexpensive, universally available, easily applicable and high diagnostic efficacy.

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