ORIGINAL ARTICLE

FREQUENCY OF INCREASE IN INTRA-RENAL RESISTIVE INDEX IN PATIENTS WITH ACUTE UNILATERAL URETERIC OBSTRUCTION DUE TO CALCULUS

Faryal Asmat
Department of Radiology, Kuwait Teaching Hospital, Peshawar, Pakistan

ABSTRACT

Background: Urolithiasis is the commonest cause of acute urinary tract obstruction. Acute obstructive uropathies can lead to acute and chronic renal failure. This study was aimed to determine the frequency of increase in intra-renal resistive index (RI) in patients with acute unilateral ureteric obstruction due to calculus.

Material & Methods: This descriptive cross-sectional study was conducted at Radiology Department, PGMI, Hayatabad Medical Complex, Peshawar. Duration of the study was one year. Total sample size was 66, using 95% confidence level, 87.5% proportion of increase in RI in acute unilateral ureteric obstruction due to calculus and 8% margin of error under WHO software for sample size determination. Non-probability consecutive sampling technique was used.

Results: In contralateral normal kidney 5(9%) patients had RI range from 0.50-0.55, 17(25%) had 0.56-0.60, 27(41%) had 0.61-0.65, 17(25%) had 0.66-0.70 while no patient had RI >0.7. Where as in affected kidney RI had increased as 1(1%) patient had RI range from 0.56-0.60, 3(4%) patients had 0.61-0.65, 5(9%) patients had 0.66-0.70, 46(70%) patients had 0.71-0.75 and 11(16%) patients had RI range 0.76-0.80. Hence it was concluded that RI increases up to 100% in affected kidney as compared to contralateral normal kidney while in affected kidney RI increases more than 0.7 in 66(86%) patients.

Conclusion: It is concluded that Doppler ultratrasound Resistive Index is a sensitive method in diagnosing early obstructed kidney, even before the appearance of hydronephrosis.

KEY WORDS: Renal obstruction; Doppler ultrasonography; Resistive index.

This article may be cited as: Asmat F. Frequency of increase in intra-renal resistive index in patients with acute unilateral ureteric obstruction due to calculus. Gomal J Med Sci 2014; 12:68-71.

INTRODUCTION

Magnitude of the urinary tract stone disease is large worldwide. In Pakistan it is estimated that approximately 12% of population develops urinary stones.[1] Urolithiasis is the commonest cause of acute urinary tract obstruction.[2] Most acute obstructive uropathies are associated with significant pain, abrupt diminution of urine flow, hematuria and can lead to acute and chronic renal failure.[3] Renal ultrasound and Doppler studies remain vital diagnostic tools in the evaluation of urinary tract obstruction because it is a rapid, low cost, non invasive and radiation free tool.[3,4] Some patients of renal obstruction presenting with acute ureteric colic are not ideal candidates for intravenous urography (IVU) e.g. in pregnancy, history of contrast-induced allergy or renal failure.[3-5]

In patients with renal colic, ultrasound may reveal directly a stone in the collecting system or it may suggest a diagnosis of obstructive uropathy by demonstrating a dilatation of the urinary tract. However, obstruction without dilatation of pelvicalyceal system is not infrequent in many acute obstructions (35%) as well as severe dilatation may exist without obstruction.[6,7]

In order to obtain more information from ultrasound during a renal colic, a colour Doppler evaluation is used. In acutely obstructed kidneys, renal Doppler recording can demonstrate altered renal perfusion before pelvicalyceal system dilatation.[8] Altered renal hemodynamics is mediated by some vasoactive factors (thromboxane A2, angiotensin II,

Corresponding Author:
Dr. Faryal Asmat
Department of Radiology
Kuwait Teaching Hospital
Peshawar, Pakistan
E-mail: faryal150@yahoo.com

endothelin and nitric oxide) which cause an initial vasodilatation and then vasoconstriction. This causes an increase of intrarenal resistance which results in decreased diastolic blood flow as compared to systolic flow which is measurable by colour doppler ultrasonography in form of resistive index (RI) of the arcuate arteries at the corticomedullary junction or the interlobar arteries.[9] Hence, an elevated RI likely reflects a significant obstruction; alternatively, a normal RI likely reflects an insignificant obstruction without renal hemodynamic changes.

Between 4 and 60 years, 0.70 constitutes the upper normal limit of RI. RI is higher than 0.70 during the first 3 years of life. As the patient ages, this value shows a tendency to increase.[6] RI greater than 0.7 or an inter-renal difference in RI greater than 0.08 compared with the normal kidney proved to be a reliable cut-off value to diagnose renal obstruction.[10] Frequency of Increased RI in patients of acute unilateral urinary tract obstruction due to calculus is 87.5%.[11] Determination of RI will help the patients in curtailing the number of needless investigations like IVU and CT, both of which have lots of radiations, are expensive than ultrasound and take lot of time. The results of the study will be shared with other health professionals so that they clinically diagnose ureteric obstruction due to calculus at an early stage by a quick, radiation free and low cost technique i.e. Doppler Ultrasound, thus reducing the morbidity (acute and chronic renal failure) due to ureteric obstruction.

This study was conducted to determine the frequency of increase in intra-renal resistive index in patients with acute unilateral ureteric obstruction due to calculus.

MATERIAL AND METHODS

This descriptive cross-sectional study was carried out at Department of Radiology, PGMI / Hayatabad Medical Complex, Peshawar. The study was of one year duration from 16th June 2010 to 16th June 2011. Non probability consecutive sampling was used as sampling technique. A total of 66 patients were included in study using 95% confidence level, 87.5% proportion of increase in RI in acute unilateral ureteric obstruction due to calculus[11] and 8% margin of error under WHO software for sample size determination.

All patients were taken from 4-60 years of age with symptoms of acute unilateral obstruction of ureter due to calculus referred for ultrasound from OPD, casualty and ward. Duration of complaints was more than or equal to six hours and up to five days preferably.

The patients with history of renal parenchymal disease, patients on dialysis, those with history of chronic renal obstruction or renal trauma, those having a single kidney or with a congenital anomaly of the kidneys, having age less than 4 years or more than 60 years and pregnant females were excluded from study.

After taking permission from the Postgraduate Medical Institute Ethics and Research Committee, all the patients fulfilling the inclusion criteria referred to ultrasound from OPD, casualty and wards were enrolled in the study. Diagnostic criteria for inclusion (acute ureteric calculus obstruction) include obstruction of the ureter due to calculus from 6 hours after obstruction to the third day presenting as flank pain that can radiate to groin, testicles, back or peri-umbilical region. Ureteric calculus is diagnosed as a radio opaque (white) shadow in the line of ureters on plain abdominal radiography, a filling defect (black) in the contrast filled ureters on intravenous urography or an echogenic shadow (white) with posterior acoustic shadow (black) in ureters on abdominal ultrasound.

Bias and confounding were controlled by using the exclusion criteria of the study and by using one ultrasound machine for all patients enrolled in study. The author did the ultrasound of all patients. For each kidney 3 readings of RI were taken and average value was used. Ultrasonography was performed after taking informed consent in Department of Radiology, HMC Peshawar.

Ultrasonography was done on Nemio XG ultrasound machine using 3. 5 MHz probe with liberal amount of jelly and the patient lying in lateral position. Measurements were made at three sites in the kidney i.e. in the upper, middle and lower poles. A 2-5mm sample volume was used and angle correction was not applied. Waveforms were optimized for measurement using the lowest pulse repetition frequency without aliasing (to maximize waveform size), the highest gain without background noise, and the lowest wall filter. Three to five waveforms were recorded at each site and the average RI was calculated. This was done on the affected kidney as well as the contra lateral normal kidney. Diagnostic criteria for renal obstruction was included RI greater than 0.7. Data for each patient was recorded on a patient's proforma.

Statistical package SPSS version 10 was used for computation and data analysis. Descriptive statistics was used to calculate mean and standard deviations for age, average RI of the afflicted and contralateral kidney. Frequency and percentage were calculated for gender and increased intra-renal RI. All the results were presented in the form of Tables.

RESULTS

Age distribution among 66 patients was analyzed as 2(3%) patients were in age range 4-10 years followed by 4(7%) patients were in age range 11-20

Table 1: Age distribution of patients with ureteric obstruction. (n=66).

Age (in years)	Frequency	Percentage
4 -10 Years	2	3%
11 -20 Years	4	7%
21 -30 Years	17	25%
31 -40 Years	23	35%
41-50 Years	13	20%
51-60 Years	7	10%

Table 2: Gender distribution of patients with ureteric obstruction. (n=66).

Gender	Frequency	Percentage
Male	43	65%
Female	23	35%
Total	66	100%

Table 3: Comparison between intra renal resistive index in affected and contralateral normal kidney (n=66).

Intra renal RI	Affected Kidney	Contralateral Normal Kidney
0.50 - 0.55	0	5(9%)
0.56 – 0.60	1(1%)	17(24%)
0.61 – 0.65	3(4%)	27(41%)
0.66 – 0.70	5(9%)	17(26%)
0.71 – 0.75	46(70%)	0
0.76 – 0.80	11(16%)	0
Mean	0.72; ± 3.85	0.64; ± 2.71

years, 17(25%) patients were in age range 21-30 years, 23(35%) patients were in age range 31-40 years, 13(20%) patients were in age range 41-50 years and 7(10%) patients were in age range 51-60 years. Mean age of the patients was 39 ±1.67 years. Gender distribution among 66 patients was analyzed as 43(65%) patients were male while 23(35%) patients were female. (Table 1 & 2)

Moreover, 53(80%) patients had hydronephrosis while 13(20%) patients didn't have hydronephrosis. Out of 20% Non hydronephrotic kidneys, 12 (92%) have increased RI.

Renal RI change in affected kidney and contralateral normal kidney was analyzed. In contralateral normal kidney 5(9%) patients had RI range from 0.50-0.55, 17(25%) patients had RI range from 0.56-0.60, 27(41%) patients had RI range from 0.61-0.65, 17(25%) patients had RI range from 0.66-0.70 while no patient had RI more than 7. Where as in affected kidney RI had increase as in 1(1%) patient had RI range from 0.56-0.60, 3(4%) patients had RI range from 0.61-0.65, 5(9%) patients had RI range from 0.66-0.70, 46(70%) patients had RI range from 0.71-0.75 and 11(16%) patients had RI range from 0.76-0.80. Hence it was concluded that RI increases up to 100% in the affected kidney as compared to contralateral normal kidney while in affected kidney RI increases more than 0.7 in 57(86%) patients. (Table 3)

DISCUSSION

The renal vasoconstrictive response that occurs with acute complete obstruction is reliably identified by duplex doppler sonography. IVU and grey-scale US are the two most common imaging examinations used in patients with acute renal colic to determine whether renal obstruction is present.[12] Evaluation with US is particularly useful in conditions when IVU is contraindicated, e.g. pregnancy, a history of reaction to contrast material, renal impairment and repeated episodes of renal colic. However, conventional US is an inaccurate test for obstruction because dilatation of the collecting system is often seen in unobstructed kidneys and may not occur or may occur late in obstructed kidneys.

In recent years, Doppler sonography was introduced in the assessment of patients with acute renal colic to measure the RI in the intrarenal arteries.[13] The role of renal Doppler US in the evaluation of acute renal obstruction has been vigorously debated. Rodgers et al[14] found an elevated RI in acutely obstructed kidneys, especially when compared with the RI in normal contralateral kidneys and with a control group of healthy subjects. Similar results were obtained by Platt et al[15] in 23 patients with acute unilateral ureteric obstruction. However, others reported that duplex Doppler sonography is highly insensitive for detecting acute ureteric obstruction.

In this study the incidence of acute unilateral ureteric obstruction was common in 20 to 50 years of age and the mean age was 39 years .Similar results were found in study done by Zaki S[16] in which 75% cases were recorded in age range 25-45 years. In another study done by Kavakli et al[17] in which 85% patients were found in age range 20-50 years.

My study shows that acute unilateral ureteric obstruction occur more in male as compare to female as in my results 65% were male where as 35% patients were female. Similar results were also cited in study done by Zaki S[16] in which 70% cases were male and 30% cases were female.[6] Similarly in another study done by Kavakli et al[17] had also shows similar results as in their study 60% patients were males and 40% patient were females.

My study shows that 80% patients had hydronephrosis and 20% patients did not had hydro-

nephrosis, out of those 20% patients, 92% have increase RI, showing that obstructed kidney can be diagnosed before the appearance of hydronephrosis. Similar results were also observed in other studies like Zaki S.[16]

Doppler US with measurement of the RI in the intrarenal arteries is very useful, as obstruction (except in the peracute stage) leads to intrarenal vasoconstriction, with a consecutive increase of the RI above the upper limit of 0.7; however, the case is different for non-obstructive dilatation. As the sensitivity of RI drops substantially after 48 hours, renal doppler US is useful for diagnosing acute renal obstruction 6–48 hours after the onset of symptoms.

The present study shows that there is a vital change of renal RI in affected kidney as compare to contralateral normal kidney. My results shows that in contralateral normal kidney most of the patients 91% were in RI range 0.56-7.0 and no patient was found above 7.0, where as in affected kidney RI had increased up to 8.0, as in my results most of the patients 86% had RI ranged from 0.71-0.80. More over my study shows that RI increases up to 100% in affected kidney as compare to contralateral normal kidney while in affected kidney RI increases more than 0.7 only in 86% patients. Similar results were also observed in study conducted by Kavakali et al[17] in which 60% patients had RI ranged from 0.56-7.0 in control group while 85% patients had RI ranged from 0.71-0.80 in affected kidney group.

CONCLUSION

It is concluded that Doppler ultrasound Resistive Index is a sensitive method in diagnosing early obstructed kidney, even before the appearance of hydronephrosis.

REFRENCES

1. Pervez A, Arif A. Role of US in evaluation of renal colic and assessment of risk factor for renal calculi. Gomal J Med Sci 2007; 5:22-7.
2. Hall J, Linton KD. Obstruction of the upper and lower urinary tract. Surgery (Oxford) 2008; 26:197-202.
3. Rishi N, Anil KS, Kaza RCM, Anand VJ. The obstructed kidney. Indian J Surg 2005; 67:21-8.
4. House MK, Gibson RN. Ultrasound diagnostic capabilities in native kidney disease. Saudi J Kidney Dis Transpl 2004; 15:251-6.
5. Sidhu R, Bhatt S, Dogra VS. Renal colic. Ultrasound Clin 2008; 3:159-70.
6. Pepe P, Motta L, Pennisi M Aragona F. Functional evaluation of the urinary tract by color-Doppler ultrasonography (CDU) in 100 patients with renal colic. Pediatric Intervention and Angiography Eur J Radiol 2005; 53:131-5.
7. de Bessa J, Denes FT, Chammas MC, Cerri L, Monteiro ED, Buchpiguel CA, et al. Diagnostic accuracy of color doppler sonographic study of the ureteric jets in evaluation of hydronephrosis. J Pediatr Urol 2008; 4:113-7.
8. Onur MR, Cubuk M, Andic C, Kartal M, Arslan G. Role of resistive index in renal colic. Urol Res 2007; 35:307-12.
9. Leipe K, Taut-Sack H. Can renal doppler sonography replace diuretic radionuclide renography in infants with hydronephrosis? Turk J Pediatr 2006; 48:221-7.
10. Amin MU, Ghaffar A. Intrarenal and intravesical color doppler sonography in patients with acute renal colic. J Surg Pak 2004; 9:40-2.
11. Saboo SS, Soni SS, Saboo SH, Chinapuvvula NR, Kaza S. Doppler sonography in acute renal obstruction. Indian J Radiol Imaging 2007; 17:188-92.
12. Hussain S. MR urography. Magnetic Resonance. Imag Clin North Am 2003; 5:95-106.
13. Meire H, Cosgrove D, Dewbury K, Farrant P. Clinical ultrasound: a comprehensive text. 2nd ed. London: Churchill Livingstone. 2001.p.149-98.
14. Rodgers PM, Bates JA, Irving HC. Intrarenal Doppler ultrasound studies in normal and acutely obstructed kidneys. Br J Radiol 2003; 65:207–12.
15. Platt JF, Rubin JM, Ellis JH. Distinction between obstructive and non-obstructive pyelocaliectasis with duplex Doppler sonography. Am J Roentgenol 2002; 153:997–1000.
16. Zaki S. Evaluation and management of urolithiasis. Med Today 2007; 5:54-60.
17. Kavakli HS, Koktener A, Yilmaz A. Diagnostic value of renal resistive index for the assessment of renal colic. Singapore Med J 2011; 52:271-80.

CONFLICT OF INTEREST
Authors declare no conflict of interest.
GRANT SUPPORT AND FINANCIAL DISCLOSURE
None declared.