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Research Article

RENAL RESISTIVE INDEX AS A PREDICTOR OF ACUTE HYDRONEPHROSIS IN PATIENTS WITH RENAL COLIC

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A B S T R A C T

Background: Urolithiasis remains a major health problem worldwide. Patients with renal colic are 33% to 68.3% risk of acute urinary obstruction (partial or complete) leading to hydroureteronephrosis. Our study was done to determine the sensitivity of the renal resistive index in diagnosing obstructive uropathy taking non-enhanced helical CT as the gold standard

Methods: This is a observational study done in Department of Urology, K.A.P.V. Government Medical College, Trichy from August 2015 - March 2017. During the study period, patients with unilateral loin pain to emergency department were evaluated with bilateral color Doppler Ultrasound and Plain CT KUB Reconstructed images. The Renal RI was calculated by subtracting the peak diastolic velocity from the peak. Renal RI >0.7 was considered diagnostic of obstructive uropathy. Delta RI >0.06 was taken as a diagnostic of obstructive uropathy.

Results: RI was found to be <0.7 in 96% (48%) of the 200 patients. Ureteric calculus was seen on CT scan in 32 (33.33%) of these patients. In 64 (67.7%) of these 96 patients, ureteric calculus was not seen on CT. The overall sensitivity of RI was 74.80% and specificity was 87.83%. The PPV of RI was 91.34% and NPV was 66.66%. The diagnostic accuracy of the test was 79.5%. Delta RI was found to be >0.06 in 104 (52%) patients. Calculus was seen on CT scan in 97 (93.26%) of these 104 patients. In the remaining of 7 (6.74%) of these 104 patients, calculus was not seen on CT. Delta RI was found to be <0.06 in 96 (48%) of the 200 patients. Calculus was seen on CT in 30 (31.25%). In 66 (68.75%) of these 96 patients, ureteric calculus was not seen on CT. By taking Delta RI value of >0.06 as a discriminatory level for obstruction, the overall sensitivity of DRI was 76.37% and specificity was 90.41%. The PPV of Delta RI was 93.26% and NPV was 68.75%. The diagnostic accuracy of the test was 81.5%.

Conclusions: Renal RI is less sensitive in diagnosing acute ureteric obstruction, as RI has been shown to be influenced by various factors. If Delta RI is applied, sensitivity and specificity in diagnosing complete ureteric obstruction will be increased.

INTRODUCTION

Urolithiasis remains a major health problem worldwide. Patients with renal colic are 33% to 68.3% risk of acute urinary obstruction (partial or complete) leading to hydroureteronephrosis. Renal duplex Doppler sonography would allow diagnosis by distinguishing obstructive dilatation from non obstructive dilatation or acute obstruction from the chronic form. Our study was done to determine the sensitivity of the renal resistive index in diagnosing obstructive uropathy taking non-enhanced helical CT as the gold standard.

Aim of the Study

To determine the diagnostic accuracy of renal arterial resistive index, delta resistive index and to compare renal RI and delta RI with CT KUB and find out sensitivity, specificity, positive predictive value, negative predictive value of the indices in the diagnosis of obstructive uropathy.

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MATERIALS & METHODS

This is a observational study done in Department of urology, K.A.P.V. Government Medical College, Trichy from August 2015 - March 2017. All patients from 20 - 60 years of age of either gender, with unilateral flank pain were included in this study after obtaining informed consent. Children under 15 years of age, >60 years of age, patients with bilateral flank pain, known cases of urolithiasis, pregnant patients and patients with CKD, HT, DM, CHD, Metabolic diseases, solitary kidney, transplanted kidney were excluded from this study.

It is an observational study to assess the value of Renal RI and Delta RI, with CT scan results as the gold standard for diagnosis of urolithiasis. Statistical methods used in this observational study are calculation of specificity, sensitivity, positive predictive value and negative predictive value of the test.

During the study period, patients with unilateral loin pain to emergency department were evaluated with thorough clinical history, physical examination, basic blood investigations, Xray KUB and abdominal USG. 200 patients were enrolled for this study and all were evaluated with bilateral color Doppler Ultrasound and Plain CT KUB Reconstructed images. CT scan results were taken as gold standard with which Doppler USG findings were compared.

The Renal RI was calculated by subtracting the peak diastolic velocity from the peak systolic velocity and dividing the result by the peak systolic velocity. Renal RI >0.7 was considered diagnostic of obstructive uropathy.

The difference in resistive index between the obstructed kidney and the normal contralateral kidney was taken as delta RI. Delta RI >0.06 was taken as a diagnostic of obstructive uropathy.

All patients subsequently underwent unenhanced CT KUB examination on the same day within 12 hours of the US examination. After analyzing the data, sensitivity, specificity, negative and positive predictive values and accuracy of Doppler US for obstructive uropathy was calculated by corresponding with CT KUB examination using 2/2 table.

RESULTS & OBSERVATIONS

Mean age of the patients in our study is 39.52 and standard deviation is 10.515. Minimum age of our study is 20 years and maximum age is 60 years with median age is 38 years. In our study out of 200 patients 130 patients were male and 70 patients were female. The male to female ratio was 65:35.

Ureteric calculus was noted on CT scan in 127 (63.5%) patients, and it was not present in 73 patients (36.5%). RI was found to be >0.70 in 104 (52%) patients. Calculus was seen on CT scan in 95 (91.34%) of these 104 patients, so these were True positive and constituted 47.5% of the total sample. In the remaining of 9 (8.66%) of these 104 patients, calculus was not seen on CT scan. These false positive patients constituted 4.5% of the total sample.

RI was found to be <0.7 in 96% (48%) of the 200 patients. Ureteric calculus was seen on CT scan in 32 (33.33%) of these patients, who were False negative and constituted 16% of the total sample. In 64 (67.7%) of these 96 patients, ureteric calculus was not seen on CT scan and the true negative constituted 32% of the total sample. By taking RI value of >0.70 as a discriminatory level for obstruction, the overall sensitivity of RI was 74.80% and specificity was 87.83%. The PPV of RI was 91.34% and NPV was 66.66%. The diagnostic accuracy of the test was 79.5%.

Other causes of loin pain seen on CT scan of 200 patients were appendicitis in 26 (13%), diverticulitis in 17 (8.5%), spondylolysis in 13 (6.5%), while no cause of pain was seen in 17 (8.5%).

Delta RI was found to be >0.06 in 104 (52%) patients. Calculus was seen on CT scan in 97 (93.26%) of these 104 patients and true positive constituted 48.5% of the total sample. In the remaining of 7 (6.74%) of these 104 patients, calculus was not seen on CT and false positives constituted 3.5% of the total sample. Delta RI was found to be <0.06 in 96 (48%) of the 200 patients. Calculus was seen on CT in 30 (31.25%) and false negatives constituted 15% of the total sample. In 66 (68.75%) of these 96 patients, ureteric calculus was not seen on CT and true negatives constituted 33% of the total sample. By taking Delta RI value of >0.06 as a discriminatory level for obstruction, the overall sensitivity of DRI was 76.37% and specificity was 90.41%. The PPV of RI was 93.26% and NPV was 68.75%. The diagnostic accuracy of the test was 81.5%

Corerelation of CT and Cdus RI Finding

CDUS RI	Calculus Present on CT	Calculus Absent on CT
>0.7	95 (TP)	9 (FP)
<0.7	32 (FN)	64 (TN)

Correlation of Cdus Delta RI with CT scan Findings

Delta RI	Calculus Present on CT	Calculus Absent On CT
>O.06	97 (TP)	7 (FP)
<0.06	30 (FN)	66 (TN)

CDUS RI Compared With Cdus Delta RI

	CDUS RI	CDUS DRI
SENSITIVITY	74.80%	76.37%
SPECIFICITY	87.83%	90.41%
PPV	91.34%	90.41%
NPV	66.66%	93.26%
DIAGNOSTIC ACCURACY	79.50%	81.5%

DISCUSSION

In this study patients presented with unilateral flank pain were initially evaluated with bilateral colour Doppler ultrasound. Renal resistivity index calculated for obstructed kidney and unobstructed contralateral kidney. Renal RI of >0.7 and delta RI of >0.06 were taken as a diagnostic obstructive uropathy.

In our study elevated RI of more than 0.7 was found to be 74.8% sensitive which is also comparable with results of Geavlete et at, and specificity of 87.83% comparable to Ashraf et al, Platt et al. Mean RI of our study found to be 0.7 (SD:0.0667) which is also comparable with results of Amin et al, Sauvian et al, Dee Toledo et al.

A majority of the patients in our study had taken NSAIDs before the Doppler examination. This also explains the overall low sensitivity of RI in our study. It is also important to state that the sensitivity and specificity of the RI varies with degree of obstruction. Data in the scientific literature confirm that this marker is more sensitive in the diagnosis of complete rather than partial obstructions.

RI is the useful prognostic marker for treatment and follow up of acute urinary tract obstruction. Patients with RI of >0.7 need prompt urinary track decompression to prevent irreversible damage. If we repeat the imaging after the decompression of the obstructive system, we can confirm the normalization of RI.

We were unable to investigate the shortest duration of acute renal obstruction that can cause elevation of RI, since most of our patients presented with renal colic of >6 h duration.

The most common reason for obtaining a normal RI in the presence of significant obstruction is a technical error. This can be corrected by the used of the correct scale (pulse-repetition frequency) to expand the wave form size to fill as much of the available display as possible.

A possible limitation of this study was that it did not include other causes of raised RI, like time-dependence and NSAID dependence factors. These factors need to be further evaluated in future researches so their effects on RI could be completely understood.

CONCLUSION

The conclusions of our study are:

1. Renal RI is less sensitive in diagnosing acute ureteric obstruction, as RI has been shown to be influenced by various factors like age, hydration status, time of presentation, degrees of obstruction, plasma renin level, pyelosinus extravasation, NSAID intake, iatrogenic factors (manual compression of transducer)
2. If Delta RI is applied, sensitivity and specificity in diagnosing complete ureteric obstruction will be increased.
3. CDUD is useful in pregnant patients, children, those with risk of contrast allergy and in follow up of recurrent stone patients to rule our new or residual obstruction.
4. Resistivity indices within the normal range did not rule out obstruction. Hence the renal sensitivity indices should not be interpreted in isolation.

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