THE CORRELATION OF RENAL RESISTIVE INDEX AND SERUM CREATININE IN PREDICTING RENAL FUNCTION IN ACUTE URETERAL OBSTRUCTION

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ABSTRACT

BACKGROUND

Early and accurate diagnosis of obstructive uropathy allows prompt and appropriate therapy, which is essential to minimise the devastating effects of urinary tract obstruction. The introduction of Duplex Doppler sonography can improve the clinical utility of ultrasonography. Doppler's ability to characterise altered waveforms in response to elevations of renal vascular resistance may be used to calculate the Resistive Index (RI).

Aim- To find the values of the renal resistive index before and after relief of obstruction and to correlate these values with the corresponding values of serum creatinine in prognosis of recovery of renal function in the acute obstructive uropathy.

MATERIALS AND METHODS

This quasi-experimental study was conducted on patients attending inpatient and casualty departments in tertiary care hospital from December 2015 to October 2017. A total of 30 patients with bilateral ureteric obstruction were prospectively evaluated by measurement of RI before drainage and at 3 days, 1 week, 2 weeks and 4 weeks after drainage. Serum creatinine was measured at all points of RI examination.

RESULTS

In our study, the mean RI values of 30 bilateral ureteric obstruction decreased significantly from 0.772 ± 0.032 to 0.634 ± 0.025 at 3 days after drainage (p= 0.001) which is significant and 0.630 ± 0.017 at 7 days after drainage (p= 0.59) which is not significant and stabilised thereafter. Serum creatinine decreased significantly 1.718 ± 0.080 before drainage to 1.395 ± 0.095 (p= 0.001) mg/dL 3 days after drainage and then to 1.124 ± 0.103 mg/dL (p= 0.001) 7 days after drainage, which is also significant and stabilised thereafter.

CONCLUSION

In the acute bilateral ureteric obstruction, the RI has a correlation with serum creatinine in early post intervention days but not in late post intervention days. A reversal of a previously elevated RI could be used as an early indicator for renal function recovery.

KEY WORDS

Doppler Ultrasound, Resistive Index, Renal Function, Serum Creatinine, Ureteric Obstruction.

HOW TO CITE THIS ARTICLE: Jadhav R, Agrawal N, Hosamani I, et al. The correlation of renal resistive index and serum creatinine in predicting renal function in acute ureteral obstruction. J. Evolution Med. Dent. Sci. 2018;7(42):4501-4504, DOI: 10.14260/jemds/2018/1004

BACKGROUND

Early and accurate diagnosis of obstructive uropathy allows prompt and appropriate therapy, which is essential to minimise the devastating effects of urinary tract obstruction on 'urinary tract structure and function.'[1] Ultrasonography remains a commonly used modality in the initial evaluation and diagnosis of the ureteric obstruction.

The introduction of Duplex Doppler sonography (DU) can improve the clinical utility of Ultrasonography in patients with urinary obstruction as it is non-invasive, easily available, portable and economical and without radiation hazard. It can be undertaken at the same time as that of ultrasonography and will be an additional diagnostic tool.

Functionally, significant obstruction of the upper urinary tract leads to a cascade of intrarenal cellular events that result in locally acting vasoactive factors, of which thromboxane A2, angiotensin II, endothelin and nitric oxide seem to be important. This series of events and the production of vasoactive mediators lead to increased renal vascular resistance.[2,3] This increase in renal vascular resistance may be detected indirectly as an increase in the resistive index of the affected kidney.[4]

Renal resistive index= (Peak systolic velocity - End diastolic velocity)/ Peak systolic velocity. The normal value is ≈ 0.60 with 0.70 being around the upper limits of normal.

Under normal homeostatic conditions, the renal circulation offers low impedance to blood flow throughout the cardiac cycle with continuous antegrade flow during diastole.[5] However, during conditions associated with

'Financial or Other Competing Interest': None.
Submission 29-08-2018, Peer Review 28-09-2018,
Acceptance 03-10-2018, Published 15-10-2018.
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DOI: 10.14260/jemds/2018/1004

increased renal vascular resistance, the decrease in renal diastolic blood flow is more pronounced than the decrease in the systolic component.[6] During extreme elevations of renal vascular resistance, diastolic flow may be non-detectable or may even show retrograde propagation.[7] Therefore, Doppler ability to characterise altered waveforms in response to elevations of renal vascular resistance may be used to calculate the resistive index and may possibly be used to discriminate among various pathophysiological conditions of the kidney.[8] This helps to delineate the significance of any RI elevation in terms of renal function and hence the need for surgical intervention.[9]

Aims and objectives of the study was to find the values of the renal resistive index before and after relief of obstruction and to correlate these values with the corresponding values of serum creatinine in prognosis of recovery of renal function in the acute obstructive uropathy.

MATERIALS AND METHODS

The quasi-experimental study was conducted prospectively on patients attending inpatient and casualty and in tertiary care hospital from December 2015 to October 2017. This is interventional study. All patients fulfilling the inclusion criteria, which includes age more than 18 and not known case of medical disorder like diabetes and hypertension were studied and recorded in the prescribed proforma for data collection with prior written consent from the patients. Ethical clearance was obtained from the Institutional Ethical Committee for the present study. A total of 30 patients with bilateral ureteric obstruction were prospectively evaluated by measurement of RI before drainage and at 3 days, 1 week, 2 weeks and 4 weeks after drainage. Serum creatinine was measured at all points of the RI examination. Sample size was taken for convenience during the study.

All patients coming with acute bilateral ureteric calculi with intervention for same.

Statistical Analysis

The statistical analysis of this study was carried out by paired 't' test, where p value < 0.05 was statistically significant and p value > 0.05 was statistically insignificant and p value < 0.01 was statistically highly significant. Software used was SPSS version 21.

RESULTS

In 30 patients with bilateral ureteric obstruction, 10 (50%) patients had undergone Double J (DJ) stenting only and 20 (50%) patients had undergone open ureterolithotomy and DJ stenting (Table No. 1 and Figure No. 1).

The mean RI values decreased significantly from before drainage 0.772 with standard deviation of 0.032 to 0.634 with standard deviation of 0.025 at 3 days after drainage (P=0.001) and 0.630 with standard deviation of 0.017 at 7 days after drainage (P=0.59) and stabilised thereafter (Table 2 and Figure 2). The mean value of serum creatinine before drainage was 1.718 with standard deviation of 0.080. At 3 days after drainage, the serum creatinine had decreased significantly to 1.395 with standard deviation of 0.095 (P=0.001). The serum creatinine continued to decrease significantly to 1.124 mg/dL with standard deviation of 0.103 at 7 days after drainage (P=0.001). No further significant change in serum creatinine was observed at 2 and 4 weeks after drainage (Table 3 and Figure 3).

Procedure	Number of Patients	% of Patients
DJ stenting	10	50.00
Open ureterolithotomy and DJ stenting	20	50.00
Total	**30**	**100.00**

Table 1. Procedure wise distribution of Patients, N= 30

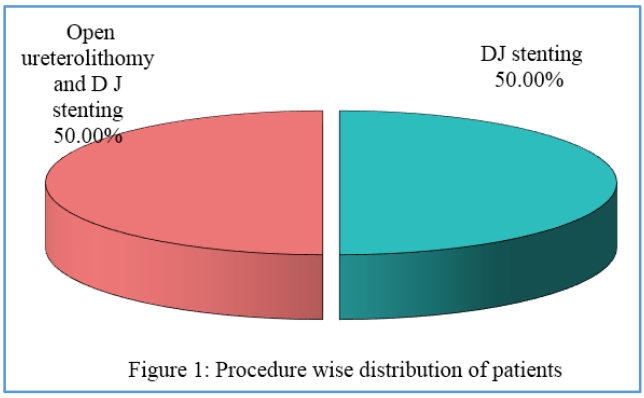

Figure 1: Procedure wise distribution of patients

Time Points	Mean	Std. Dv.	Mean Diff.	SD Diff.	% of Change	Paired t	P-value
Pre-op	0.772	0.032					
Day 3	0.634	0.025	0.138	0.042	17.90	15.4981	0.0001*
Pre-op	0.772	0.032					
Day 7	0.630	0.017	0.141	0.029	18.32	23.1286	0.0001*
Pre-op	0.772	0.032					
Day 14	0.631	0.031	0.141	0.046	18.26	14.4748	0.0001*
Pre-op	0.772	0.032					
Day 28	0.632	0.030	0.140	0.045	18.14	14.5116	0.0001*
Day 3	0.634	0.025					
Day 7	0.630	0.017	0.003	0.028	0.50	0.5361	0.5976
Day 3	0.634	0.025					
Day 14	0.631	0.031	0.003	0.041	0.43	0.3105	0.7592
Day 3	0.634	0.025					
Day 28	0.632	0.030	0.002	0.040	0.29	0.2128	0.8335
Day 7	0.630	0.017					
Day 14	0.631	0.031	0.000	0.037	-0.07	-0.0583	0.9541
Day 7	0.630	0.017					
Day 28	0.632	0.030	-0.001	0.036	-0.22	-0.1775	0.8608
Day 14	0.631	0.031					
Day 28	0.632	0.030	-0.001	0.004	-0.14	-1.0000	0.3287

Table 2. Comparison of Different Time Points with respect to Resistive Index Scores by Paired T-Test, N= 30

*p < 0.05

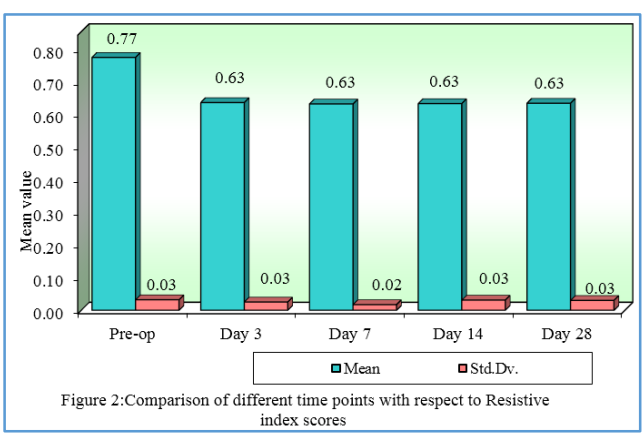

Figure 2:Comparison of different time points with respect to Resistive index scores

Time Points	Mean	Std. Dv.	Mean Diff.	SD Diff.	% of change	Paired t	P-value
Pre-op	1.718	0.080					
Day 3	1.395	0.095	0.323	0.061	18.78	24.7369	0.0001*
Pre-op	1.718	0.080					
Day 7	1.124	0.103	0.594	0.090	34.58	30.9586	0.0001*
Pre-op	1.718	0.080					
Day 14	1.109	0.111	0.609	0.092	35.45	31.0150	0.0001*
Pre-op	1.718	0.080					
Day 28	1.105	0.121	0.614	0.104	35.71	27.7501	0.0001*
Day 3	1.395	0.095					
Day 7	1.124	0.103	0.271	0.063	19.45	20.2629	0.0001*
Day 3	1.395	0.095					
Day 14	1.109	0.111	0.286	0.077	20.52	17.3464	0.0001*
Day 3	1.395	0.095					
Day 28	1.105	0.121	0.291	0.087	20.85	15.7217	0.0001*
Day 7	1.124	0.103					
Day 14	1.109	0.111	0.015	0.047	1.33	1.5041	0.1475
Day 7	1.124	0.103					
Day 28	1.105	0.121	0.020	0.050	1.74	1.8336	0.0809
Day 14	1.109	0.111					
Day 28	1.105	0.121	0.005	0.021	0.41	1.0000	0.3287

Table 3. Comparison of Different Time Points with respect to Creatinine Scores by Paired T-Test, N= 30

*p < 0.05

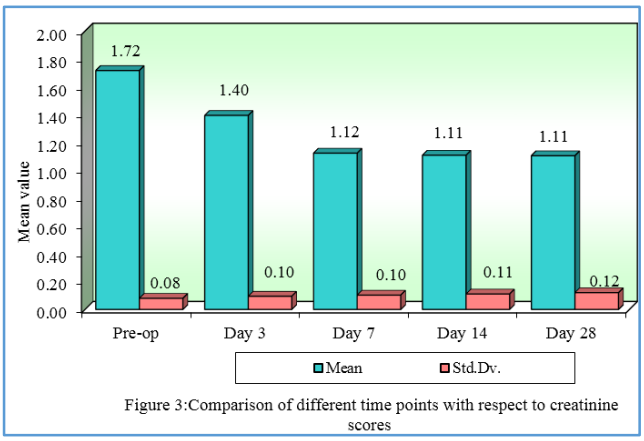

Figure 3:Comparison of different time points with respect to creatinine scores

DISCUSSION

Urinary tract stone disease has been a part of the human condition for millennia. Obstructive uropathy is usually associated with dilatation of the upper urinary tract**.** Early and accurate diagnosis of obstructive uropathy allows prompt and appropriate therapy, which is essential to minimise the devastating effects of urinary tract obstruction on urinary tract structure and function. The accurate prediction of the recoverability of kidney function after the release of obstruction is of great clinical value to the urologist and nephrologist. Doppler ability to characterise altered waveforms in response to elevations of renal vascular resistance may be used to calculate the resistive index.

In a study conducted by Shokier et al,[9] the difference between the mean RI values before and after drainage at day 3 was statistically significant (0.78 ± 0.05 versus 0.64 ± 0.06, P=0.001) with no significant change thereafter at day 7, 14 and 28. The serum creatinine before drainage at 3 days after drainage (P= 0.001), at 7 days after drainage (P= 0.001) with significant change in which 20% reduction was considered as significant change with no further significant change in serum creatinine observed at 2 and 4 weeks after drainage.

In 30 cases of bilateral ureteric obstruction, it was found that the mean RI values decreased significantly from before drainage 0.772 ± 0.032 to 0.634 ±0.025 at 3 days after drainage (P= 0.001) and 0.630 ± 0.017 at 7 days after drainage (P= 0.59) which is not significant and no significant change thereafter which was comparable with Shokier et al.[9]

Similarly, in 30 cases of bilateral ureteric obstruction, it was found that the mean value of serum creatinine before drainage was 1.718 ± 0.080. The serum creatinine had decreased significantly to 1.395 ± 0.095 (P= 0.001) at 3 days after drainage, which is significant. The serum creatinine continued to decrease significantly to 1.124 mg/dL ± 0.103 at 7 days after drainage (P= 0.001) with no further significant change in serum creatinine was observed at 2 and 4 weeks after drainage which is comparable with Shokier et al.[9]

This clinical study is to correlate RI elevations with markers of kidney function in the setting of obstruction. It helps to delineate the significance of any RI elevation in terms of renal function and hence the need for surgical intervention. Moreover, if a good correlation between RI and renal function holds true in the setting of chronic obstruction, this will help in the evaluation of a hydronephrotic kidney under surveillance by doing non-invasive DU, obviating the need for frequent isotope renography.

CONCLUSION

In the setting of acute complete ureteric obstruction, the RI has a correlation in early post intervention days and not in late post intervention days with serum creatinine. A reversal of a previously elevated RI could be used as an early indicator that recovery of renal function is likely.

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