Comparison Between Resistivity Index of Renal Artery in Normal Kidney and Calculi Obstructed Kidney

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Abstract:

Doppler ultrasonography has been informed to be able to differentiate between obstructive and non-obstructive renal disease. It has also been suggested that severe urinary obstructions may cause decrease in blood flow and increase in vascular resistance. Doppler measurement of the resistive index can detect these changes. Doppler ultrasound can determine intrarenal resistivity index (RI) in renal stone obstruction. RI values provide reliable cutoff values to compare the normal and obstructed kidney resistivity index.

Objective:

To compare the resistivity index of renal artery in normal kidney and calculi obstructed kidney.

Methods:

A total of 100 individuals were included in this study to compare the resistivity index of renal artery in normal kidney and calculi obstructed kidney.

Results:

A significant increase was found after the comparison between resistivity index of normal kidney and calculi obstructed kidney with significant p-value ($0.000 < 0.05$). The study showed that the obstruction causes increase in resistivity index as compared to normal kidney.

Conclusions:

It was concluded that calculi obstructed kidney causes prominent changes in the value of resistivity index as compared to the resistivity index of normal kidney.

Keywords:

Resistivity index**,** Renal Artery, Calculi obstructed kidney

Introduction

Doppler ultrasonography can determine intrarenal resistivity index in renal stone obstruction. Resistivity index (RI) values provide reliable cutoff values to compare the normal and obstructed kidney resistivity index[1]. Renal vascular resistance increases due to obstruction and causes drop in diastolic flow. The obstructed kidney wave form show predominant changes[2]. Doppler ultrasonography has been informed to be able to differentiate between obstructive and non-obstructive renal disease. It has also been suggested that severe urinary obstruction may cause decrease in blood flow and increase in vascular resistance[3].The intrarenal arterial impedance is measured by the resistivity index of RI by the following formula: ([PSV– EDV]/PSV). Ultrasound (US) is an extremely useful technique for examination of the urinary tract. The advantages of using a non-invasive test, which is painless and does not involve irritation to either patient or operator, are obvious[5]. US provide information about renal length which is used to estimate the renal mass and the presence or absence of hydronephrosis[6]. Renal sinus appears hyperechoic due the sinus fat of PCS which is surrounding the vessels. The main renal artery and vein should not be confused with a mild degree of PCS dilatation at the hilum of the kidney[7]. Doppler is helpful in the assessment of intrarenal vessels, the system set to detect low or moderate velocities, flow can be identified in almost all patients, in the vessels at renal hilum, particularly if the angle of incidence is optimized to achieve angles less than 60^0 relative to the course of vessels[8]. The main renal arteries are traced using anterior approach. The intrarenal vasculatures and renal arteries can also be imaged using flank approach[9].Renal arteries show a low resistance waveform pattern similar to the other parenchymal organs. To image the main renal artery the anterior approach is used[10]. The age and the area of sample is important factor in which resistivity index depends to calculate the values. In the hilar region, the value of main renal artery is higher (0.65 ± 0.17) as compared to the small distal arteries and minimum in the

interlobar arteries (0.54 ± 0.20). RI increases in the conditions like hypertension, tubular-interstitial disease etc. Intrarenal RI can also be evaluated in different nephrological issues, like in renal hypertension, advance renal damage leading to renal failure. The normal and pathological resistance to flow the value of RI 0.70 is used to differentiate [11]. In intrarenal arteries the RI is useful for diagnosis intrarenal vascular resistance and also monitors the successive increase of RI in obstruction above the upper limit of 0.70 [12].

The study conducted by A. Kmetec,D. Peskar-Babnik. shows the mean RI for the obstructed kidney remained above the discriminatory threshold (> 0.70) during the first 71 h of obstruction. Only in those obstructed for > 72 h was the mean RI on the obstructed side slightly below the threshold, but difference b/w the kidneys was significant. The measurement of RI is a reliable diagnostic method for detecting the acute renal obstruction.[12] A study conducted by MD Brian D.C. shows complete obstruction caused a significant increase in RI, partial obstruction failed to do so.[13] On the other hand study conducted by Sonali S Saboo, Sachin S Soni shows doppler sonography is a useful diagnostic tool in unilateral acute renal obstruction.[14] The importance of the current study is to identify the risk factors of the renal stones leading to the increased RI. After identification of the possible causes the researcher will try to educate the patients through health education for prevention and to decrease the renal stone morbidity in the society.

Methods:

A comparative study was conducted at Gilani ultrasound Center, opposite General Hospital Lahore. Sample size is 100.Non probability sampling procedure will be done. 100 patients were included after approval of synopsis from Institutional Review Board (IRB). Mindray DC-07 was used to compare the RI of normal kidney and calculi obstructed kidney. Renal artery was evaluated trans-abdominally at center/proximal/distal using curved array multi-frequency probe 2.5 to 5MHz. Data was tabulated and analyzed by SPSS version 21.0.

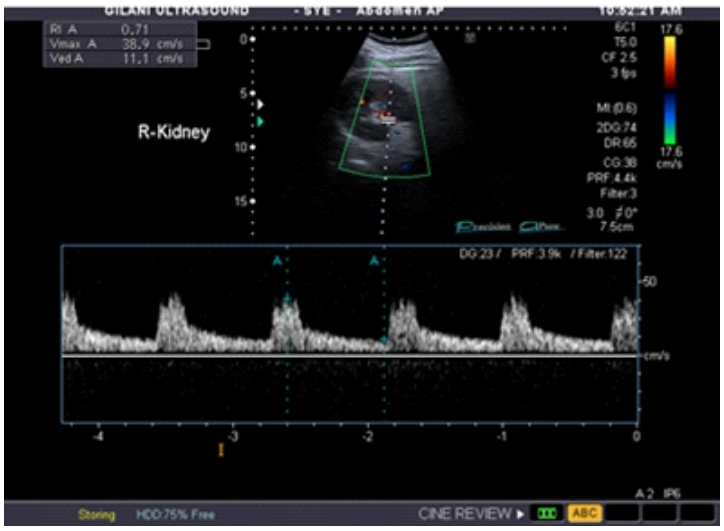

Figure 1: Resistivity Index due to calculi obstruction.

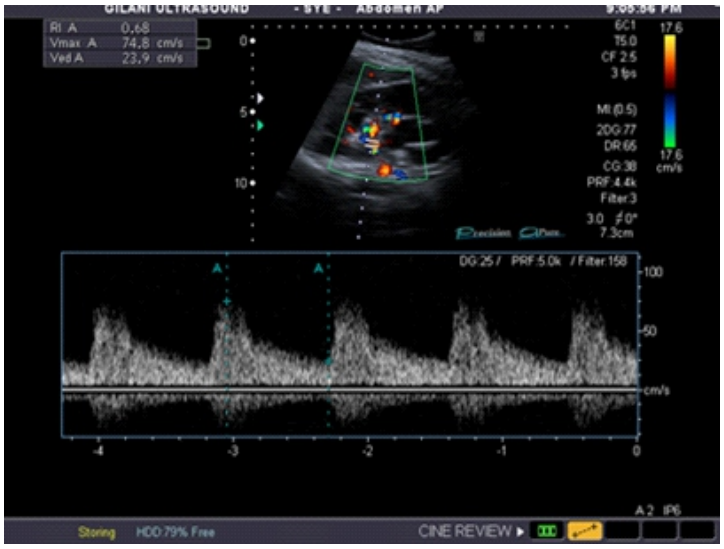

Figure 2: Resistivity Index due to calculi obstruction.

Figure 3: Resistivity Index pattern of normal kidney.

Results:

In this comparative study, 100 individuals were scanned, 50 were normal individuals and 50 individuals with calculi obstructed kidney. In normal individuals, the minimum age was 17 and maximum was 62 and the mean age was (33.76± 11.49) years. On the other hand, in individuals of calculi obstructed kidney, the minimum age was 18 and maximum was 65, and the mean age was 40 ± 11.98. In normal individuals, the mean ± SD RI was (0.588 ±0.040) and in calculi obstructed individual, the mean ± SD RI was (0.6236± 0.022) (Table-1 & Graph-1). The mean difference of RI of obstructed and normal kidney was 0.0356 with standard error of difference 0.0065 was found to be statistically significant as p-value is 0.000 < 0.05 (Table 1). As shown in the images the resistivity index is 0.71 and 0.68 is increased due to calculi obstruction (Figure & Figure 2). On the other hand normal kidney showed normal RI pattern (Figure 3). A significant increase was found after the comparison between RI of normal kidney and calculi obstructed kidney with significant p-value (0.000 < 0.05). The study showed that the obstruction cause increases in RI as compared to normal kidney.

	Group	N	Mean	Std. Deviation	Mean Difference	Std. Error Difference	t	p-value
RI	Obstructed	50	0.6236	0.04039	0.0356	0.00653	5.45	0.000
	Normal	50	0.588	0.02231			(76.36)	

Table 1: Mean Difference of RI

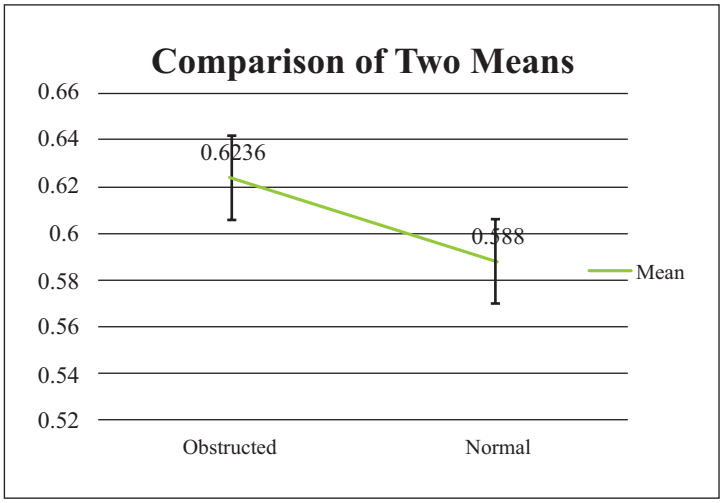

Figure 5: Graphical presentation on comparison of two means.

Discussion:

A significant difference between RI of renal artery in normal kidney and calculi obstructed kidney (0.000<0.05) was observed. The results showed significant difference between RI of renal artery in normal kidney and calculi obstructed kidney. There are few researches on the RI related to the renal calculi whereas literature shows studies on RI and RAS, therefore, it will have positive impact on patient treatment and benefits. This is very interesting and is quite similar to many earlier studies such as Granata A et al. who found in renal obstruction RI value provide a reliable source to differentiate between normal and pathological resistance to flow[15]. The study is also proved that caluli obstruction caused increased resistivity index. All the previous studies showed obstruction caused increase in resistance to flow[16,17]. It also provided reliable cutoff value to differentiate between normal and pathological resistance to flow[18,19]. The results also proved that obstruction caused an increase in RI of renal artery and provided a reliable value to differentiate normal and pathological resistance to flow.

Conclusions:

It was concluded that calculi obstructed kidney caused prominent changes in the value of resistivity index as compared to the resistivity index of normal kidney. The effect of obstruction has caused elevation of resistivity index pattern.

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