

Resistive Index of Intrarenal Vessels in Patients with Ureteric Calculi

Noor Kathem Al-Waely¹, Noorabbashummadi¹, Khaldoon Raheem Khudhair²

¹Ph.D. Lecturer, ²Researcher, College of Medicine, Al-nahraine University, Iraq

Abstract

Background: Urolithiasis is a common health problem with potential harmful effects on the renal parenchyma if inappropriately addressed. Doppler US is a non-invasive imaging modality with the potential to better characterize obstructive uropathy than grey scale US. **Objective:** to evaluate the Doppler ultrasound findings in patients with renal ureteric calculi and correlate them with other US findings related to obstruction by the calculus.

Method: This analytic cross-sectional study was conducted in the ultrasound unit at the Consultation Center/ Al-Nahrain Medical College for the period from September 2017 to January 2018. A net of thirty five patient with renal stones were enrolled in the study. Greyscale and Doppler US were performed for both the affected and the contralateral sides. Certain US and Doppler findings were evaluated.

Results: 13 (37.15%) of our patients had mild, 13 (37.15%) moderate and 9 (25.7%) severe hydro nephrosis. The average of RI that considered affect the kidney was 0.68, and non-congested kidney was 0.56.

Conclusion: In patients with acute renal colic we use Gray scale sonography with Doppler US in diagnosis of renal stones.

Keywords: Renal colic, ureteric stones, Doppler US, Obstruction, Resistive index.

Introduction

Urolithiasis is usual urological problems, renal colic is usual complain face urologist in practice ⁽¹⁾. Obstructive uropathy is define as blockage of usual urine flow at some parts of urinary tract, the evidence of blockage diagnosed by US depend on the anatomical measurement of dilation of the pelvicalyceal system and ureter near the point of obstruction, scintigraphy has more direct evidence of diagnosis of obstruction, but Doppler US nowadays have more functional data in assumed renal obstruction ⁽²⁾. Obstruction lead to high pressure inside urinary tract, causing physical and physiologic

alterations, obstructive nephropathy lead to permanent loss of renal task ⁽²⁾. The pain occur when stone become in ureter or renal pelvic is sever recurrent that radiated to flank and groin and inner thigh, this colic associated by urgency, blood in urine, sweating, nausea and vomiting with agitation⁽³⁾. Stone that found in upper and mid part of urinary tract lead to sever pain in back or flank region, this pain is become very sever when the stone pass down the ureter and cause temporary obstruction, and the pain become less sever when the stone sited in a specific site if there is incompletely obstructive ⁽³⁾. When the stone at lower part of ureter lead to groin or testicular pain in male or labia majora pain in female, this occur due to damage to olio inguinal or genital branch of the genitofemoral nerves ⁽³⁾. CT scan is very effective in the early diagnosis, management scheduling and follow up of patients with urolithiasis ⁽⁴⁾. Non-contrast CT have more benefit than basic radiography and ultrasoundsensitivity (>95%) and specificity (>96%) for diagnosis and detection of stone. It is faster to diagnosis

Corresponding Author:

Dr. Noor Kathem Al-Waely

Ph.D. Lecturer, College of Medicine, Al-nahraine University, Iraq

e-mail: qaisajam1981@gmail.com

and not need to give intravenous contrast^(5,6,7). US use in the emergency unit can be helpful in diagnosis and avoid CT lead to decrease aggregate radiation mount without any complication, pain levels and hospitalization⁽⁸⁾. More stone can diagnosed by US as hyperechogenic foci with posterior shadowing (Figure 1). US cannot detect

small stone < 5mm, due to loss of posterior shadowing, in med ureter the stone not diagnose whatever their size can be concealed by superimposing intestinal loops and gas more likely in obese patients also due to vascular calcifications, clots⁽⁹⁾. The accuracy of US in diagnosis renal stones depend on size and place of these stones⁽¹⁰⁾.

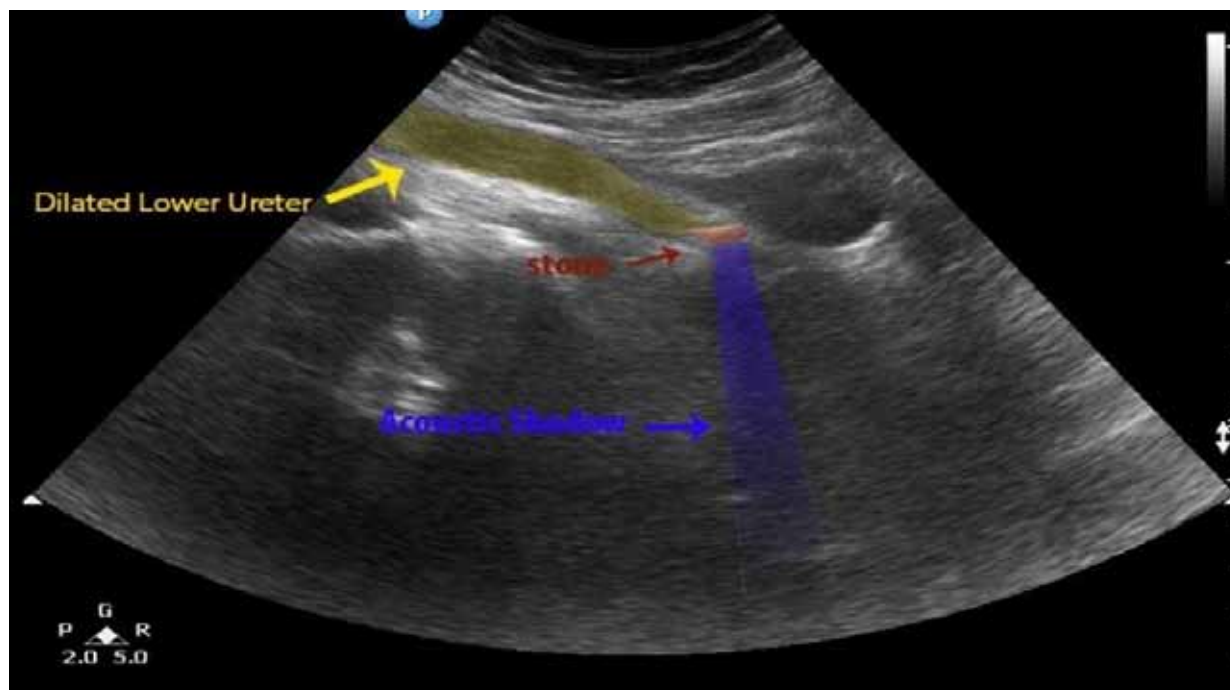


Figure 1: Ureteric stone seen as echogenic foci with posterior shadowing⁽⁸⁾

The RI is defined as: (peak systolic velocity – lowest diastolic velocity)/peak systolic velocity. When resistance become high in distal vessels this lead to decrease in diastolic flow and lead to increase of RI and vice versa⁽¹¹⁾. A plain abdominal (KUB) film can identify large radiopaque calculi. However, smaller calculi and/or radiolucent stones may go undetected. Obstruction/hydronephrosis cannot be adequately assessed⁽¹⁰⁾. **Aim of study** :to evaluate the Doppler ultrasound findings in patients with renal ureteric calculi and correlate them with other US findings related to obstruction by the calculus.

Method

This analytic cross-sectional study was conducted in the ultrasound unit at the Consultation Center/Al-Nahrain Medical College for the period from September 2017 to January 2018 A net of thirty five patient with renal colic were enrolled in the study.

Inclusion Criteria: All adult patients with renal colic suspected of having ureteric stones and referred to the US unit in AL-Nahrain Medical College consultation center who have definite uerteric calculus detected either through the US exam or by other imaging modalities (mainly CT).

Exclusion Criteria: Patient with contralateral renal or ureteric stones, patients with ipsilateral renal stones, patients with chronic illnesses that may affect the hemodynamics of intrarenal vessels (hypertension, DM, advanced atherosclerotic disease).

Examination technique: brief clinical data were retrieved from the patient prior to scanning including the side, duration of colic and the presence of associated symptoms. Notes were made regarding whether the patient had performed any other imaging tests prior to ultrasound referral (KUB or CT) and their results were evaluated .All patients included in the study were

examined by grey scale ultrasound using Logiq P6 pro ultrasound machine (GE healthcare, USA) utilizing the convex ultrasound probe with a frequency of 3.5 MHz . Patients were first examined in the supine position and lateral decubitus positioning was performed as necessary. Both the affected and the contralateral kidneys were evaluated for size (normal or enlarged) degree of hydronephrosis (mild, moderate or severe) and if visible the stone was evaluated for maximum dimension and site (upper, mid, lower ureter or VUJ) . Doppler interrogation was performed afterwards. Both arcuate and interlobar arteries in the affected and the contralateral kidneys were evaluated by pulsed Doppler imaging during attempted breathhold and after adequate patient positioning, three measures for each reading were taken and the average was recorded. Thereafter the urinary bladder was evaluated by color Doppler to detect

the presence or absence of ureteric jet at the side of ureteric stone. Statistical analysis was done using SPSS Software V24. Data were presented in tables and cross-tables and graph design (pie charts). P-value < 0.05 is significant.

Results

The study sample included 35 patients presented with ureteric stones. (51.4%) of the patients were males and (48.6%) were females. Age range of these subjects was 10-60 years. Most (71.4%) of the patients included in the study were below 40 years.

We had 22 patients (62.9%) presented within 5 days of their complaint. On the other hand, a significant proportion of patients (37.1%) had delayed presentation after 5 days (table 1).

Table 1: Duration of symptoms (days)

Duration of colic					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	<5	22	62.9	62.9	62.9
	5-10	7	20.0	20.0	82.9
	>10	6	17.1	17.1	100.0
	Total	35	100.0	100.0	

Regarding the size of the stone 37.1% of patients had stones sized 5-10 mm, 34.3% of patients had stone within the size range of 10-15 mm (table 2)

Table 2: Size of stone

	Frequency	%
<5	1	2.9
5-10	13	37.1
11-15	12	34.3
>15	9	25.7
Total	35	100.0

Most of the stones were within the upper part of the ureter 34.3%, slightly lower percent were within the lower ureter (31.4%) with equal proportion found within the midrate and VUJ (17.1%)

Slightly higher percent of the affected kidneys (51.43 %) were enlarged in size. Only 28.6% of the affected kidneys had reduced cortical thickness. Hydro nephrosis with variable grades was present in all affected kidneys (table 3).

Table 3: Hydro nephrosis grade

	Frequency	%
Mild	13	37.1
Moderate	13	37.1
Sever	9	25.7
Total	35	100.0

Evaluating the ureteric jet revealed it was present in 20 out of 35 cases (57.1%) .The mean RI of arcuate arteries in the affected kidneys was (0.69) compared with the mean RI in the contralateral normal kidneys (0.57) .Likewise, the mean RI of interlobar arteries in the affected kidney (0.68) compared to the mean RI of interlobar arteries in the contralateral kidney (0.57) Taking 0.68 value as a cutoff between normal and abnormal RI the sensitivity of the RI in arcuate arteries and interlobar arteries as a marker of ureteric obstruction by stones were 95% and 94.4% respectively. The specificity of RI in arcuate and interlobar arteries were 68% and 65.4% .No significant correlation between the mean RI of the arcuate arteries and the following parameters.

RI of arcuate vs. grade of hydro nephrosis P value=0.73. RI of arcuate vs. size of the stone P value =0.43. Likewise, no significant correlation between the mean RI of the interlobar arteries and the other parameters evaluated in the study. RI of interlobar vs.

grade of hydro nephrosis P value=0.95. RI of interlobar vs. size of the stone P value =0.11. RI of interlobar vs. site of the stone P value =0.74. The only significant association was between RI of arcuate arteries and site of the stone as in table 4.

Table 4: Association of RI within arcuate arteries with the site of the stone

		Site of stone				Total
		VUJ	Lower ureter	Upper ureter	Mid ureter	
Mean RI (arcuate aa) of affected side	≤0.68	2	8	6	0	16
	>0.68	4	3	6	6	19
Total		6	11	12	6	35

P value = 0.033 (significant).

Discussion

Hydro nephrosis Pyelocaliectasis: can be define as obstruction or blockage of urinary tract under US examination 13 (37.15%) of total patients with mild, 13(37.15%) moderate and 9 (25.7%) severe hydro nephrosis. In our study no one of patients with absence of hydronephrosis. Contrast to another study done by Platt JF et al. ⁽¹²⁾, showed that 30% of patients had no dilation and with obstruction. This difference from our study is due to late presentation and variable degree of obstruction cause by stone, 1 (2.9%) of patients with <5 mm size of obstruction, and max. size in current study was 22 mm. The site of the obstructing calculus was upper ureter in 12 (34.3%) of our patients, lower ureter in 11 (31.4%), mid ureter in 6 (17.1%) and VUJ in 6 (17.1%).

Sensitivity: The sensitivity of Resistivity Index in predicting ureteric obstruction was 95% .92% sensitivity have documented by Platt et al. ⁽¹²⁾by use US (RI) in diagnosis of obstruction, while another study done by Haroun A ⁽¹³⁾ stated that sensitivity was 64 %. In current study RI of obstruction and blocked kidney was 0.68 and non- obstructed was 0.56. this 2 values was within normal range (≤ 0.68) with significant difference, only 54.28% of patients had obstruction present with high RI,Platt et al. ⁽¹²⁾ showed the mean of RI (0.77 ± 0.05) in patients with obstructed kidney (acute or chronic). So this results revealed that RI was elevated due to renal and non-renal diseases (>0.7). the cause of decrease of RI in our study was 34.2% of patients had obstruction with elevated RI > 0.71 . Cronan JJ et al.⁽¹⁴⁾ showed that only 37% of patients with any levels of obstruction diagnosed

by RI by used US. So the differences between studies is due to change in degree of obstruction and vasodilatation and then vasoconstriction may not happen reliably in clinical exercise. In some patients with renal colic the obstruction is irregular so RI supposedly not raise even this irregular obstruction continue. The hemodynamic variations in congested kidneys were intrarenal rather than general measures ⁽¹⁴⁾.RI in control group was < 0.68 in all patients.

Conclusion

In patients with acute renal colic we use Gray scale sonography with Doppler US in diagnosis of renal stones.

Ethical Clearance: The Research Ethical Committee at scientific research by ethical approval of both environmental and health and higher education and scientific research ministries in Iraq

Conflict of Interest: The authors declare that they have no conflict of interest.

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