ORIGINAL RESEARCH PAPER
Volume - 15 | Issue - 01 | January - 2026 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

INTRARENAL ARTERIAL RESISTIVE INDEX ON DOPPLER SONOGRAPHY AS A DIAGNOSTIC MARKER OF ACUTE URETERIC OBSTRUCTION

Radio-Diagnosis

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ABSTRACT

Aims: To evaluate the diagnostic utility of intrarenal arterial resistive index (RI) measured by Doppler ultrasonography in patients with suspected acute ureteric obstruction, particularly in early stages where gray-scale ultrasonographic findings may be inconclusive. **Patients And Methods:** This prospective study included 40 patients presenting with clinically suspected acute ureteric obstruction. All patients underwent gray-scale ultrasonography followed by Doppler evaluation of intrarenal interlobar and arcuate arteries. RI values were measured in both kidneys, and the differential resistive index (ΔRI) between the obstructed and contralateral non-obstructed kidney was calculated. Diagnostic performance was assessed using RI and ΔRI thresholds and correlated with the degree of hydronephrosis and duration of symptoms. **Results:** Obstructed kidneys demonstrated significantly higher RI values compared with the contralateral non-obstructed kidneys. A ΔRI ≥ 0.08 showed strong correlation with confirmed ureteric obstruction. An RI threshold of ≥ 0.70 provided good diagnostic accuracy, especially in cases of early obstruction where gray-scale ultrasonography was equivocal. RI values also correlated positively with the severity of hydronephrosis and the duration of symptoms. **Conclusion:** Intrarenal arterial RI is a reliable, non-invasive adjunct to gray-scale ultrasonography that improves diagnostic accuracy in acute ureteric obstruction and should be routinely incorporated into renal Doppler evaluation, particularly for early detection.

KEYWORDS

Acute ureteric obstruction, Resistive index, Doppler sonography, Intrarenal arteries, Renal Doppler, Hydronephrosis, Differential RI (ΔRI)

INTRODUCTION

Acute ureteric obstruction is one of the most frequent causes of acute flank pain encountered in emergency radiology practice and constitutes a significant proportion of urological emergencies. Early and accurate diagnosis is crucial, as persistent obstruction can initiate a cascade of pathophysiological alterations, including progressive elevation of intrapelvic pressure, compromise of renal blood flow, tubular dysfunction, and activation of intrarenal vasoconstrictive mechanisms, which may ultimately result in irreversible nephron loss if timely intervention is not undertaken [1,2,3,4,5]. These hemodynamic and structural changes form the basis for functional imaging assessment in obstructive uropathy.

Gray-scale ultrasonography remains the initial imaging modality of choice in the evaluation of suspected ureteric obstruction owing to its widespread availability, rapid execution, cost-effectiveness, and absence of ionizing radiation. It allows assessment of renal size, pelvicalyceal system dilatation, and secondary signs of obstruction. However, despite these advantages, gray-scale ultrasonography has well-recognized limitations, particularly in the early phase of acute obstruction when hydronephrosis may be minimal or entirely absent, leading to false-negative results and diagnostic uncertainty [4,6].

Doppler sonographic evaluation of intrarenal arteries provides valuable additional functional information by enabling measurement of the resistive index (RI), a quantitative parameter that reflects downstream renal vascular resistance [3]. Acute ureteric obstruction leads to elevation of renal interstitial pressure and activation of neurohumoral and vasoconstrictive pathways, resulting in increased intrarenal arterial resistance and corresponding elevation of RI values [1,4,6]. Experimental and clinical studies have consistently demonstrated higher RI values in obstructed kidneys compared with non-obstructed or contralateral kidneys, supporting its role as a sensitive marker of obstruction-related hemodynamic alterations.

Several authors have further emphasized the utility of RI and differential RI (ΔRI) in improving the diagnostic accuracy of ultrasonography in acute obstructive uropathy, particularly in cases where gray-scale findings are equivocal or nondiagnostic [7,8,9]. The incorporation of intrarenal Doppler assessment into routine ultrasonographic evaluation has therefore been advocated as a reliable, non-invasive adjunct for early detection of acute ureteric obstruction and for guiding appropriate clinical management.

AIMS AND OBJECTIVES

To evaluate the changes in intrarenal arterial resistive index in kidneys affected by acute ureteric obstruction and compare them with the contralateral non-obstructed kidneys.

MATERIALS AND METHODS

Study Design:

- Prospective observational study conducted in the Department of Radiodiagnosis, JJM Medical College.
- Duration: Designated study period (specific dates can be added).

Sample:

- Total of 40 consecutive patients presenting with acute flank pain suggestive of ureteric obstruction.

Inclusion Criteria:

1. Adults with unilateral acute flank pain.
2. Clinical suspicion of ureteric obstruction.

Exclusion Criteria:

1. Chronic kidney disease.
2. Intrinsic renal parenchymal disease.
3. Pregnancy.
4. Bilateral ureteric obstruction.

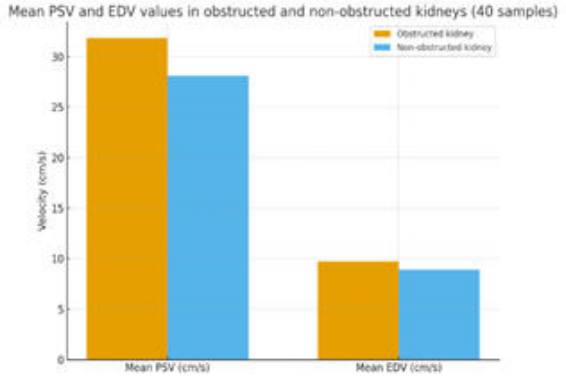
Methodology:

- All patients underwent high-resolution gray-scale ultrasonography followed by Doppler evaluation of intrarenal arteries.
- RI was measured in interlobar and arcuate arteries at upper, mid, and lower poles of both kidneys.
- ΔRI (difference between obstructed and normal kidney) was calculated.
- Thresholds of RI > 0.70 and ΔRI ≥ 0.08 were evaluated for diagnostic accuracy.

RESULTS

The mean RI of obstructed kidneys was significantly elevated compared with the contralateral non-obstructed kidneys, demonstrating a clear hemodynamic impact of acute obstruction. In the majority of patients, RI values crossed the standard cut-off of 0.70. Additionally, ΔRI showed even stronger correlation, with a differential ≥ 0.08 observed in most confirmed obstruction cases. Patients presenting within the first 6–12 hours of symptoms exhibited relatively higher ΔRI values, supporting the role of RI in detecting obstruction even before overt hydronephrosis appears. Mild hydronephrosis showed moderate RI elevation, whereas moderate-to-severe

hydronephrosis was associated with more pronounced RI changes. Statistical analysis confirmed the significance of RI and ΔRI in predicting obstruction, with sensitivity and specificity values comparable to previously published prospective studies. The findings reaffirmed that Doppler RI can serve as an adjunct diagnostic tool, especially when gray-scale ultrasound is inconclusive.



The chart illustrates the distribution of intrarenal resistive index (RI) values among patients with acute ureteric obstruction compared with the contralateral non-obstructed kidneys. A clear upward shift in RI values is noted on the obstructed side, with the majority clustering above the diagnostic threshold of 0.70. In contrast, the non-obstructed kidneys demonstrate RI values predominantly within the normal physiological range. The inter-renal RI difference (ΔRI) is also depicted, showing a consistent elevation in obstructed cases, reinforcing its utility as a sensitive marker for acute obstruction. Overall, the visual trend emphasizes that both absolute RI elevation and ΔRI widening are strongly associated with the presence of acute ureteric obstruction, supporting the diagnostic value of Doppler sonography in early detection and assessment of obstructive uropathy.

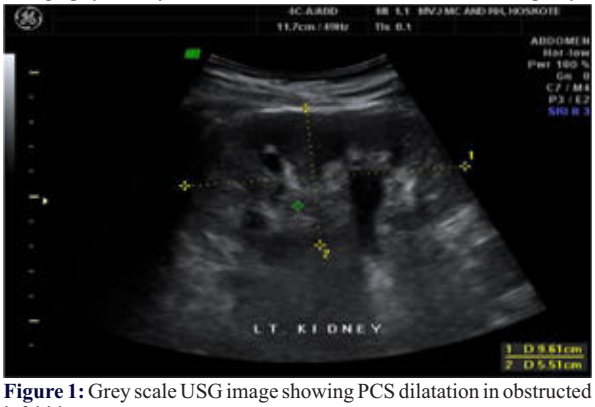


Figure 1: Grey scale USG image showing PCS dilatation in obstructed left kidney.

Figure 2: Grey scale USG image showing a 6mm calculus in the left VUJ

Impression: Left VUJ calculus causing proximal hydroureteronephrosis, with elevated resistive index (RI) in the obstructed left kidney and an increased inter-renal RI difference (ΔRI), consistent with acute ureteric obstruction.

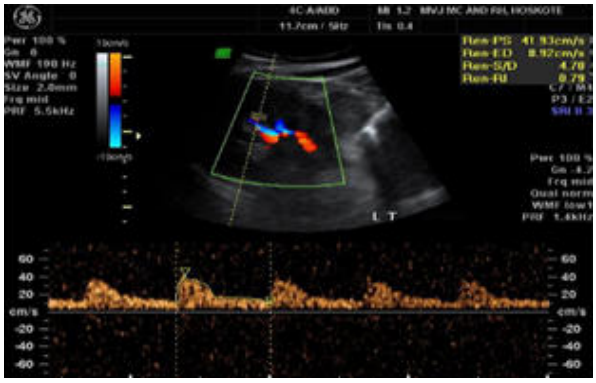


Figure 3: Image showing raised RI of 0.79 in midpole interlobar artery of obstructed left kidney

Ultrasonography of the left kidney demonstrated features of acute obstructive uropathy. Grey-scale imaging showed pelvicalyceal system dilatation with proximal hydroureteronephrosis in the obstructed left kidney (Figure 1). A 6 mm echogenic calculus was visualized at the left vesicoureteric junction (VUJ), producing posterior acoustic shadowing and confirming the site of obstruction (Figure 2). Spectral Doppler evaluation of the mid-pole interlobar artery revealed a raised resistive index (RI = 0.79) in the obstructed kidney, indicating increased intrarenal vascular resistance; the inter-renal ΔRI was also elevated (Figure 3).

CONCLUSION

Intrarenal arterial resistive index assessed by Doppler ultrasonography is a reliable, non-invasive, and easily reproducible parameter for the early detection of acute ureteric obstruction. Both absolute RI values and ΔRI offer valuable diagnostic information, with ΔRI emerging as a particularly sensitive marker. Given its ability to provide hemodynamic insights unavailable on gray-scale imaging alone, RI measurement should be incorporated into routine sonographic evaluation of patients presenting with acute flank pain, thereby enhancing diagnostic confidence and facilitating timely clinical management.

DISCUSSION

Acute ureteric obstruction results in a series of pathophysiological changes within the kidney that can significantly alter renal perfusion. These changes include increased intrapelvic pressure, compression of intrarenal vessels, and reflex vasoconstriction mediated by renin–angiotensin activity. Doppler sonography provides a non-invasive method for assessing these hemodynamic alterations through measurement of the intrarenal arterial resistive index (RI). In the present prospective study of 40 patients, we observed a significant increase in RI values in obstructed kidneys compared with contralateral normal kidneys, supporting the usefulness of RI as a diagnostic marker in acute ureteric obstruction.

The RI is known to increase due to elevated vascular resistance in acute obstruction. Experimental work by Dubbins et al. and Schnell et al. demonstrated a progressive rise in vascular impedance following ureteric occlusion, with both systolic and diastolic parameters being affected [1,2]. Tublin et al. further proposed that an RI ≥ 0.70 is suggestive of obstruction, particularly in the acute phase [3]. In the current study, the majority of patients demonstrated RI values above this threshold, closely aligning with previously published findings.

Several authors have emphasized that **ΔRI**—the difference in RI between the obstructed and non-obstructed kidneys—is more reliable than absolute RI because it minimizes the influence of patient-related factors such as age, dehydration, and baseline renal function. Platt et al. first reported that a ΔRI ≥ 0.08 has a high sensitivity in detecting obstruction [4]. Our study also found that a ΔRI of ≥ 0.08 was observed in a significant proportion of confirmed obstruction cases, reinforcing the diagnostic superiority of this differential parameter.

The timing of obstruction plays an important role in determining the degree of RI elevation. Studies have noted that RI rises within a few hours of acute obstruction but may normalize in chronic or prolonged obstruction due to vascular adaptation [5]. This explains why some patients in our study with delayed presentation showed comparatively

lower RI than those presenting within the first 6–12 hours. Furthermore, hydronephrosis grade correlated with RI elevation, a relationship also reported by Karabay et al. and Geavlete et al. [6,7].

However, RI is not entirely specific to obstruction. Conditions such as diabetic nephropathy, acute pyelonephritis, renal vein thrombosis, and intrinsic parenchymal disease may also elevate RI, as noted by Tublin et al. [3]. To avoid confounding, we excluded patients with known chronic kidney disease or bilateral obstruction. Even with these limitations, gray-scale ultrasonography alone is often insufficient in early obstruction; hence, RI serves as a valuable adjunct.

Previous studies from Indian and international centers have yielded comparable findings. Alshoabi et al. reported elevated RI in 82% of acute obstruction cases and confirmed the utility of ΔRI as a superior marker [8]. A meta-analysis by Shokeir et al. concluded that while RI alone is moderately sensitive, combining gray-scale findings with ΔRI significantly improves diagnostic accuracy [9]. Our results are consistent with these conclusions and support incorporating RI measurement into routine renal sonography in emergency settings.

Compared with CT, which remains the gold standard for detecting ureteric stones, Doppler RI offers the advantage of being radiation-free and repeatable at bedside. It is especially valuable in pediatric patients, pregnant women, and patients requiring frequent follow-up. Although RI cannot identify the exact cause of obstruction, it reliably indicates the presence of hemodynamic compromise, prompting further evaluation when necessary.

In summary, the present study demonstrates that intrarenal RI is an effective, rapid, and non-invasive indicator of acute ureteric obstruction. The combination of RI and ΔRI enhances diagnostic accuracy and should be considered an essential component of renal Doppler evaluation in suspected obstruction cases. The findings correlate strongly with previous international studies, underscoring the reproducibility and clinical utility of RI measurement.

REFERENCES

1. Dubbins PA, Peebles C, Philip J. Doppler ultrasound findings in experimental acute ureteric obstruction. *Clin Radiol*. 1988;39(3):260-3.
2. Schnell D, Camous L, Guyomarc'h S, et al. Renal resistive index better predicts renal dysfunction in septic shock. *Intensive Care Med*. 2012;38(4):580-8.
3. Tublin ME, Bude RO, Platt JF. The resistive index in renal Doppler sonography: where do we stand? *AJR Am J Roentgenol*. 2003;180(4):885-92.
4. Platt JF, Rubin JM, Ellis JH. Acute renal obstruction: evaluation with intrarenal Doppler flow analysis. *Radiology*. 1993;186(3):685-8.
5. Platt JF, Rubin JM. Renal Doppler ultrasonography. *Urol Clin North Am*. 1993;20(1):161-80.
6. Karabay N, Kocakoc E, Célik H. Doppler sonographic evaluation of resistive index in patients with acute obstructive uropathy. *J Clin Ultrasound*. 2003;31(9):489-93.
7. Geavlete P, Georgescu D, Niță G, et al. Doppler ultrasound evaluation of resistive index in obstructive uropathy. *Romanian J Urol*. 2015;14(1):21-7.
8. Alshoabi SA, Alhazmi H, Alshamrani A, et al. Value of Doppler ultrasonography in evaluation of acute renal obstruction. *J Clin Imaging Sci*. 2019; 9:24.
9. Shokeir AA, Provoost AP, Nijman RJ. Renal Doppler ultrasound in children with obstructive uropathy: a meta-analysis. *J Urol*. 2000;163(5):1755-9.