RESEARCH ARTICLE ISSN: 2349-2678

Contents lists available at www.ijpba.in

International Journal of Pharmaceutical and Biological Science Archive

NLM (National Library of Medicine ID: 101738825)

Index Copernicus Value 2019: 71.05

Volume 10 Issue 1; January-February; 2022; Page No. 95-98

Correlating Renal Parenchymal Thickness and Renal Resistive Index with Renal Function in the Obstructed Urinary System

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Conflicts of Interest: Nil

Conflicts of Interest: Nil

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ABSTRACT

Renal obstruction is a significant cause of renal dysfunction, and timely diagnosis and management are critical to prevent irreversible damage. The renal parenchymal thickness (RPT) and renal resistive index (RI) are two important parameters in evaluating renal function in obstructed urinary systems. This study investigates the correlation between RPT, RI, and renal function in patients with obstructed urinary systems, aiming to determine whether these parameters can serve as reliable markers for renal impairment. Results indicate a significant inverse relationship between RPT and renal function, as well as a positive correlation between RI and renal dysfunction, suggesting their potential as diagnostic and prognostic tools in clinical practice.

Keywords: Renal Parenchymal Thickness, Renal Resistive Index, Renal Function, Obstructed Urinary System, Ultrasound, Renal Impairment, Renal Obstruction, Diagnostic Biomarkers, Urology, Chronic Kidney Disease, Nephrology, Obstructive Uropathy.

Introduction

Renal obstruction is one of the leading causes of chronic kidney disease (CKD) and acute kidney injury (AKI), affecting kidney function through increased intrarenal pressure, impaired filtration, and subsequent fibrosis. (1) Early detection and monitoring of renal obstruction are critical for preventing permanent damage. Among various diagnostic tools, ultrasound imaging remains a non-invasive, accessible method to evaluate renal function and structure.(2)

Renal parenchymal thickness (RPT) and renal resistive index (RI) are key parameters that provide insight into renal pathology. RPT, measured using ultrasound, reflects the degree of renal parenchymal atrophy, often seen in long-standing obstructive uropathy. (3) On the other hand, RI, calculated from Doppler ultrasonography of the renal artery, is a marker of renal vascular resistance and can indicate impaired renal perfusion, often associated with obstructive conditions.(4)

This study explores the relationship between these two parameters—RPT and RI—and their correlation with renal function in patients with obstructed urinary systems, aiming to assess their utility as markers for renal impairment.

Aim

The primary aim of this study is to evaluate the correlation between renal parenchymal thickness (RPT) and renal resistive index (RI) with renal function in patients with obstructed urinary systems.

Objectives

1. To analyze the relationship between RPT and renal function in patients with urinary obstruction.
2. To investigate the association between RI and renal function in obstructed urinary systems.

Materials and Methods

This prospective study was conducted at tertiary care center. Patients with obstructed urinary systems were included, based on clinical, radiological, and biochemical evaluation. Ethical approval was obtained, and all participants provided informed consent.

Inclusion Criteria:

1. Adults (≥18 years) diagnosed with obstructive uropathy based on clinical and radiological assessment.
2. Patients with evidence of renal impairment (elevated serum creatinine and/or low glomerular filtration rate, GFR).
3. Patients who underwent renal ultrasound and Doppler studies to measure renal parenchymal thickness (RPT) and renal resistive index (RI).
4. Willingness to participate in the study and provide informed consent.

Exclusion Criteria:

1. Patients with non-obstructive causes of kidney dysfunction (e.g., diabetic nephropathy, glomerulonephritis).
2. Patients with significant comorbidities (e.g., uncontrolled hypertension, severe cardiac disease) that could interfere with renal function evaluation.
3. Patients who had undergone prior renal surgery or nephrectomy.
4. Pregnant or breastfeeding women.
5. Patients unable to undergo ultrasound or Doppler studies due to technical limitations.

Study Procedures: Each patient underwent a renal ultrasound to measure renal parenchymal thickness (RPT) and Doppler ultrasound to calculate the renal resistive index (RI). Renal function was assessed by serum creatinine levels, glomerular filtration rate (GFR), and urine output measurements. Data were collected at baseline and analyzed for correlation between RPT, RI, and renal function indicators.

Result

Table 1: Correlation Between Renal Parenchymal Thickness (RPT) and Renal Function

Patient ID	RPT (mm)	Serum Creatinine (mg/dL)	GFR (mL/min/1.73m²)	Urine Output (mL/day)
1	14	1.8	52	900
2	18	1.3	70	1100
3	12	2.1	45	600
4	20	0.9	85	1200
5	15	1.5	60	800
6	10	2.3	38	500
7	17	1.0	75	950

Table 2: Correlation Between Renal Resistive Index (RI) and Renal Function

Patient ID	RI (%)	Serum Creatinine (mg/dL)	GFR (mL/min/1.73m²)	Urine Output (mL/day)
1	0.74	1.8	52	900
2	0.58	1.3	70	1100
3	0.80	2.1	45	600

4	0.55	0.9	85	1200
5	0.65	1.5	60	800
6	0.82	2.3	38	500
7	0.60	1.0	75	950

Discussion

The results from Table 1 show a clear inverse correlation between renal parenchymal thickness (RPT) and renal function parameters, particularly serum creatinine and GFR. As RPT decreases, indicating atrophy of the renal parenchyma, there is a corresponding decline in renal function. This supports findings from previous studies, which have indicated that thinning of the renal parenchyma is associated with reduced glomerular filtration rate (GFR) and worse renal outcomes in patients with chronic renal obstruction (5).

Similarly, Table 2 demonstrates a positive correlation between renal resistive index (RI) and renal dysfunction. As the RI increases, there is a notable deterioration in renal function, with higher serum creatinine levels and lower GFR values. (6)The increased RI suggests impaired renal perfusion, which is a common feature in obstructive uropathy, as the increased resistance in the renal vasculature leads to reduced blood flow to the kidneys. This finding aligns with previous research by Ohta Y et al. (2005), who observed that elevated RI is a predictor of poor renal outcomes in patients with obstructive nephropathy.(7)

Both parameters—RPT and RI—serve as reliable markers for assessing renal function in obstructed urinary systems. They provide valuable information that can aid in the early diagnosis and monitoring of renal dysfunction in these patients. RPT, reflecting atrophy of the renal tissue, is an indicator of chronic damage, while RI serves as an indicator of renal vascular resistance and acute changes in renal perfusion.

These results are consistent with the findings of studies by Ghadirpour A et al. (2014), who reported a significant association between increased RI and impaired renal function in obstructed kidneys, and by Granata A, et al. (2014), who found that reduced RPT correlates with worsening renal function in obstructed uropathy.(8, 9)

Conclusion

This study underscores the importance of renal parenchymal thickness (RPT) and renal resistive index (RI) as non-invasive markers for assessing renal function in patients with obstructed urinary systems. Both RPT and RI are strongly correlated with renal dysfunction, providing valuable insights into the degree of renal impairment and potential renal damage. These parameters could serve as useful tools in the clinical management of patients with obstructive uropathy, aiding in diagnosis, prognosis, and monitoring of renal function.

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