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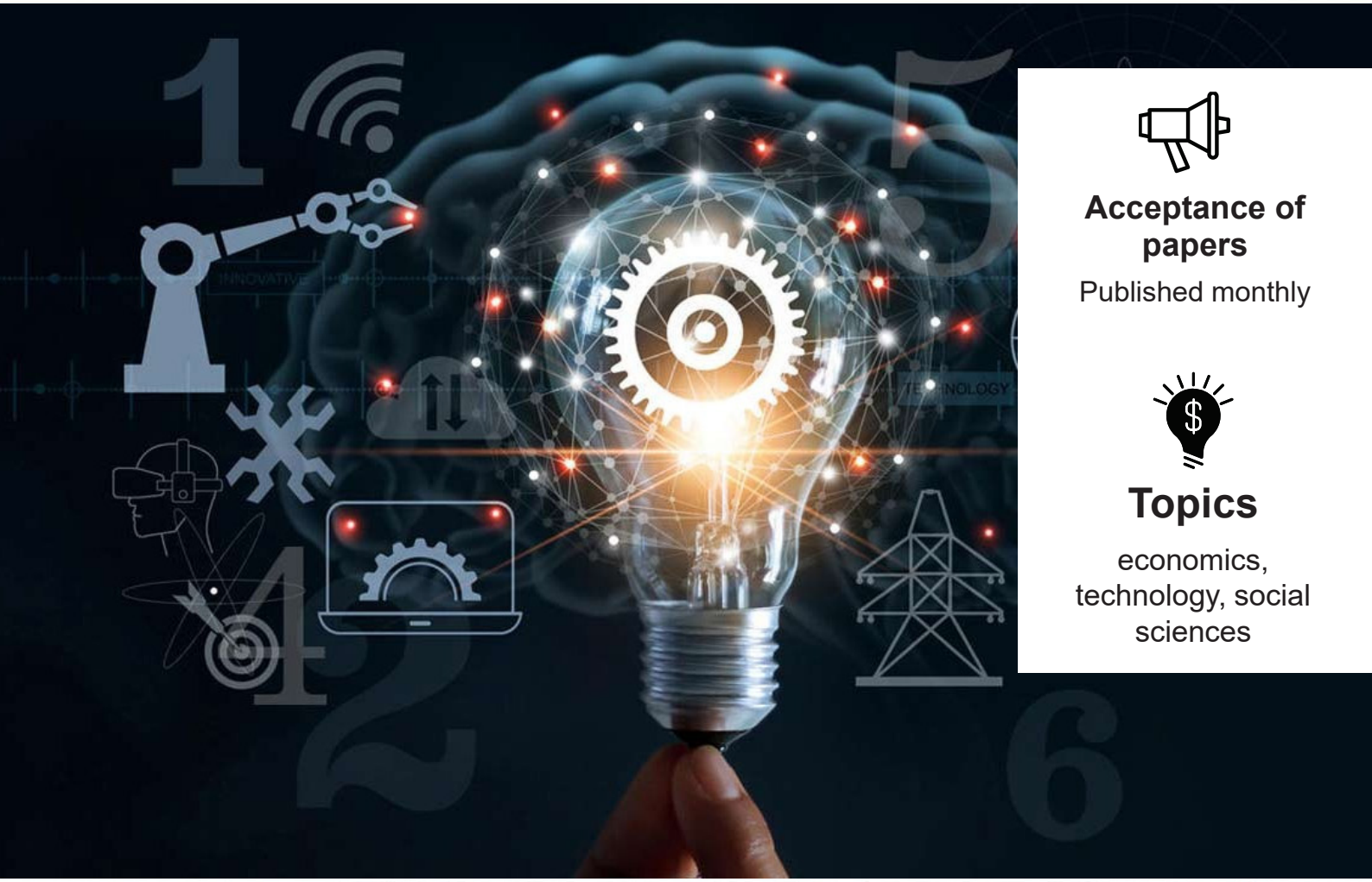

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CONTENTS

CHARACTERISTICS OF INTERSTITIAL NEPHRITIS AGAINST THE BACKGROUND OF UROPATHY IN CHILDREN

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Abstract: This study presents the clinical and laboratory parameters of interstitial nephritis (IN) in pediatric practice in the presence of concomitant uraturia. It is demonstrated that a comprehensive assessment of family history, clinical and instrumental data, along with in-depth laboratory investigations, enables early detection of IN. Early recognition of the pathology ensures more effective prevention of disease progression and the development of microbial-inflammatory complications.

Key words: interstitial nephritis, pediatrics, diagnosis, hyperuricemia, uraturia.

INTRODUCTION

Interstitial nephritis (IN) represents a heterogeneous group of renal disorders characterized by inflammation and edema of the renal interstitium and tubules, frequently leading to impaired kidney function. In pediatric nephrology, the timely recognition of IN is of particular importance, as children are more susceptible to long-term complications that may culminate in chronic kidney disease (CKD). The etiology of interstitial nephritis in children is multifactorial, encompassing immunological reactions, drug-induced nephrotoxicity, infections, and metabolic disorders such as uraturia and hyperuricemia.

Among these, the presence of uropathy—particularly in the form of urate metabolic disturbances—has emerged as a significant co-factor that may exacerbate the inflammatory process within the renal interstitium. Uraturia, defined as the excessive excretion of uric acid crystals in the urine, may not only reflect underlying metabolic dysfunction but also act as a potential contributor to tubular injury. Despite this, interstitial nephritis associated with urate metabolism abnormalities remains underdiagnosed in early stages due to the nonspecific nature of its clinical manifestations.

In this context, a comprehensive approach integrating family history, clinical symptoms, imaging modalities, and advanced laboratory techniques is essential for early detection and intervention. Such strategies are particularly critical in pediatric populations, where the window for preventing long-term renal damage is narrower. This study aims to characterize the clinical and laboratory features of interstitial nephritis in children with concomitant uraturia and to emphasize the importance of early diagnostic criteria in mitigating disease progression and associated microbial-inflammatory complications.

Relevance

According to literature data, interstitial nephritis (IN) accounts for 2.2% to 15.0% of urinary tract diseases in children. IN often develops against the background of metabolic disorders, particularly hyperuricemia and uraturia [1,2,3,4,5]. Kidney dysfunction associated with such factors is observed in 11–16% of pediatric patients with chronic urological pathology [6,7,8,9,10].

Objective of the Study

To assess the effectiveness of non-invasive diagnosis of interstitial nephritis in children with uraturia.

MATERIALS AND METHODS

This observational cross-sectional study involved 86 pediatric patients aged between 4 and 15 years (mean age: 9.2 ± 2.8 years) from 64 different families. The participants were selected based on the presence of clinical or laboratory signs suggestive of interstitial nephritis in the context of uraturia or hyperuricemia. All children underwent a comprehensive diagnostic protocol aimed at evaluating renal function, metabolic status, and anatomical integrity of the urinary system. Clinical assessment included the collection of detailed family and perinatal histories to identify hereditary predispositions, maternal complications during pregnancy, or perinatal risk factors. Physical examination covered anthropometric measurements, general health status, and specific attention to signs such as elevated blood pressure, altered diuresis, and peripheral or periorbital edema, particularly morning eyelid puffiness, which may indicate early fluid retention.

Laboratory investigations comprised a complete blood count, general urinalysis, and microscopic examination of urinary sediment using the Nechiporenko method to quantify red and white blood cells as well as casts. Biochemical analyses included measurement of serum uric acid, creatinine, and xanthine oxidase activity, performed using automated analyzers following standardized laboratory protocols. These parameters were selected to reflect purine metabolism activity and renal filtration efficiency.

Instrumental diagnostic procedures involved renal ultrasonography, including Doppler scanning, to assess kidney morphology, parenchymal structure, echogenicity, and possible anatomical anomalies such as nephroptosis or obstruction. In cases with suspected functional impairment or structural irregularities, excretory urography (intravenous pyelography) was performed to evaluate the collecting system, urinary tract patency, and glomerular filtration dynamics. The combination of imaging and laboratory data enabled a non-invasive yet detailed assessment of kidney health.

All examinations were conducted with the informed consent of the parents or legal guardians and in accordance with the ethical standards of the institutional research committee, complying with the principles of the Declaration of Helsinki. Anonymity and confidentiality of the patient data were fully preserved throughout the study.

RESULTS AND DISCUSSION

Family history and genetic factors. In 56 out of 86 children (65%), a family history of somatic renal pathologies such as pyelonephritis, glomerulonephritis, and urolithiasis was identified. Genealogical analysis revealed a high incidence of renal dysfunction across 2–3 generations (38 cases), indicating a hereditary predisposition to the development of IN against a background of metabolic disorders. These findings are consistent with international data, which also report a 60% occurrence of familial urological conditions.

Biochemical markers. The mean serum uric acid concentration was 0.345 ± 0.021 mmol/L, which is 1.4 times higher than the upper limit of normal (0.11–0.36 mmol/L). In the excretory test, urinary uric acid levels reached 5.89 ± 0.25 mmol/L (reference range: 1.5–4.0 mmol/L). Xanthine oxidase activity ranged from 162 to 256 mmol/L/sec (mean: 198.4 ± 25.6), exceeding the normative value (1.10 ± 0.20 mmol/L/sec) by an average of 1.8 times. Correlation analysis revealed a significant association between xanthine oxidase levels and structural changes in the renal parenchyma detected by ultrasound ($r = 0.62$; $p < 0.01$).

Table 1. Interstitial nephritis in children.

Parameter	Value / Frequency
Children with family history of renal diseases	56 out of 86 (65%)
Genealogical renal dysfunction (2–3 generations)	38 cases
Mean serum uric acid	0.345 ± 0.021 mmol/L
Normal serum uric acid range	0.11–0.36 mmol/L
Mean urinary uric acid	5.89 ± 0.25 mmol/L
Normal urinary uric acid range	1.5–4.0 mmol/L
Xanthine oxidase activity (mean)	198.4 ± 25.6 mmol/L/sec
Normal xanthine oxidase activity	1.10 ± 0.20 mmol/L/sec
Ultrasound abnormalities observed	25 out of 86 (29%)
– Irregular kidney contour	17%
– Bilateral pyelocaliceal-megalo-ureteral system	5%
– Nephroptosis	4%

– Pyelocaliceal obstruction	3%
Decreased GFR (65–70 ml/min/1.73 m²)	18 children
Morning eyelid puffiness	21 cases (24.4%)
Nocturia	18 cases (20%)
Macroscopic hematuria	28 cases (32.5%)
Casts and leukocyte threads in urine	14 cases

Mildly symptomatic cases (absence of edema and marked arterial hypertension) were observed in 67 children (77.9%). Morning eyelid puffiness was recorded in 21 cases (24.4%), consistent with findings from the study by Petrov A.Yu. et al. (2018). Nocturia was noted in 18 children (20%), while either difficulty or increased frequency of urination was observed in 29% of cases. Macroscopic hematuria (up to 300,000 erythrocytes/ml according to the Nechiporenko method) was detected in 28 children (32.5%), among whom 14 showed the presence of urinary casts and leukocyte threads (table 1).

Ultrasound examination of the kidneys revealed anatomical abnormalities in 25 children (29%): irregular kidney contours (17%), bilateral pyelocaliceal-megalo-ureteral system (5%), nephroptosis (4%), and pyelocaliceal obstruction (3%). Excretory urography confirmed the ultrasound findings and showed a decrease in glomerular filtration rate to 65–70 ml/min/1.73 m² in 18 children. These changes correlated with elevated urinary uric acid levels ($p < 0.05$), confirming the role of metabolic stress in the development of morphofunctional renal impairments.

CONCLUSION

The findings of this study highlight the critical importance of early diagnosis of interstitial nephritis in children with uraturia, which can be effectively achieved through a multidisciplinary and integrated diagnostic approach. By systematically evaluating family and clinical histories, conducting expanded biochemical testing, and employing non-invasive imaging techniques, healthcare providers can detect early-stage renal dysfunction even in the absence of overt clinical symptoms. The data suggest a strong correlation between metabolic disturbances—particularly elevated uric acid levels and increased xanthine oxidase activity—and structural renal changes, underscoring the pathogenic role of uraturia in interstitial tissue injury.

Timely recognition of these alterations enables the design of individualized treatment protocols aimed at addressing the underlying metabolic imbalance and preserving renal function. Moreover, early therapeutic intervention reduces the likelihood of disease progression to chronic interstitial nephritis and minimizes the risk of secondary microbial-inflammatory complications. This approach not only improves the long-term prognosis for pediatric patients but also decreases the burden of chronic kidney disease in the broader healthcare system. Therefore, regular screening of children with metabolic risk factors and a positive family history of renal disease is recommended as part of preventive pediatric nephrology practice.

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