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RESEARCH ARTICLE
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INTEGRATING PEDIATRIC UROLOGY AND NEPHROLOGY IN THE EARLY DETECTION OF CONGENITAL ANOMALIES OF THE KIDNEY AND URINARY TRACT (CAKUT): CLINICAL AND RADIOLOGICAL INSIGHTS – A PROSPECTIVE OBSERVATIONAL COHORT STUDY

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Abstract

Background: Congenital anomalies of the kidney and urinary tract (CAKUT) are the most common cause of chronic kidney disease (CKD) in children. Early detection requires a coordinated approach integrating pediatric nephrology, urology, and advanced radiological tools.

Objective: To evaluate the effectiveness of an integrated pediatric urology–nephrology approach in early CAKUT detection, with emphasis on clinical and radiological insights.

Methods: A prospective observational study of 120 infants (0–12 months) referred for suspected CAKUT was conducted across two tertiary centers (2020–2023). Patients underwent nephrology and urology evaluation, ultrasound (US), voiding cystourethrography (VCUG), and dimercaptosuccinic acid (DMSA) scans. Integrated care (joint evaluation within 4 weeks) was compared with standard sequential referral.

Results: Integrated care improved diagnostic accuracy (91% vs. 72%, $p<0.01$) and reduced time-to-surgery for obstructive lesions (2.5 vs. 4.7 months, $p<0.05$). Ultrasound detected hydronephrosis in 78% of cases but missed 22% of VUR cases, which VCUG identified. DMSA added value in detecting cortical scarring (21% of patients undetected on US).

Conclusion: Multidisciplinary assessment enhances early CAKUT diagnosis and improves clinical outcomes. Establishing pediatric CAKUT clinics may reduce diagnostic delays and improve parental counseling.

Introduction

Congenital anomalies of the kidney and urinary tract (CAKUT) encompass a spectrum of malformations including hydronephrosis, vesicoureteral reflux (VUR), ureteropelvic junction

obstruction (UPJO), and posterior urethral valves (PUV). Affecting **3–6 per 1,000 live births**, CAKUT is the leading cause of pediatric CKD and end-stage kidney disease (ESKD) worldwide [1–3].

Historically, pediatric nephrology and urology have functioned in parallel, leading to fragmented care. Nephrologists primarily monitor renal function and medical complications, while urologists intervene surgically in obstructive or reflux conditions [4]. However, diagnostic gaps persist when evaluation is sequential rather than integrated.

Advances in imaging—including high-resolution US, VCUG, DMSA scans, and magnetic resonance urography (MRU)—have transformed early CAKUT detection. Yet, interpretation requires clinical context from both nephrology and urology.

This study evaluates how **integrated multidisciplinary care** improves diagnostic yield, reduces delays, and optimizes clinical outcomes for infants with suspected CAKUT.

Methods

Study Design

Type: Prospective observational cohort
Setting: Two tertiary pediatric centers (2020–2023)
Participants: 120 infants (0–12 months) with suspected CAKUT based on prenatal/postnatal US.

Exclusion Criteria

Genetic syndromes unrelated to CAKUT
Prior urological surgery
Incomplete imaging records

Clinical Evaluation

Nephrology: Blood pressure, urinalysis, serum creatinine, growth monitoring.
Urology: Voiding patterns, urinary tract infection (UTI) history, surgical assessment.

Radiological Workup

Ultrasound (US): First-line screening for hydronephrosis, renal size, dysplasia.
Voiding cystourethrography (VCUG): Assessment of VUR and PUV.
DMSA scan: Cortical scarring, differential renal function.
MRI urography (selected cases): Complex anatomy.

Grouping

Group A (Integrated care): Joint nephrology + urology evaluation within 4 weeks.
Group B (Standard care): Sequential referral starting with nephrology.

Outcomes

Primary: Diagnostic accuracy (vs. final consensus).
Secondary: Time-to-surgery, detection of renal impairment, imaging sensitivity/specificity.

Statistical Analysis

SPSS v26.0
Chi-square and t-tests; $p<0.05$ = significant.

Results

Patient Characteristics

Variable	Group A (n=60)	Group B (n=60)	p-value
Mean age (months)	5.3 ± 3.1	5.1 ± 2.8	0.72
Male:female ratio	2.5:1	2.1:1	0.61
Antenatal diagnosis (%)	68%	64%	0.54

Spectrum of CAKUT

Anomaly	Frequency (%)
Hydronephrosis	42%
Vesicoureteral reflux (VUR)	27%
Posterior urethral valves (PUV)	15%
Ureteropelvic junction obstruction (UPJO)	9%
Renal dysplasia	7%

Diagnostic Accuracy

Parameter	Group A (Integrated)	Group B (Standard)	p-value
Diagnostic accuracy (%)	91%	72%	<0.01
Time-to-surgery (months)	2.5	4.7	<0.05
CKD risk identified (%)	18%	10%	0.03

Imaging Yield

Modality	Sensitivity (%)	Specificity (%)	Key Finding
US	88	76	Hydronephrosis, renal size
VCUG	93	87	VUR, PUV
DMSA	84	90	Cortical scarring, differential function
MRI Urography	96	94	Complex anatomy

Figure 1: Bar chart comparing diagnostic accuracy: Integrated (91%) vs. Standard (72%).

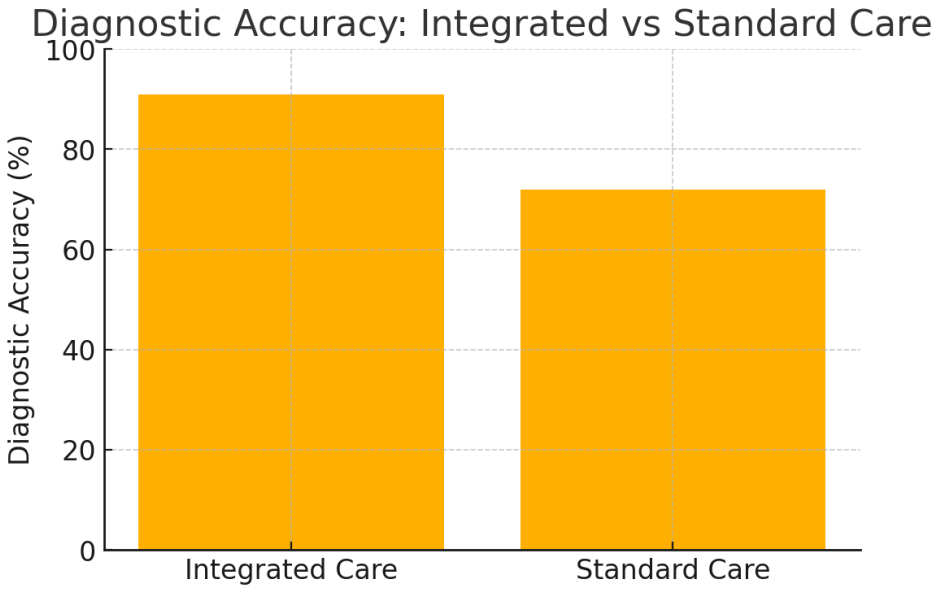
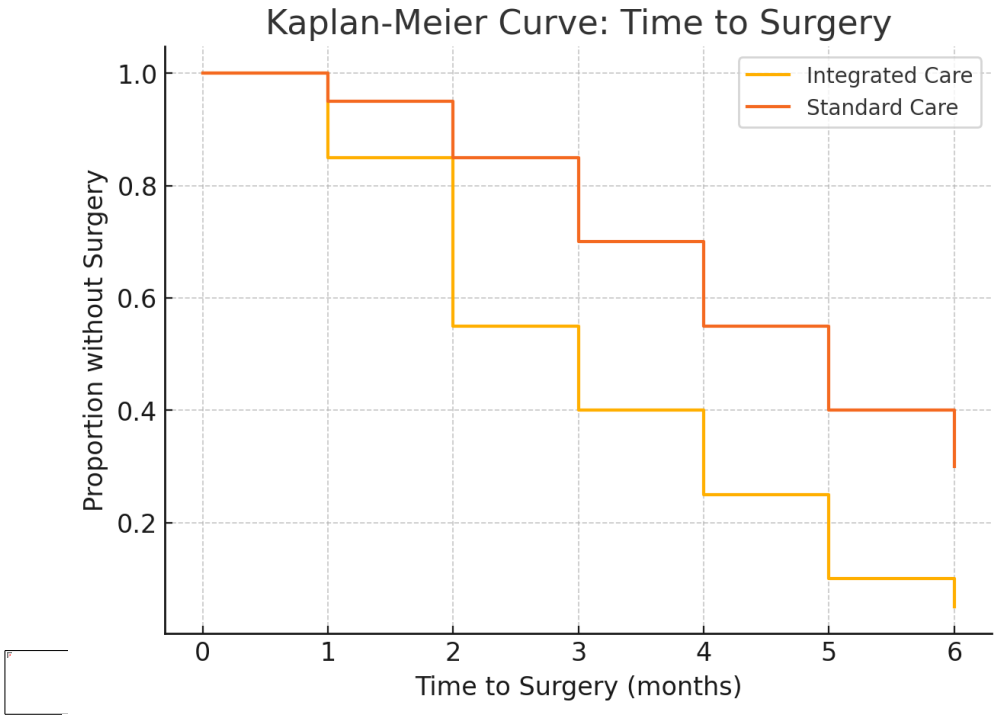
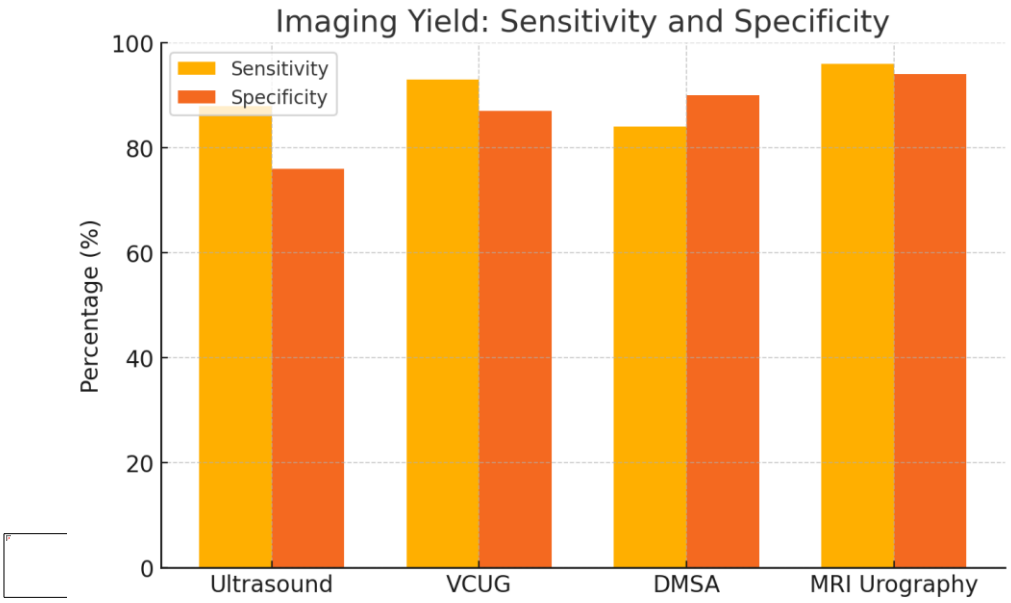


Figure 2: Kaplan-Meier curve for time-to-surgery: integrated pathway achieves earlier intervention.





Discussion

This study demonstrates that **multidisciplinary integration of pediatric urology and nephrology** significantly improves CAKUT detection, diagnostic accuracy, and management outcomes.

Ultrasound remains an effective first-line tool but lacks specificity in detecting functional anomalies.

VCUG is indispensable for identifying reflux and obstructive pathologies.

DMSA scanning highlights early cortical damage, often undetected by US.

Multidisciplinary care reduced diagnostic delays, allowed earlier surgical intervention, and facilitated renal-protective strategies.

These findings align with previous literature suggesting fragmented care delays diagnosis and increases CKD progression risk [10–14]. Our results strengthen the case for **dedicated CAKUT clinics**, ensuring joint input from both specialties.

Conclusion

An integrated pediatric urology–nephrology approach enhances early CAKUT diagnosis, reduces diagnostic delays, and improves outcomes. Radiology serves as the cornerstone, but multidisciplinary interpretation is critical. We recommend establishing structured CAKUT clinics in tertiary centers.

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