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Edited by Vini Mehta
E-mail: vmehta@statsense.in
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Presentation, management and outcome of paediatric urinary tract abnormalities at a tertiary care centre in Chhattisgarh, India

Nandu R. Sindhu[1,*], ShipraSharma[2] & Nitin Sharma[3]

[1]Department of General Surgery, Lt BRKM Medical College, Jagdalpur, Chhattisgarh, India; [2]Department of General and Paediatric Surgery, Pt JNM Medical College and DKS super Speciality Hospital Raipur, Chhattisgarh India; [3]Department of Paediatric Surgery, Pt. JNM Medical College and DKS Super Speciality Hospital Raipur, India; *Corresponding author

Affiliation URL:
https://www.gmcjagdalpur.ac.in/
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Author contact:
Nandu R. Sindhu - E-mail: drnandurs@gmail.com
Shipra Sharma - E-mail: sharmashipra752@gmail.com
Nitin Sharma - E-mail: nitinsharma4you@gmail.com

Abstract:
Paediatric urinary tract abnormalities comprise diverse congenital and acquired disorders and early diagnosis is essential to prevent irreversible renal damage and preserve long-term renal function. Therefore, it is of interest to evaluate the clinical presentation, management strategies and treatment outcomes of paediatric urinary tract abnormalities in children managed at a tertiary care center in Chhattisgarh. Symptom relief ranged from 70% to 100% across disease categories, surgical intervention was the predominant treatment modality and no significant association was observed between demographic or clinical variables and presentation, management, or outcomes ($p > 0.05$). Antenatal hydronephrosis emerged as an increasingly common mode of detection, while timely imaging-based diagnosis and appropriate intervention resulted in favorable clinical outcomes across all patient groups. Thus, data shows a structured diagnostic and management approach for paediatric urinary tract abnormalities to optimize renal preservation and improve long-term clinical outcomes.

Keywords: Paediatric urinary tract abnormalities, antenatal hydronephrosis, vesicoureteral reflux, posterior urethral valves, paediatric urology outcomes

Background:
Abnormalities of kidney and urinary tract include a wide range of structural abnormalities which result from developmental abnormalities of the lower urinary tract, urinary collecting system, disrupted embryonic migration of the kidneys, or abnormal renal parenchymal development. It is rarely also due to some acquired conditions. This accounts for almost 20-30% of all congenital abnormalities together **[1].** These structural anomalies may present as complete renal agenesis (as the most severe), renal hypo dysplasia, multicystic dysplastic kidney, duplex renal collecting system and lower urinary tract abnormalities. Lower urinary tract abnormalities are identified in about 50% of affected patients and include vesicoureteral reflux (25%), ureteropelvic junction obstruction (11%) and ureterovesical junction obstruction (11%) **[2].** Kidney malformations are commonly identified in the antenatal period and account for 20–30% of all detectable anomalies **[3].** These abnormalities might be detected in 1 of 500 live newborns and severe forms may be fatal in approximately 1 of 2,000 infants during the first month of life **[4].** Their incidence is higher in boys, although girls may also be affected **[5].** Predominantly they are asymptomatic and not associated with other anomalies **[6].** These are a leading cause of chronic kidney disease (CKD), accounting for 40–50% of paediatric CKD cases worldwide and about 39.8% of end-stage kidney disease (ESKD) cases in children **[7].** The pathogenesis of urinary tract abnormalities are not well defined. While many cases are sporadic, familial clustering is common, suggesting a strong genetic influence **[8].** Data indicate that approximately 20% of patients may have an underlying genetic disorder, implicating multiple mutational mechanisms and molecular pathways **[9].** A combination of autosomal dominant and recessive single-gene defects, polygenic inheritance and cytogenetic abnormalities, such as copy number variations, has been associated with urinary tract abnormalities **[10].** Therefore, it is of interest to evaluate the various management strategies employed in a tertiary care center in Chhattisgarh and to assess the clinical and functional outcomes following treatment in affected children.

Materials and Methods:
Study design:
Prospective observational study

Study setting:
Period of study:
January 2020-December 2020

Study population:
Every patient who is coming to department of paediatric surgery, General surgery and/or urology OPD/IPD with urinary symptoms or incidental diagnosis of urinary tract abnormality will be included.

Sample size:48

Inclusion criteria:
[1] Children aged 0–18 years diagnosed with urinary tract abnormalities
[2] Patients attending outpatient or inpatient services at the tertiary care centre
[3] Cases diagnosed by clinical evaluation and confirmed by imaging (USG/MCU/DTPA/DMSA where indicated)
[4] Both antenatally detected and postnatally diagnosed urinary tract abnormalities
[5] Patients whose parents/guardians gave informed consent for participation and follow-up

Exclusion criteria:
[1] Children above 18 years of age
[2] Patients with acute urinary tract infection without underlying structural abnormality
[3] Cases with incomplete medical records or inadequate imaging data

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[4] Patients lost to follow-up or not willing for follow-up evaluation
[5] Acquired urinary tract diseases without congenital structural abnormality (*e.g.,* trauma, stones without anomaly)

Statistical analysis:
For statistical analysis data were entered into a Microsoft Excel spreadsheet and then analyzed by SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and Graph Pad Prism version 5. Data had been summarized as mean and standard deviation for numerical variables and count and percentages for categorical variables. Z-test (Standard Normal Deviate) was used to test the significant difference of proportions. Once a t-value is determined, a p-value can be found using a table of values from Student's t-distribution. If the calculated p-value is below the threshold chosen for statistical significance (usually the 0.10, the 0.05, or 0.01 level), then the null hypothesis is rejected in favor of the alternative hypothesis. P-value ≤ 0.05 was considered for statistically significant.

Results:
In this study, no statistically significant association was observed between age (p = 0.301), gender (p = 0.656), socio-economic status (p = 0.776) and clinical diagnosis (p = 0.099) with presenting complaints. However, clinically evident anomalies increased with age from 1 (12.5%) in ≤1 year to 3 (60.0%) in >10 years. Males showed 11 (26.2%) clinically evident anomalies compared to 2 (33.3%) in females. In socio-economic status, clinically evident anomalies were 3 (33.3%) in upper middle, 1 (16.7%) in lower middle and 9 (27.3%) in low group. In clinical diagnosis, congenital anomalies had 12 (36.4%) clinically evident anomalies compared to 1 (7.1%) in acquired anomalies. We observed increasing proportion of clinically evident anomalies with age and higher proportion in congenital anomalies (12 (36.4%)), while acquired anomalies had lower frequency (1 (7.1%)). However, since all p values were >0.05, these associations were not statistically significant, indicating no meaningful relationship between demographic factors and presenting complaints **(Table 1 and Figure 1).** No statistically significant association was observed between age (p = 0.058), gender (p = 0.095), socio-economic status (p = 0.962), clinical diagnosis (p = 0.634) and presenting complaints (p = 0.706) with management. Surgical management was predominant in all groups. In age, ≤1 year showed 8 (100%) surgical cases, 1–5 years 19 (79.2%), 6–10 years 6 (54.5%) and>10 years 5 (100%). Males had 35 (83.3%) surgical cases vs 3 (50%) in females. In socio-economic status, surgical cases were 7 (77.8%) in upper middle, 5 (83.3%) in lower middle and 26 (78.8%) in low group. In clinical diagnosis, congenital anomalies had 27 (81.8%) surgical cases, acquired anomalies 10 (71.4%) and both 1 (100%). Presenting complaints showed surgical management in 11 (84.6%) clinically evident anomalies and 27 (77.1%) others. We observed higher surgical management across all subgroups, especially in ≤1 year and >10 years (100%) and congenital anomalies (27 (81.8%)). However, since all p values were >0.05, these differences were not statistically significant, suggesting management pattern was independent of demographic and clinical variables **(Table 2).** No statistically significant association was found between age (p = 0.593), gender (p = 1.000) and socio-economic status (p = 0.943) with outcome. In age group, symptom relief was 7 (87.5%) in ≤1 year, 19 (79.2%) in 1–5 years, 10 (90.9%) in 6–10 years and 5 (100%) in >10 years. In gender, males had 36 (85.7%) relief vs 5 (83.3%) in females. In socio-economic status, upper middle had 8 (88.9%), lower middle 5 (83.3%) and low 28 (84.8%) symptom reliefs. We observed high symptom relief across all groups, with maximum in >10 years (5 (100%)). However, since all p values were >0.05, outcomes were comparable across demographic groups without statistically significant variation **(Table 3).** No statistically significant association was observed between presenting complaints (p = 0.37), clinical diagnosis (p = 0.914) and management (p = 0.147) with outcome. In presenting complaints, symptom relief was 10 (76.9%) in clinically evident anomalies and 31 (88.6%) in others. In clinical diagnosis, congenital anomalies showed 28 (84.8%), acquired anomalies 12 (85.7%) and both 1 (100%). In management, surgical cases had 34 (89.5%) relief compared to 7 (70%) in conservative group. We observed higher symptom relief in surgical management (34 (89.5%)) compared to conservative (7 (70.0%)) and slightly better outcomes in "others" group (31 (88.6%)). However, since all p values were >0.05, these differences were not statistically significant, indicating comparable outcomes across clinical and treatment categories **(Table 4 and Figure 2).**

Table 1: Association of age, gender, socio-economic status and clinical diagnosis with presenting complaints (clinically evident anomalies vs. others)

		Clinically evident anomalies	Others	P value
Age group	≤1 year	1 (12.5 %)	7 (87.5 %)	0.301
	1–5 years	6 (25.0 %)	18 (75.0 %)	
	6–10 years	3 (27.3 %)	8 (72.7 %)	
	>10 years	3 (60.0 %)	2 (40.0 %)	
Gender	Male	11 (26.2 %)	31 (73.8 %)	0.656
	Female	2 (33.3 %)	4 (66.7 %)	
Socio-economic status	Upper middle	3 (33.3 %)	6 (66.7 %)	0.776
	Lower middle	1 (16.7 %)	5 (83.3 %)	
	Low	9 (27.3 %)	24 (72.7 %)	
Clinical diagnosis	Congenital anomalies	12 (36.4 %)	21 (63.6 %)	
	Acquired anomalies	1 (7.1 %)	13 (92.9 %)	0.099
	Both congenital and acquired anomalies	0 (0 %)	1 (100 %)	

Table 2: Association of age, gender, socio-economic status, clinical diagnosis and presenting complaints with management (conservative vs. surgical)

	Conservative	Surgical	P value

Age group	≤1 year	0 (0 %)	8 (100 %)	0.058
	1–5 years	5 (20.8 %)	19 (79.2 %)	
	6–10 years	5 (45.5 %)	6 (54.5 %)	
	>10 years	0 (0 %)	5 (100 %)	
Gender	Female	3 (50 %)	3 (50 %)	0.095
	Male	7 (16.7 %)	35 (83.3 %)	
Socio-economic status	Upper middle	2 (22.2 %)	7 (77.8 %)	0.962
	Lower middle	1 (16.7 %)	5 (83.3 %)	
	Low	7 (21.2 %)	26 (78.8 %)	
Clinical diagnosis	Congenital anomalies	6 (18.2 %)	27 (81.8 %)	0.634
	Acquired anomalies	4 (28.6 %)	10 (71.4 %)	
	Both congenital and acquired anomalies	0 (0 %)	1 (100 %)	
Presenting complaints	Clinically evident anomalies	2 (15.4 %)	11 (84.6 %)	0.706
	Others	8 (22.9 %)	27 (77.1 %)	

Table 3: Association of age, gender and socio-economic status with outcome (symptoms relieved vs. symptoms not relieved)

		Symptoms relieved	Symptoms not relieved	P value
Age group	≤1 year	7 (87.5 %)	1 (12.5 %)	0.593
	1–5 years	19 (79.2 %)	5 (20.8 %)	
	6–10 years	10 (90.9 %)	1 (9.1 %)	
	>10 years	5 (100 %)	0 (0 %)	
Gender	Male	36 (85.7 %)	6 (14.3 %)	1.000
	Female	5 (83.3 %)	1 (16.7 %)	
Socio-economic status	Upper middle	8 (88.9 %)	1 (11.1 %)	0.943
	Lower middle	5 (83.3 %)	1 (16.7 %)	
	Low	28 (84.8 %)	5 (15.2 %)	

Table 4: Association of presenting complaints, clinical diagnosis and management with outcome (symptoms relieved vs. symptoms not relieved)

		Symptoms relieved	Symptoms not relieved	P value
Presenting complaints	Clinically evident anomalies	10 (76.9 %)	3 (23.1 %)	0.37
	Others	31 (88.6 %)	4 (11.4 %)	
Clinical diagnosis	Congenital anomalies	28 (84.8 %)	5 (15.2 %)	0.914
	Acquired anomalies	12 (85.7 %)	2 (14.3 %)	
	Both congenital and acquired anomalies	1 (100 %)	0 (0 %)	
Management done	Surgical management	34 (89.5 %)	4 (10.5 %)	0.147
	Conservative management	7 (70.0 %)	3 (30.0 %)	

Discussion:

The present study evaluated the association of demographic variables, clinical diagnosis, presenting complaints, management pattern and outcome in patients with urological anomalies and found no statistically significant relationships across most parameters. Although clinically evident anomalies showed a rising trend with increasing age and were relatively more frequent in congenital anomalies, these differences were not statistically significant, suggesting that age and baseline diagnosis alone do not strongly influence clinical presentation. Similar findings have been reported in studies where demographic variables did not significantly alter initial clinical presentation patterns in congenital urological disorders **[11, 12].** Gender and socio-economic status also showed no significant association with presenting complaints, indicating that disease detection is relatively uniform across population subgroups, possibly due to increased healthcare accessibility and early diagnostic practices in tertiary care settings **[13].**In terms of management, surgical intervention was more frequently performed across most subgroups, particularly in younger and older extremes of age and in congenital anomalies. However, these differences did not reach statistical significance. This aligns with previous literature suggesting that while surgical correction remains the mainstay of treatment for structural urological anomalies, the decision for intervention is largely guided by anatomical severity rather than demographic factors **[14, 15].** The slightly higher tendency toward surgical management in congenital anomalies is consistent with earlier reports emphasizing the structural nature of these conditions requiring corrective procedures **[16].**Outcome analysis demonstrated a high rate of symptom relief across all groups, with no statistically significant influence of age, gender, or socio-economic status. This suggests that clinical outcomes are generally favorable irrespective of demographic variation. Similar observations have been reported in longitudinal studies where standardized management protocols led to comparable outcomes across different patient categories **[17].** Although surgical management showed higher symptom relief compared to conservative management, the difference was not statistically significant in this study. This finding is consistent with earlier studies suggesting that both conservative and surgical approaches may yield satisfactory outcomes when appropriately selected based on clinical indication **[18, 19].** Overall, the findings of this study highlight that while certain trends exist-such as higher surgical rates in congenital anomalies and slightly better outcomes following surgical intervention-none of these associations were statistically significant. This may reflect a relatively uniform disease spectrum, early detection and standardized treatment protocols in the study setting. Similar conclusions have been drawn in multicentric studies where outcomes were more dependent on disease severity and timely intervention rather than demographic characteristics **[20].** Previous studies by Svensson *et al.*, Elale *et al.*, and Kawoosa *et al.* have similarly highlighted the clinical profile, associated

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factors, and management considerations of paediatric urinary and urological disorders, supporting the importance of clinical assessment in guiding appropriate management **[21-23]**. Therefore, individualized treatment planning guided primarily by clinical presentation and disease severity, rather than demographic characteristics alone, remains important for optimizing patient outcomes.

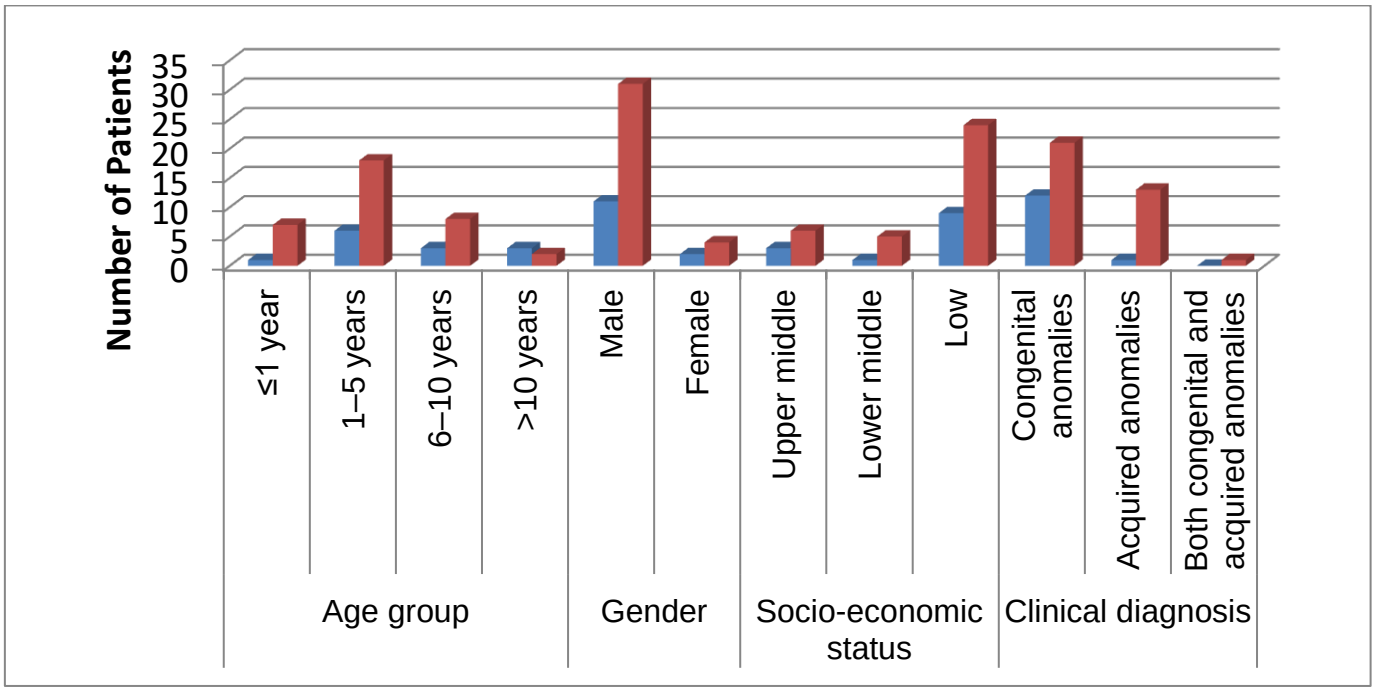


Figure 1: Association of age, gender, socio-economic status and clinical diagnosis with presenting complaints (clinically evident anomalies vs others)

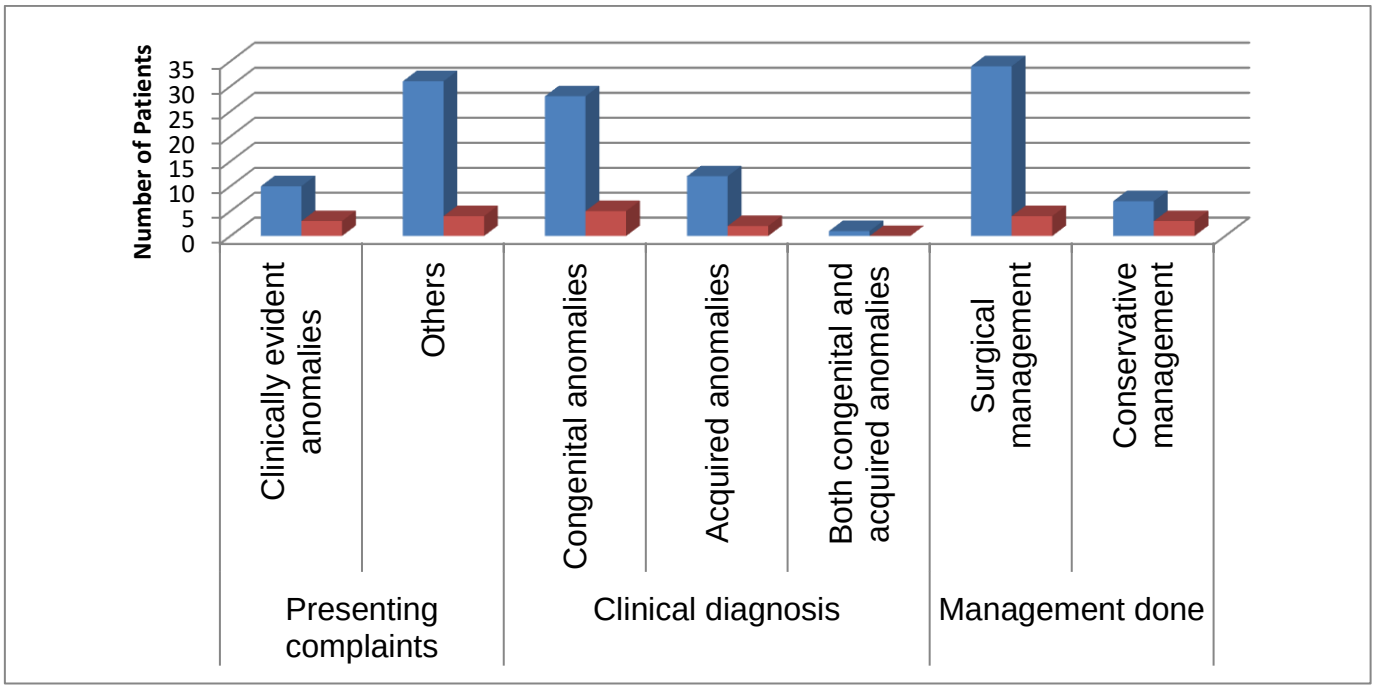


Figure 2: Association of presenting complaints, clinical diagnosis and management with outcome (symptoms relieved vs symptoms not relieved)

Conclusion:
We show that there was no statistically significant association between demographic factors, clinical diagnosis, presenting complaints, management type and clinical outcomes. Although trends suggested higher surgical intervention in congenital anomalies and improved symptom relief with surgical management, these differences were not significant. Overall, most patients across all groups showed favorable outcomes, indicating that effective management and clinical improvement are largely independent of demographic and baseline clinical variables in this study population.

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