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# "Role Of Ultrasonography In Diagnosing Vesico Ureteral Reflux In Paediatric Patients With Urinary Tract Infection – A One Year Hospital Based Cross-Sectional Study"

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## ABSTRACT

**Background:** Urinary tract infections (UTIs) are prevalent bacterial diseases in children, often linked to vesicoureteral reflux (VUR), a common underlying cause. Traditionally, the diagnosis of VUR has relied on invasive micturating cystourethrography (MCU).

**Objectives:** to assess the accuracy of ultrasonography (USG) for predicting and grading VUR in pediatric patients with UTIs.

**Methodology**: The present study was conducted in the Department of (Radiology) Radio- diagnosis, KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belgaum (Belagavi) from January 2023 to December, 2023.

**Results**: It was a one-year observational study where in a cohort of 42 pediatric patients, predominantly in early to mid-childhood (54.7%), underwent evaluation, with a male-to-female ratio of 6:1. USG identified 38 true positive cases of VUR and 4 false negatives, while both USG and MCU showed no false positives or true negatives. Among the findings, bilateral Grade IV VUR was most prevalent, followed by bilateral Grade V VUR, 90.4 % of all grade VUR were accurately diagnosed and 68.4% cases were graded accurately, 75% of the low-grade being diagnosed on USG and 44% of cases were accurately graded 96.6 % of the high-grade cases were accurately diagnosed on USG with 75.8 % of them accurately graded In addition to VUR grading, USG provided insights into kidney size, shape, signs of chronic pyelonephritis, ureteric characterization, intrapelvic echoes indicating persistent infection, poor urine emptying due to reflux, and dynamic reflux assessment. Furthermore, USG detected renal scarring, atrophic changes, and intrapelvic echogenicities, facilitating comprehensive management decisions. Conclusion: Ultrasonography emerges as a promising non-invasive tool for assessing VUR in pediatric UTI patients, offering reliable diagnostic accuracy and additional parameters for comprehensive clinical management.

**Keywords**: *urinary tract infection, vesicoureteral reflux, ultrasonography, micturating cystourethrography, pediatric nephrology*

## 1. INTRODUCTION

Urinary tract infection (UTI) is the most prevalent bacterial diseases in children [1]. Common causes of UTI include vesicoureteral reflux (VUR), bladder- bowel dysfunction (BBD), congenital abnormalities of the kidneys and urinary tract (CAKUT), and the status of circumcision in young boys[2,3,4]. Between 85% and 90% of UTIs are brought on by Escherichia coli. Additional typical microbes consist of Klebsiella, Proteus, Enterococcus, and Enterobacter species[5,6,7].

Boys have a higher prevalence of it (3.7%) in the first year of life compared to girls (2%) and beyond infancy, girls have a much higher prevalence[8,9]. In girls, the incidence during prepubertal age is 3%, whereas in boys, it is 1%. Within the

first six to twelve months following the initial UTI, there is a 12% to 30% chance of a recurrence[10,11]. Timely identification and treatment of UTI are crucial in preventing both acute consequences and kidney scarring & its sequelae. Much research has been done on pediatric UTI in the past 2 decades, especially in the areas of renal imaging and long-term antibiotic prophylaxis following UTI.

One of common cases of bacterial infection in young infants is urinary tract infection (UTI). The developing kidneys may sustain long-term, irreversible damage if diagnosis and therapy are delayed. Hypertension, renal failure, and renal scarring are possible outcomes[12]. 20% to 35% of children who are assessed for bacteriuria are thought to experience vesico-ureteral reflux. Following their first UTI, vesicoureteral reflux is diagnosed in over 60% of children under the age of one year[13].

The traditional method of diagnosing vesico-ureteral reflux is micturating cystourethrography. Despite being a day care procedure, this one procedure has poor compliance, necessitates antibiotic coverage, requires extensive counseling, which requires painful catheterization and should only be done after recovering from a

febrile illness. On the other hand, these kids would greatly benefit from a method or investigative tool that, in the absence of an invasion, yields comparable or almost comparable results in the diagnosis of vesico-ureteral reflux with one tool of USG. Therefore, the goal of this study is to ascertain if ultrasonography should be employed in kids who have vesico-ureteral reflux-related urinary tract infections.

One of the most prevalent urinary tract abnormalities in children is vesicoureteral reflux (VUR), which is linked to reflux nephropathy[14]. To prevent the development of reflex nephropathy, it is especially crucial to check for VUR in infants who have hydronephrosis at the prenatal stage or recurrent febrile urinary tract infections[15]. The relationship between VUR and chronic nephropathy is still up for debate, though[16]. It is frequently advised that high-risk children be kept out of VUR, especially if they have hydronephrosis, kidney damage, or a complex urinary tract infection[17].

Currently, radionuclide cystography (RNC) and retrograde voiding cystourethrogram with X-ray (VCUG)[18] are the two procedures commonly employed to diagnose VUR. Due to their intermittent imaging and irradiation, both approaches have limited sensitivity[19].

When a febrile urinary tract infection (UTI) first occurs, the goal of renal and bladder ultrasonography (RBUS) is to identify any anatomic abnormalities that need to be further evaluated (such as further imaging or urologic consultation). In order to track renal growth, RBUS also assesses the renal parenchyma and renal size)[20]. The clinical situation determines when to perform RBUS. Early on in an acute infection, RBUS may be misleading because, as animal studies have shown, dilatation brought on by an endotoxin from Escherichia coli during an acute infection might be mistaken for hydronephrosis, pyonephrosis, or obstruction)[21].

**Need for the study:**

Vesico-ureteral reflux is most common cause of febrile lower urinary tract infections in paediatric patients. The diagnosis is usually achieved by micturating cystourethrography, which is a invasive and painful procedure experienced by the these children. The use of ultrasonography with its doppler values, if can diagnose the presence of vesico-ureteral reflux will be helpful in diagnosing and then confirming with micturating cystourethrography and treating these children to prevent exacerbation and sequelae of urinary tract infection like pyelonephritis, urosepsis and renal abscess. The ultrasonography has also a regional importance here, as no study has been done in this part in state or country regarding the use of ultrasonography in diagnosis of vesico-ureteral reflux which can either be missed or diagnosed late with the fear of invasiveness of the procedure of micturating cystourethrography which is extensively practised in this regional setup.

**AIMS & OBJECTIVES**

1. To evaluate the accuracy of ultrasonography in predicting vesico-ureteral reflux cases diagnosed on micturating cystourethrography in paediatric patients.
2. To study the accuracy of ultrasonography in predicting the grade of vesico-ureteral reflux cases diagnosed on micturating cystourethrography in paediatric patients.

## 2. MATERIAL AND METHODS

**Source of Data:**

Patients visiting to the paediatric & paediatric surgery OPD, admitted in paediatric & paediatric surgery ward and referred to radiology department of KLEs Dr.Prabhakar Kore Hospital and MRC. The patients with the diagnosis of vesico-ureteral reflux by micturating cystourethrography were counseled and subjected to ultrasonography during the 1 year period from January 2023 to December 2023.

**Study Design:**

Prospective cross-sectional study

**Study Period:**

January 2023 to December 2023

**Sample Size:**

The minimum sample size formula based on prevalence rate is n=Zα2(1-P)/d2 Where P is the percentage of prevalence and d is the percentage likely difference in the prevalence. Zα is linked with the level of significance. For 5% level of the significance Zα 1.96. Ref: With P 60% and d= 15% of P= 9%, the sample size is

40.97. This sample size will be raised to 42.

**Sampling technique:**

Purposive sampling. Patients of age 2 months to 12 years with diagnosis of urinary tract infection will be included in the study.

**Inclusion Criteria:**

- Patients of age 2 months to 12 years of both the sexes
- Clinically diagnosed cases of urinary tract infection.

**Exclusion Criteria:**

- Operated cases of vesico-ureteral reflux.
- Children with multi-system anomalies.

**Study protocol:**

The study will be conducted using GE VOLUSON P8 ultrasonography machine manufactured by GE Healthcare. All the cases of vesico-ureteral reflux will be subjected to ultrasonography by single senior radiologist and the findings will be noted and analysed. The findings of micturating cystourethrography would not be revealed to the radiologist except the presence of urinary tract infection. Consent will be taken from all the patients or parents. All the data collected will be entered in to MS Excel sheet, data will be tabulated & tables, charts and graphs will be prepared.

**Data collection procedure:**

Ultrasonography of the patients fulfilling all the inclusion and exclusion criteria as described above.

**Statistical Method**

Data was analyzed using statistical software R version 4.2.0 and Microsoft Excel. Categorical variables were represented by frequencies and percentages. Continuous variables were represented by Mean ± SD / Median (Min, Max) form. Only descriptive analysis was applicable for the parameters we had taken as there was neither the comparison group nor the controls.

## 3. RESULTS

**Table 1: Age wise distribution of the study participants (N=42)**

| Sl no | Age | Frequency | Percentage |
|---|---|---|---|
| 1 | <5 | 6 | 14.2 |
| 2 | 5-10 | 23 | 54.7 |
| 3 | >10 | 13 | 30.9 |

The mean age of the study population is 8.2 years. The first age group, consisting of children under 5 years, accounts for 6 individuals, which constitutes 14.2% of the total surveyed population. This indicates a relatively smaller proportion of very young children in the sample. The second age group, comprising individuals aged between 5 to 10 years, is the largest, with 23 individuals. This group represents a significant majority, making up 54.7% of the total population. This suggests that the majority of the surveyed individuals are in the early to mid-childhood range. The third age group,

which includes individuals older than 10 years, has 13 members, corresponding to

30.9 % of the total population. This indicates a substantial presence of older children and adolescents in the sample.

**Table 2: Gender wise distribution of the study participants (N=42)**

| Sl no | Gender | Percentage |
|---|---|---|
| Male | 36 | 85.7 |
| Female | 6 | 14.2 |

The study involved 36 male participants, comprising 85% of the population, and 6 female participants, comprising 14.2% of the population.

**Table 3: Distribution of presenting complaints among the study participants (N=42)**

| Sl. no | Presenting complaints | Frequency | Percentage |
|---|---|---|---|
| 1 | Burning micturition | 6 | 14.2 |
| 2 | Pain abdomen | 7 | 16.6 |
| 3 | Poor stream | 18 | 42.8 |
| 5 | Poor urinary stream and increased frequency of micturition | 5 | 11.9 |
| 6 | Recurrent history of fever | 6 | 14.2 |

The most common complaint is "Poor stream," reported by 18 individuals, which constitutes 42.8 % of the surveyed population. This indicates that nearly half of the individuals experienced issues with the flow of urine. Two other complaints are reported by an equal number of individuals, each by 6 people, making up 14.2 % of the population each. These complaints are "Burning micturition," and "Recurrent history of fever." Pain abdomen was reported by 7 people, making up 16.6 % of the population. This distribution shows that a significant portion of the population experiences discomfort or pain during urination, abdominal pain, or recurrent fever episodes. Additionally, the complaint of "Poor urinary stream and increased frequency of micturition" is reported by 5 individuals, representing 11.9 % of the population. This indicates that a smaller, but notable, fraction of the population suffers from both a weak urinary stream and frequent urination.

**Table 4: Distribution of history of congenital anomalies among the study participants (N=42)**

| Sl.No | History of congenital anomalies | Frequency | Percentage |
|---|---|---|---|
| 1 | Anal atresia | 4 | 9.5 |
| 2 | Crossed fused ectopic kidney | 3 | 7.1 |
| 3 | Phimosis | 7 | 16.6 |
| 4 | Posterior urethral valve | 9 | 21.4 |

| | | | |
|---|---|---|---|
| 5 | Nil | 19 | 45.2 |

The most frequently reported condition is "posterior urethral valve," which is observed in 9 individuals, accounting for 21.4 % of the surveyed population. This indicates that this condition is relatively a common congenital anomaly in this group. Phimosis is noted in 7 individuals corresponding to 16.6 % of population. Anal atresia is reported in 4 individuals and Crossed fused ectopic kidney in 3 individuals. These conditions constitute 9.5% and 7.1 % of the population respectively. This suggests that these two congenital anomalies are less common but still present in a notable portion of the surveyed individuals. The largest category, however, is those with no history of congenital anomalies, labeled as "Nil." This group includes 19 individuals, making up 45.2 % of the population. This indicates that a significant portion of the surveyed individuals do not have any reported congenital conditions.

**Table 5: Distribution of various grades of VUR in MCU among the study participants (N=42)**

| Sl no | MCU findings | Frequency | Percentage |
|---|---|---|---|
| 1 | Bilateral Grade I VUR | 3 | 7.1 |
| 2 | Bilateral Grade II VUR | 7 | 16.6 |
| 3 | Bilateral Grade III VUR | 8 | 19 |
| 4 | Bilateral Grade IV VUR | 10 | 23.8 |
| 5 | Bilateral Grade V VUR | 9 | 21.4 |
| 6 | Right Grade II VUR | 2 | 4.7 |
| 7 | Right Grade IV VUR | 3 | 7.1 |

The most prevalent finding is "Bilateral Grade IV VUR," observed in 10 individuals, which constitutes 23.8 % of the surveyed population.

"Bilateral Grade V VUR" is identified in 9 individuals, accounting for 21.4 % of the population. This higher-grade reflux, although less common than Grade IV, still represents a significant portion of the surveyed individuals, indicating a notable presence of more severe VUR. " Bilateral grade III VUR " is identified in 8 individuals each, accounting for 19 % of population each. "Bilateral grade I and Right grade II VUR " is identified in 2 individuals each, accounting for 4.7 % of population each. “Right grade IV VUR” is noted in 3 individuals, accounting for 7.1 % of the population. This indicates that unilateral VUR is present but less frequent compared to the bilateral cases.

**Table 6: Distribution of cases into unilateral and bilateral cases on MCU (N=42)**

| Sl. no | vesico-ureteric reflux | Frequency | Percentage |
|---|---|---|---|
| 1 | Unilateral | 37 | 88.1 |
| 2 | Bilateral | 5 | 11.9 |

The study found that 88.1% of the population, comprising 37 individuals with bilateral vesicoureteral reflux and 11.9% with unilateral vesicoureteral reflux, indicating that the majority of the population suffers from bilateral vesicoureteral reflux.

**Table 7: Depicts renal and ureter parameters in accurately graded cases on ultrasonography**

| Grade | Anteroposterior renal pelvis diameter (cm) | | Proximal ureter (cm) | | Distal ureter (cm) | |
|---|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | Minimum | Maximum |

| | | | | | | |
|---|---|---|---|---|---|---|
| I | 0.3 | 0.3 | - | - | 0.5 | 0.6 |
| II | 0.7 | 0.8 | 0.5 | 0.8 | 0.4 | 0.7 |
| III | 1.5 | 1.7 | 0.6 | 0.8 | 0.7 | 0.8 |
| IV | 1.6 | 2.4 | 0.9 | 1.6 | 0.8 | 1.7 |
| V | 2.2 | 2.6 | 1.3 | 1.7 | 1.2 | 1.7 |

**Table 8: Accuracy of ultrasonography in detecting all grade vesico-ureteral reflux (N=42).**

| VUR | POSITIVE CASES | NEGATIVE CASES |
|---|---|---|
| MCU | 42 | 0 |
| USG | 38 | 4 |

Among the cases diagnosed, USG identified 38 true positive cases (positive on both USG and MCU) and 4 false negative cases (negative on USG but positive on MCU). There were no false positives (positive on USG but negative on MCU), and no true negatives (negative on both USG and MCU).

**Table 9: Accuracy of ultrasonography in grading all grade vesico-ureteral reflux cases (N=38).**

| | Number of cases | Percentage |
|---|---|---|
| Accurately graded | 26 | 68.4 |
| Not accurately graded | 12 | 31.6 |

Of the 38 cases (or 90.4% of all cases discovered in USG), 26 cases constituting 68.4

% were graded appropriately, while 12 cases i.e. 31.6% were not graded correctly.

**Table 10: VUR detection and grading on both MCU and USG**

| | prediction and grading of VUR on MCU (+) | Detection of VUR on USG (+) | Grading of VUR on USG (+) | Grading of VUR on USG (-) | Detection of VUR on USG (-) |
|---|---|---|---|---|---|
| Bilateral grade I VUR | 3 | 2 | 1 | 1 | 1 |
| Bilateral grade II VUR | 7 | 5 | 2 | 3 | 2 |
| Bilateral grade III VUR | 8 | 7 | 4 | 3 | 1 |
| Bilateral grade IV VUR | 10 | 10 | 7 | 3 | 0 |
| Bilateral grade V VUR | 9 | 9 | 9 | 0 | 0 |
| Right grade II VUR | 2 | 2 | 1 | 1 | 0 |
| Right grade IV VUR | 3 | 3 | 2 | 1 | 0 |
| Total | 42 | 38 | 26 | 12 | 4 |

**Table 11: Depicts accuracy of USG in detection and grading of low grade VUR (grade I and II) on USG**

| | prediction and grading of VUR on MCU (+) | Detection of VUR on USG (+) | Grading of VUR on USG (+) | Grading of VUR on USG (-) | Detection of VUR on USG(-) |
|---|---|---|---|---|---|
| Bilateral grade I VUR | 3 | 2 | 1 | 1 | 1 |
| Bilateral grade II VUR | 7 | 5 | 2 | 3 | 2 |
| Right grade II VUR | 2 | 2 | 1 | 1 | 0 |
| Total | 12 | 9 | 4 | 5 | 3 |

Among the study population of 42,

12 children were diagnosed and graded with low-grade VUR (grade I and grade II) on MCU.

2 cases (66.6%) among the 3 cases of bilateral grade I VUR were diagnosed on USG and one (50%) among them were accurately graded.

5 cases (71.4 %) among the 7 cases of bilateral grade II VUR were diagnosed on USG and 2 (40 %) among them were accurately graded.

All the cases (2 cases) right grade II VUR were diagnosed on USG and 1 (50 %) among them were accurately graded.

9 cases of low-grade VUR were diagnosed on USG, constituting for 75% cases, 4 children were correctly graded on USG, constituting for 44.4 % cases among the cases diagnosed on USG.

3 children among the 12 children were not detected with VUR on USG and 5 children were not correctly graded among the 9 diagnosed children.

**Table 12: Depicts accuracy of USG in detection and grading of high grade VUR (grade III, IV and V ) on USG**

| | Detection and grading of VUR on MCU (+) | Detection of VUR on USG (+) | Grading of VUR on USG (+) | Grading of VUR on USG (-) | Detection of VUR on USG (-) |
|---|---|---|---|---|---|
| Bilateral grade III VUR | 8 | 7 | 4 | 3 | 1 |
| Bilateral grade IV VUR | 10 | 10 | 7 | 3 | 0 |
| Bilateral grade V VUR | 9 | 9 | 9 | 0 | 0 |
| Right grade IV VUR | 3 | 3 | 2 | 1 | 0 |
| Total | 30 | 29 | 22 | 7 | 1 |

Among the study population of 42,

30 children were diagnosed and graded with high-grade VUR (grade III, grade IV and grade V) on MCU.

7 cases (87.5%) among the 8 cases of bilateral grade III VUR were diagnosed on USG and 4 (57.1 %) among them were accurately graded.

All the cases (13 cases) of right grade IV and bilateral grade IV VUR were diagnosed on USG, however 2 cases (66.6 %) of right grade IV, 7 cases (70%) of bilateral grade IV were accurately graded.

All the cases (9 cases) of bilateral grade V were accurately diagnosed and correctly graded on USG.

29 cases are diagnosed on USG, constituting for 96.6 % cases and 22 children were correctly graded on USG, constituting

for 75.8 % cases among the cases diagnosed on USG.

1 child among the 30 children was not detected with VUR on USG and 7 (24.1 %) children were not correctly graded among the 29 diagnosed children.

## 4. DISCUSSION

The purpose of this study was to evaluate the accuracy of ultrasonography in predicting vesico-ureteral reflux cases diagnosed on micturating cystourethrography in paediatric patients and further grade those cases.

In the present study, the sample size is 42, A thorough clinical history was noted, symptoms were recorded, and any associated congenital anomalies were studied.

Three age groups comprise the sample: children under five years old, those between five and ten years old, and those above ten years old. There are fewer very young children in the first age group, which makes up 14.2% of the overall population. With 54.7% of the population in this age bracket, the majority of people fall into the early to mid-childhood range. Older children and teenagers make up 30.9% of the third age group.

In the present study, males outnumbered females (36 males; 85.7 % and 6 females; 14.2 %).

Arzu Kovanlikaya et al.'s study did not specify age distribution in detail, focusing more on the presence and grading of VUR across 268 renal units in 134 cases. This broad age inclusion may differ from our more segmented approach, potentially impacting the observed prevalence and diagnostic parameters due to the varying physiology and disease presentation in different age groups[22].

Huang et al.'s study included 310 children aged up to 2 years, with a median age of 5 months. The majority (86.1%) were under 1 year old, including 89.7% of boys and 80% of girls. This study's focus on a younger cohort, primarily infants, contrasts with our broader age range and could explain differences in diagnostic

performance metrics, as VUR presentation and detection might vary significantly between infants and older children[23].

Urine flow was a problem for most of the people surveyed, with "poor stream" being the most often mentioned concern. Six individuals reported burning micturition and recurring fever, while seven reported stomach pain, indicating pain or discomfort during urination or recurrent fever episodes. A lower percentage, 11.9%, reported more frequent micturition and a weak urine stream, suggesting that a sizable segment of the population experiences these problems.

The most common congenital anomaly in the surveyed population is posterior urethral valve, observed in 21.4% of individuals. Phimosis is reported in 16.6% of individuals, while anal atresia and crossed fused ectopic kidney are less common but still present in 9.5% and 7.1% of the population, respectively. The largest category is "Nil," comprising 45.2% of the population.

In Grade I reflux cases, reflux of urine is seen in the distal ureter with its dilatation, however proximal ureter was not dilated.

In Grade II reflux cases, reflux of urine is seen in the ureter and renal pelvis, however pelvis was not dilated.

In the higher grade refluxes (Grade III, IV and V), along the reflux, dilatation of the ureter and pelvicalyceal system was seen.

Grade III, Grade IV and Grade V showed mild, moderate and severe dilatation of the pelvicalyceal system respectively with blunting of calyces in grade IV and grade V vesicoureteral reflux.

According to the study, bilateral Grade IV VUR is the most prevalent, making up 23.8% of the participants in the survey. 21.4 % of the population has bilateral Grade V VUR, which is a more severe form of VUR. 19% of those surveyed have bilateral Grade II and III VUR, whereas 4.7% and 7.1% of participants had bilateral Grade I and Right Grade II VUR, respectively.

The study reveals that 88.1% of the population has bilateral reflux, with 37 individuals having bilateral vesicoureteral reflux and 11.9% having unilateral reflux.

Among the diagnosed cases, the USG found 38 true positive cases and 4 false negative cases; neither the USG nor the MCU found any false positives or true negatives.

Of the 38 cases (or 90.4% of all cases discovered in USG), 26 cases constituting 68.4 % were graded correctly, while 12 cases i.e. 31.6% were not graded correctly.

12 cases were diagnosed with low-grade VUR on MCU, with 9 cases (75%) being diagnosed on USG. 44% of cases were correctly graded on USG, while 3 (25%) children were not detected with VUR and 5 (66%) were not correctly graded among the 9 diagnosed children.

Even though the accuracy of detection and grading of the lower grade VUR on USG in low, the surgical management is not advised in lower-grade cases and have better prognosis.

29 were diagnosed with high-grade VUR on MCU, with 22 cases (75.8 %) correctly graded on USG. Out of these, 1 child was not detected with VUR on USG, and 24.1 % children were not correctly graded.

Study conducted by Leroy et al demonstrate that ureteral dilatation has the best diagnostic accuracy (compared with renal length, pelvic dilatation, urinary tract dilatation, and corticomedullary differentiation, with 73% sensitivity and 88% specificity for the detection of high-grade VUR[24]

USG is a safer and less stressful procedure compared to MCU, which requires a catheter insertion and contrast material. It uses sound waves to produce images, protecting both patients and medical staff. USG is accessible in most medical settings, unlike MCU which requires specialized equipment and personnel. It is particularly beneficial for young patients.

USG, while not as detailed as MCU, can dynamically assess bladder and ureters using color flow or Doppler imaging to detect reflux during voiding. Its ability to provide serial monitoring of VUR without repeated radiation doses is crucial, especially in pediatric cases.

While MCU remains valuable for detailed grading and real-time assessment of VUR severity, USG offers significant advantages in terms of safety, accessibility, and cost-effectiveness, especially for initial screening and follow-up evaluations.

MCU stops at the kidney, but USG looks at the kidney with respect to size, shape (shows signs of chronic pyelonephritis) and helps in ureteric characterization, persistent infection in the form of intrapelvic echoes and poor emptying of refluxed urine.

USG is also helpful in picking up additional parameters such as renal scarring, atrophic kidney, intrapelvic echogenicities, and dilated ureter.

USG is also helpful in prognosticating the disease process and providing a non-hesitant view of management and whether observational uroprophylaxis or surgical treatment is to be planned for the given clinical scenario.

## 5. CONCLUSION

Our study supports the use of USG as a valuable tool for screening, diagnosis as well as follow-up of vesicoureteral reflux cases and grading of the vesico-ureteral reflux in paediatric patients in higher-grade cases. Renal pelvis diameter and ureteral dilatation shows best accuracy is diagnosing & grading all-grade and high grade vesico-ureteral reflux.

## 6. LIMITATIONS

- One of the limitations of this study is the small sample size of 42 patients. A small sample size limits the statistical power of the study, making it difficult to make inferences. Additionally, in this study the sampling of participants was limited to known cases of VUR, thus inherently carrying risk of selection bias.
- The study's cross-sectional design limits the follow-up duration when ideally long- term follow-up is essential to assess the progression of VUR and the impact of early diagnosis and intervention on patient outcomes.
- While the accuracy of USG in detecting high-grade VUR (grades III-V) are reported to be high, the accuracy in detecting low-grade VUR (grades I-II) is lower. This discrepancy highlights a limitation in the diagnostic capability of USG for less severe cases of VUR, which may lead to underdiagnosis or misclassification of the condition in some patients.
- USG is advantageous due to its non-invasive nature and lack of radiation exposure, it may not provide the same level of detail as MCU, particularly for low-grade VUR.

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- **Conflict of interest:** None

**Disclaimers: None**

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