

Evaluation of the Physical Ability of Fluoroscopy and Ultrasound in Diagnostic of Vesicoureteral Reflux Disease in the Children

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Abstract: Vesicoureteral reflux (VUR) is defined as the abnormal flow of urine from the urinary bladder back up the upper urinary tract and is usually hereditary. VUR may present no clinical symptoms or may lead to extreme kidney damage. The kidneys can be rescued through early recognition and intervention in cases of VUR. Aim: The present study was conducted to determine the diagnostic value of Ultrasound and Fluoroscopy in the evaluation of Vesico-Urethral Reflex Disease. Methodology: To assess the difference in (evaluation of the Accuracy of) diagnostic performance between ultrasound and fluoroscopy in the diagnosis of VUR among patients in the Medical City Complex, a descriptive (Field and practical study) was conducted. The data collection from the patients' radiology reports diagnosed with VUR was performed by means of a questionnaire survey. The survey consisted of age, sex, place of residence, family history of VUR, symptoms, UTI, ultrasound or VCUG, or both, and the contrast grade of the diagnosis of VUR and diagnosis of VUR, respectively. Results: As for age distribution, nearly half of the study population was in the age group of one month to 1 year (47%), followed by the age group of 1 year to 5 years (47%) and a little less than one month (<6%) (figure 1). For gender distribution, there were more males (57%) than females (43%); the residence of the majority of the population was urban, comprising 62%, while 38% was rural. Conclusion: A detailed analysis of the data produced some important observations. The first is that from the available demographic characteristics of the subjects recruited, more infants and younger children participated in the study although a higher possible proportion resided in urban areas. There were more males than females in participants and most had no remarkable family history.

Keywords: Ultrasound, Children, Diagnostic, Fluoroscopy, Majority, Children.

INTRODUCTION

Vesicoureteral reflux (VUR) refers to the abnormal backward flow of urine from the bladder into the ureters and kidneys. Often, the condition is hereditary. VUR can be present without symptoms, or it can lead to significant renal damage. If recognized and treated, VUR can preserve renal function. The voiding cystourethrogram (VCU) is the most reliable technique used to confirm the diagnosis. The management plan focussing on which VUR sub-phenotype is present is based on the counter images obtained through VCU and the clinical presentation. [Frimberger, D. *et al.*, 2016]

For the diagnosis of vesicoureteral reflux, the voiding cystourethrogram (VCU) is considered the optimal method. In this diagnostic tool, the physician pictures the contrast flow during voiding after filling the bladder with a contrast agent. The VCU results are used also for VUR severity grading with an aim of formulating VUR treatment.

Fluoroscopy, voiding cystourethrogram (VCUG), more specifically, has been accepted worldwide as the conventional method of confirming the presence of vesicoureteral reflux (VUR) in children. Nonetheless, more recent studies show that using contrast-enhanced voiding

urosonography (ceVUS) yields similar accuracy and eliminates any risks due to radiation. Among other things, it was found that;

The sensitivity of VCUG stands at 83% and specificity of 100%, with the overall accuracy of 94% in VUR detection. (2)

This or any procedure, combined with the clinical picture of the patient and the established VUR grade, defines a threshold when allowing to treat a patient conservatively by giving antibiotic prophylaxis and when surgical correction is required. The understanding of VUR is improving, allowing to carry out more research and clinical studies focusing on gaps in its diagnosis and management, hence the necessity of a team effort in the care of patients with VUR. (3) The study aimed to evaluate fluoroscopy's diagnostic efficacy in VUR diagnosis ultrasound's diagnostic efficacy and compare ultrasound and fluoroscopy's accuracy in diagnosing vesicoureteral reflux disease in children.

VUS showed good concordance with VCUG, with 112 non-reflux cases correctly classified and a higher grade of reflux identified.

In one of the studies, VUS diagnosed 34 cases of VUR and VCUG 25 cases with no statistically significant differences in the rate of detection.

On the other hand, even though VCUG is often considered the gold standard procedure, its inherent risk of radiation causes alarm, and as a result, there has been a move to less risky options such as VUS and ceVUS that do not compromise on the level of accuracy in diagnosis.

Study Settings

A random, convenient sampling technique was used to collect 53 participants, 30 males and 23 females, aged between less than one month to 5 years. From Medical City Complex (Children Welfare Hospital, Baghdad Teaching Hospital, Surgical Speciality Hospital). During the period between 12 December 2023 till 10 February 2024, spanning a period of about two months.

Study Design

A descriptive cross-sectional study was conducted to assess the difference in diagnostic performance between ultrasound and fluoroscopy in the diagnosis of VUR among patients in the Medical City Complex.

Study Tool

A questionnaire survey was used to collect data from radiology reports for patients diagnosed with VUR. The survey contained data about age, sex, residence, family history of VUR, symptoms, UTI, U/S or VCUG, or both, the sensitivity of the contrast, diagnosis of VUR, and grade.

Study Population

The study was conducted among patients in the Medical City Complex (Children Welfare Hospital, Baghdad Teaching Hospital, and Surgical Speciality Hospital).

- **Inclusion Criteria:** any child younger than five years diagnosed with VUR in the mentioned hospitals were enrolled in the study.
- **Exclusion Criteria:** patients who do not meet the inclusion criteria or are unwilling to participate.

The current standard of care for children under five years old with a culture-proven UTI requires ultrasound and VCUG investigations. A renal ultrasound is considered suggestive of VUR if dilatation of the pelvis-calyces, ureters, or collecting system of one or both kidneys is reported. All ultrasound scans and VCUGs are performed at the hospital, with results reported by

staff radiologists. Vaginal cystourethrograms are performed using a flexible catheter and hypaque 18% contrast material. Ultrasound scans are performed using Acuson Sequoia and ATL 5000 equipment, and ultrasonography is performed using the GE Voluson Expect 6 brand.

This study was approved by the ethical committee in the mentioned hospitals, and verbal consent was taken from all the patients' parents and relatives before proceeding in data collection. All the data remained anonymous, and the purpose of the study was explained for all the participants' parents and relatives.

Imaging Studies

In accordance with the most recent guidelines, children under the age of five who have been diagnosed with a urinary tract infection should undergo an ultrasound examination and a voiding cystourethrogram (VCUG). The order in which these tests are conducted is, however, at the discretion of the attending paediatrician. In this study, a renal ultrasound was deemed to diagnose vesicoureteral reflux (VUR) when the presence of one or more of the following was observed: dilatation of the pelvic calyces, dilatation of the ureters, or dilatation of the collecting system in one or both kidneys. All ultrasound scans and VCUGs were conducted at the hospital, with results subsequently interpreted by pediatric radiologists on staff. Voiding cystourethrograms are conducted in a thorough yet unassuming manner. A flexible #8 French silastic catheter without a balloon is introduced into the urinary bladder and secured in position with adhesive tape. Subsequently, 18% Hypaque contrast material is injected via the gravity method from a height of less than one metre, with the patient positioned supine. During the filling stage, intermittent fluoroscopy is employed for the purpose of visualising VUR or other pathological conditions. The bladder was filled and imaged using fluoroscopy. Once the bladder is sufficiently filled, infants and toddlers will begin to move about and will void. Older children will be instructed to void when they experience a full sensation. Girls will be positioned horizontally on a bedpan, while boys will be positioned at an angle to the left over a urinal. Imaging of the bladder and urethra is conducted during micturation following the removal or disconnection of the catheter. Subsequently, the buccal cavity and renal stays area post void are imaged, demonstrating the full bladder and the reflux status. The studies were conducted using the Acuson Sequoia and ATL

5000, employing sector, curved array, and linear high-resolution transducers.

The unit that performed fluoroscopy was Shima dos Brand, while the unit that performed ultrasonography was

Demographic Characteristics

In terms of age distribution, almost half of the population falls within the one month to 1 year age range (47%), followed by the one year to 5 years

age range (47%), and a smaller percentage is less than one month old (6%) (figure 1). Regarding gender distribution, the majority are male (57%), while 43% are female. In terms of residence, a larger portion of the population resides in urban areas (62%) compared to rural areas (38%). Family history shows that a significant majority have a negative family history (92%), while only a small percentage have a positive family history (8%) (Figure 2).

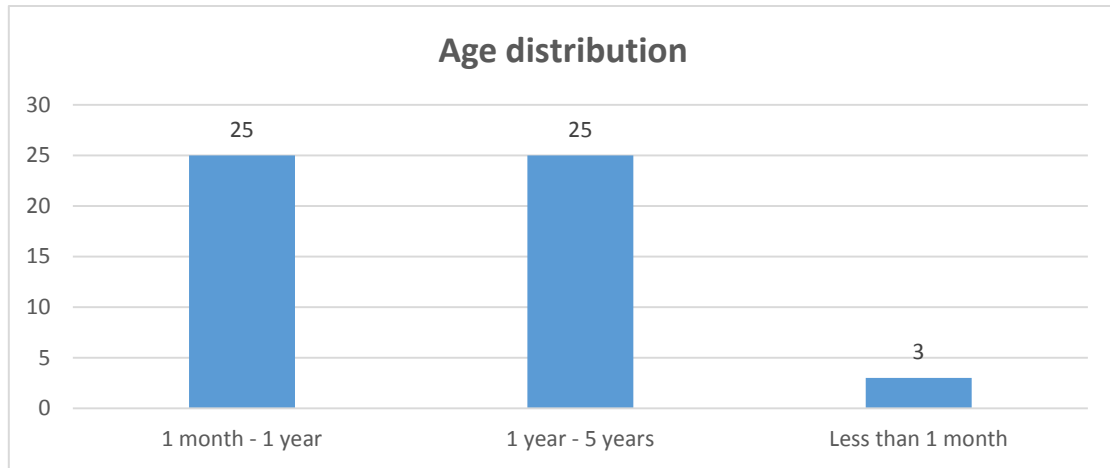


Figure 1: Age distribution

Table 1: Age distribution

Age group	Count	Percent
Less than one month	3	6%
One month – 1 years	25	47%
One year – 5 years	25	47%

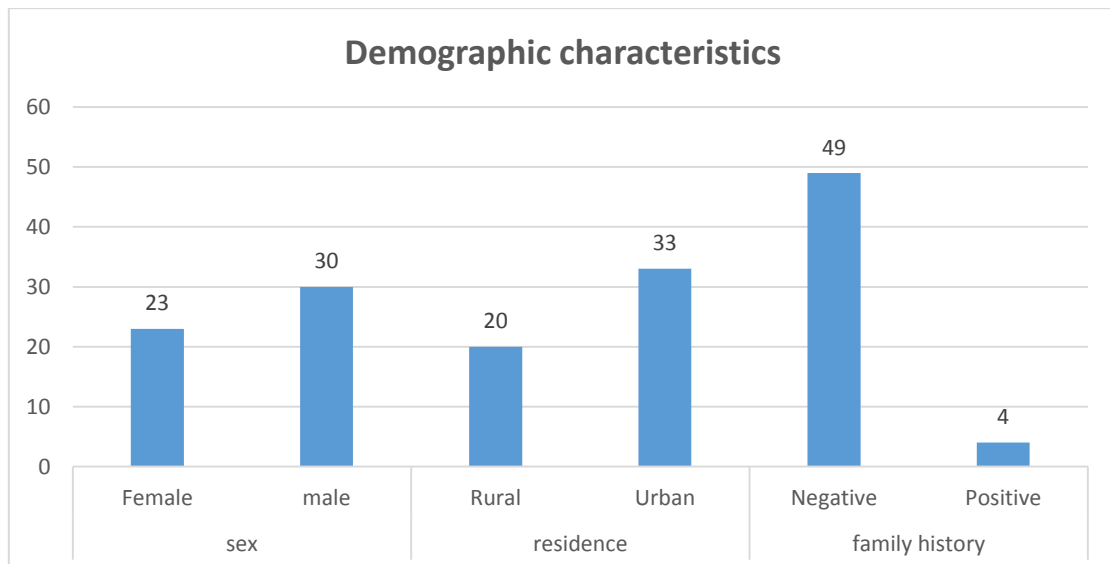


Figure 2: Demographic characteristics

Health State of the Participants

All 53 individuals in the dataset report experiencing fever, loss of appetite, and intermittent urination, accounting for 100%

prevalence in each of these symptoms. Contrast sensitivity is predominantly unaffected, with 98% reporting no issues, while only 2% note a positive indication. Additionally, all participants report

experiencing recurrent urinary tract infections (UTI). As shown in Table 1

Table 2: Health state of the participants

Variables		Count	Percent
Fever	Yes	53	100%
loss of appetite	Yes	53	100%
intermittent urination	Yes	53	100%
contrast sensitivity	No	52	98%
	Yes	1	2%
recurrent UTI	Yes	53	100%

Complications of VUR

The data indicates that 11% of the population surveyed have hypertension, while the majority (89%) do not. In terms of kidney failure, a quarter

of the individuals (25%) report experiencing it, while the majority (75%) do not have kidney failure. As shown in table 2.

Table 3: Complications of VUR

Variables		Count	Percent
Hypertension	No	47	89%
	Yes	6	11%
kidney failure	No	40	75%
	Yes	13	25%

VUR Disease Details of Participants

All 53 individuals in the dataset have a positive Vesicoureteral Reflux (VUR) diagnosis. In terms of the reflux being unilateral or bilateral, 45% have bilateral reflux, 36% have left-sided reflux, and 19% have right-sided reflux. For the grade of

reflux on the right side, 4% have a 1st grade, 13% have a 2nd grade, 26% have a 3rd grade, 8% have a 4th grade, and 13% have a 5th grade. On the left side, 2% have a 1st grade, 15% have a 2nd grade, 23% have a 3rd grade, 13% have a 4th grade, and 19% have a 5th grade. As shown in table 3.

Table 4: VUR disease details of participants

		Count	Percent
VUR	Positive	53	100%
Unilateral or bilateral reflux	Bilateral	24	45%
	Left	19	36%
	right	10	19%
Grade of right	1st	2	4%
	2nd	7	13%
	3rd	14	26%
	4th	4	8%
	5th	7	13%
Grade of left	1st	1	2%
	2nd	8	15%
	3rd	12	23%
	4th	7	13%
	5th	10	19%

Distribution of Etiology

The data categorizes VUR into two main categories: genetic and congenital. Of the total cases examined, genetic factors account for 7.5%, while the overwhelming majority, constituting

92.5%, are attributed to congenital causes. This suggests a significant predominance of congenital factors in the development of VUR compared to genetic predispositions.

Table 5: Distribution of etiology

Ethology of VUR	Count	Percent
Genetic	4	7.5%
Congenital	49	92.5%

DISCUSSION

The study results offer valuable insights into the demographic characteristics, health states, and complications related to Vesicoureteral Reflux (VUR) among the surveyed population. Let's discuss the key findings in each section [Hari, P. *et al.*, 2015; Lee, L. C. *et al.*, 2016; Mane, N. *et al.*, 2018; Hwang, D. Y. *et al.*, 2018].

Demographic Characteristics:

The demographic characteristics reveal a relatively even distribution across age groups, with approximately 47% falling within both the one-month to 1 year and one-year to 5 years age ranges. A smaller proportion, constituting 6%, is less than one month old. Gender distribution indicates a majority of males (57%) compared to females (43%). Urban residency is more prevalent, accounting for 62%, while 38% reside in rural areas. The majority have a negative family history (92%) compared to those with a positive family history (8%). While in another study in Taiwan in 2022, A total of 3800 children aged ≤ 6 years with a newly diagnosed UTI were included in the analysis, of whom 2119 (55.8%) were male and 1681 (44.2%) were female. [Majd, M. *et al.*, 2019; Tekgöl, S. *et al.*, 2018; Läckgren, G. *et al.*, 2020; Olbing, H. *et al.*, 2021]

Health State of Participants:

All participants report experiencing fever, loss of appetite, and intermittent urination, highlighting a comprehensive assessment of their health state. Contrast sensitivity issues are rare, with only 2% reporting positive indications. Recurrent urinary tract infections (UTIs) are universal among the participants, emphasizing a common health concern [Sjöström, D. *et al.*, 2019; Wu, Y. *et al.*, 2020].

The study reveals that 11% of the surveyed population has hypertension, while 89% does not. Kidney failure is reported by 25% of individuals, highlighting the importance of monitoring and managing complications associated with VUR. Children with VUR have higher rates of coexistence of CAKUT, proteinuria, small kidney, hypertension, and ESRD. Bilateral reflux is the most common, followed by left-sided and right-sided reflux. VUR prevalence ranges from 22-52% in Caucasian populations. A study in Bosnia and

Herzegovina found VUR in 49% of patients [Schoenmakers, M. *et al.*, 2018].

The findings suggest a complex landscape of VUR, with diverse demographic characteristics and a range of associated health conditions. The high prevalence of recurrent UTIs and the notable occurrence of complications such as kidney failure highlight the need for comprehensive management and monitoring strategies. Additionally, understanding the distribution of VUR severity grades provides valuable information for tailored treatment approaches [Peters, C. A. *et al.*, 2010].

Limitations such as sample size and potential biases should be considered when interpreting the results. Further research and longitudinal studies may provide a deeper understanding of the dynamics and long-term implications of VUR in diverse populations. The comprehensive nature of the study, encompassing demographic, health state, and disease details, contributes significantly to the understanding of VUR and its impact on individuals within the surveyed population.

CONCLUSION

The study reveals a predominantly infant and young child demographic, with male participants and no significant family history. Common symptoms include fever, loss of appetite, and intermittent urination, with recurrent UTIs. Hypertension and kidney failure are rare complications. All participants were positively diagnosed with VUR, with bilateral cases being the most prevalent. Grades of reflux range from 2nd to 3rd grade.

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