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The Spectrum of Urinary Tract Diseases on Conventional Imaging in the Paediatric Population of Srikakulam District

Dr B.Narendra Naidu[1],
Dr B.R. Nagaraj, MDRD, DMRD, FICR[2]
[1](Third year postgraduate, Dept of Radio-Diagnosis, GEMSand Hospital, Andhra Pradesh)
[2](Professor and HOD, Dept of Radio-Diagnosis, GEMS and Hospital, Andhra Pradesh)

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ABSTRACT
Background: Congenital anomalies of the kidney and urinary tract (CAKUT) include a wide spectrum of anomalies, with a reported incidence of up to 2% of births. CAKUT account for almost one-fourth of all birth defects. These are major causes of kidney disease in children and account for more than 40% of end-stage renal disease (ESRD. CAKUT includes a wide spectrum of anomalies such as pelviureteral junction obstruction (PUJO), multicystic dysplastic kidney (MCDK), renal hypoplasia, horseshoe kidney, ectopic kidney, primary vesicoureteric reflux (VUR), posterior urethral valve (PUV), and vesicoureteral junctional obstruction (VUJO). It is important to diagnose these anomalies and initiate therapy to prevent or delay the onset of ESRD.
Aim of the study: This study evaluates the radiological spectrum of congenital anomalies of the kidney and urinary tract (CAKUT) in a pediatric population using conventional contrast studies.
Materials and Methods: A cross-sectional retrospective observational study was conducted from March 2018 to December 2019 which included 50 patients. Data from conventional contrast techniques such as intravenous urography and micturating cystourethrogram was obtained and categorized based on underlying renal and urinary tract structural/functional malformations and anomalies.
Results: The most common anomaly was hydronephrosis (10, 20%), followed by vesicoureteric reflux (VUR) (8, 16%), posterior urethral valves (2, 4%), duplex collecting system (1, 2%), aberrant vessel causing dilatation of left renal pelvicalyceal system (1,2%) and vesicoureteric junction calculus (1, 2%). Hydronephrosis (9, 90%) and vesicoureteric reflux (6, 75%) were common in males. The most common age group affected with hydronephrosis (8, 80%) and vesicoureteric reflux (4, 50%) is 1day to 3years.
Conclusion: Radiologic investigations continue to be one of the most important sources of clinical information in the assessment of kidney and urinary tract disorders. The average age at clinical presentation for the different subgroups of anomalies indicates delay in referral. We stress the need for prompt referral to initiate appropriate therapeutic strategies in children with congenital anomalies of the kidney and urinary tract.
Keywords-CAKUT, Hydronephrosis, Vesicoureteric reflex, Posterior urethral valve, Duplex collecting system.

I. INTRODUCTION

Congenital anomalies of the kidney and urinary tract (CAKUT) include a wide spectrum of anomalies, with a reported incidence of up to 2% of births. CAKUT account for almost one-fourth of all birth defects. These are major causes of kidney disease in children and account for more than 40% of end-stage renal disease (ESRD. CAKUT includes a wide spectrum of anomalies such as pelviureteral junction obstruction (PUJO), multicystic dysplastic kidney (MCDK), renal hypodysplasia, horseshoe kidney, ectopic kidney, primary vesicoureteric reflux (VUR), posterior urethral valve (PUV), and vesicoureteral junctional obstruction (VUJO). It is important to diagnose these anomalies and initiate therapy to prevent or delay the onset of ESRD.

II. MATERIALS AND METHODS

A cross-sectional retrospective observational study was conducted from March 2018 to December 2019 which included 50 patients. Data from conventional contrast techniques such as intravenous urography and micturating cystourethrogram was obtained and categorized based on underlying renal and urinary tract structural/functional malformations and anomalies.

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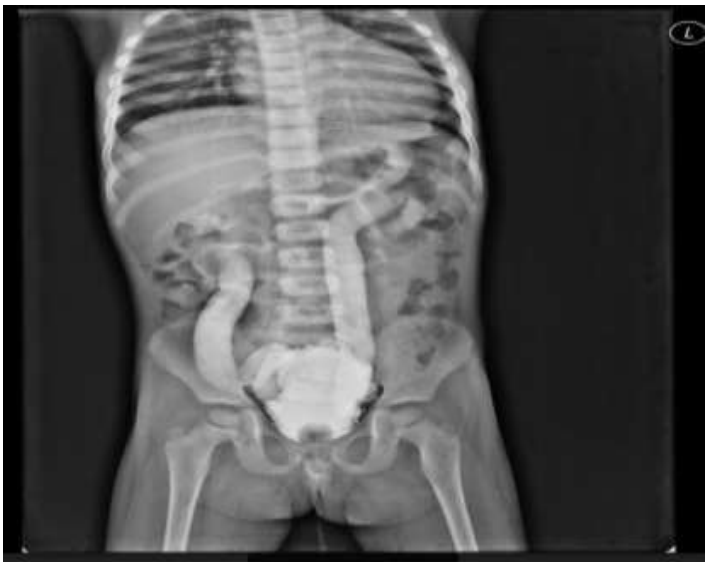
Examination technique :

Conventional contrast techniques such as intravenous urography and micturating cystourethrogram. Voiding cystourethrography is an examination method by which after retrograde introducing of a contrast agent into the bladder, screening is done during micturition. Voiding cystourethrography is most often done in children suffering from urinary infections to confirm or exclude the existence of vesicoureteral reflux. Intravenous urography is the examination of the urinary tract including renal parenchyma, calyces and pelvis after intravenous injection of contrast media.

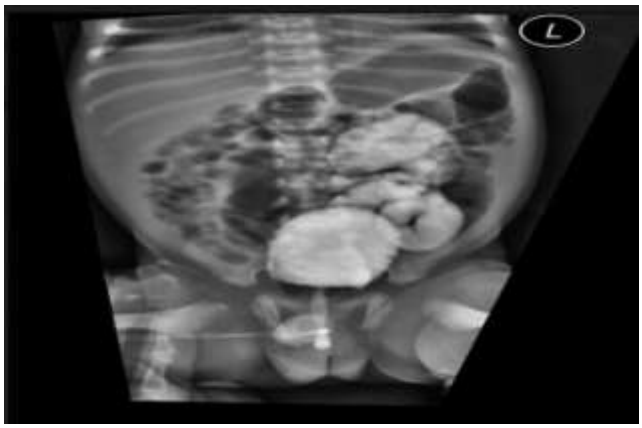
III. DATA ANALYSIS

Statistical analysis of the data was performed by using Microsoft Excel. Data was represented in the form of frequencies and percentages with the help of tables, bar diagrams.

Imaging findings



Mcug image showing GradeIV VESICOURETRAL REFLEX(VUR)



MCUG image showing Left GradeV VESICO URETRAL REFLEX(VUR)

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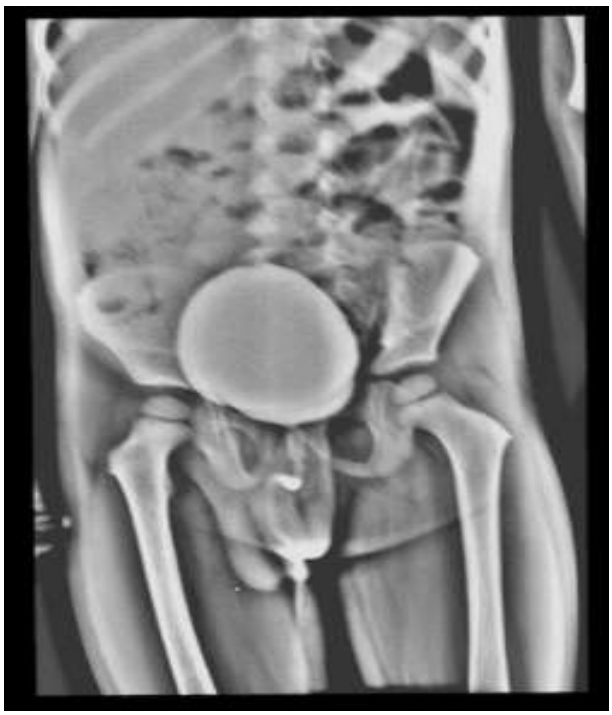
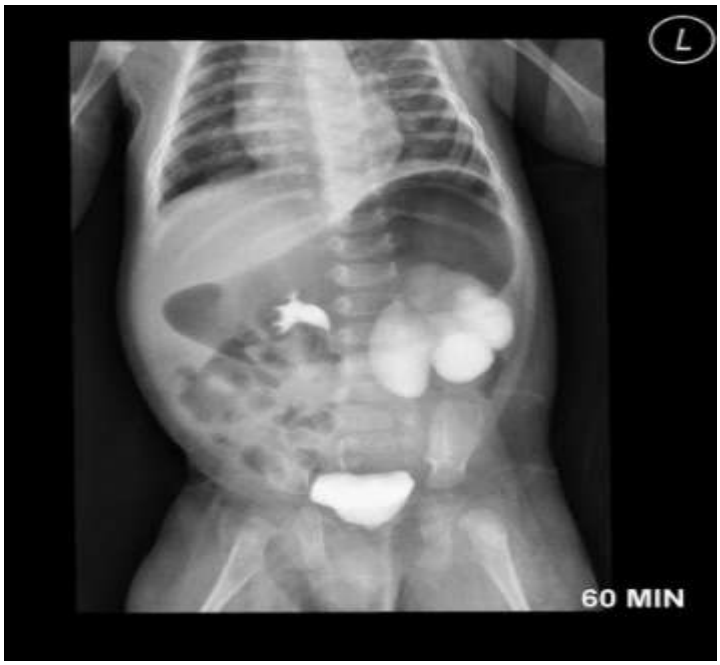


MCUG image showing dilated proximal urethra s/o of posterior urethral valve



IVU image at 60 min showing LEFT GROSS HYDRONEPHROSIS

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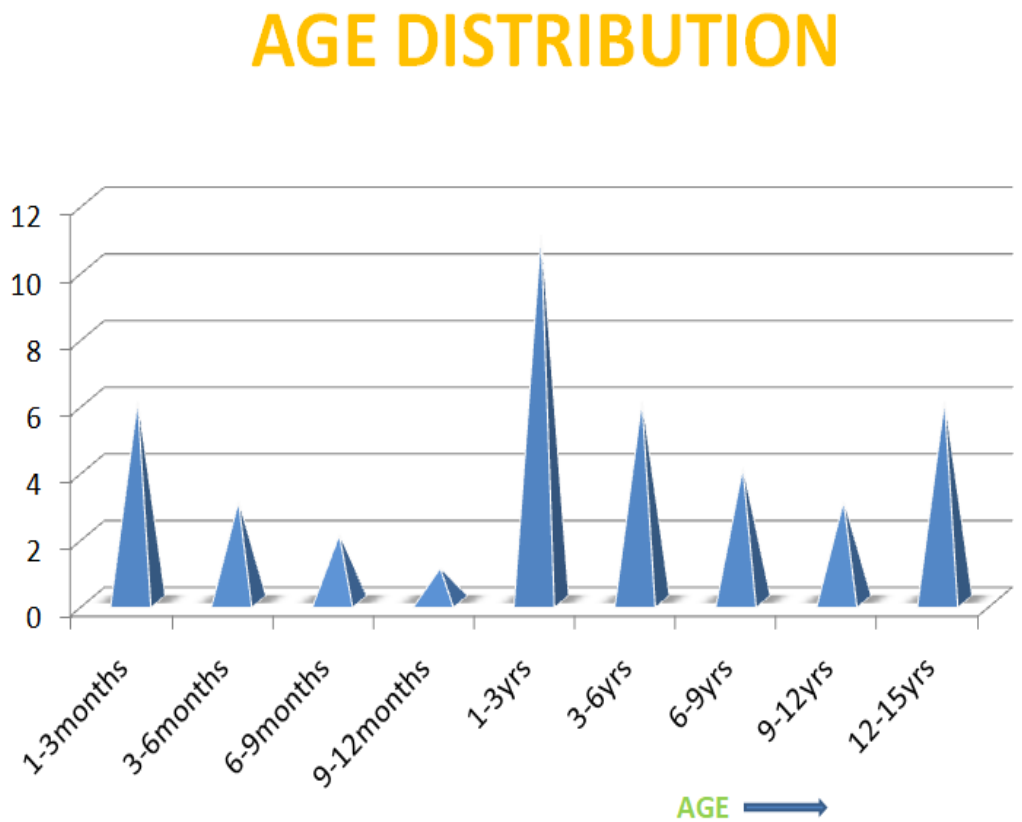
IV. RESULTS:

The most common anomaly was hydronephrosis(10, 20%),followed by vesicoureteric reflux(VUR) (8, 16%), posterior urethral valve (2, 4%), duplex collecting system(1, 2%), vesicoureteric junction calculus (1, 2%), aberrant vessels causing dilatation of left renal pcs (1,2%).Hydronephrosis is most common in males (9, 90%), and vesicoureteric reflux is most common in males (6, 75%). The most common age group affecting hydronephrosis is up to 3years (8, 80%). The most common age group affected with vesicoureteric reflux is up to 3yrs (4, 50%).



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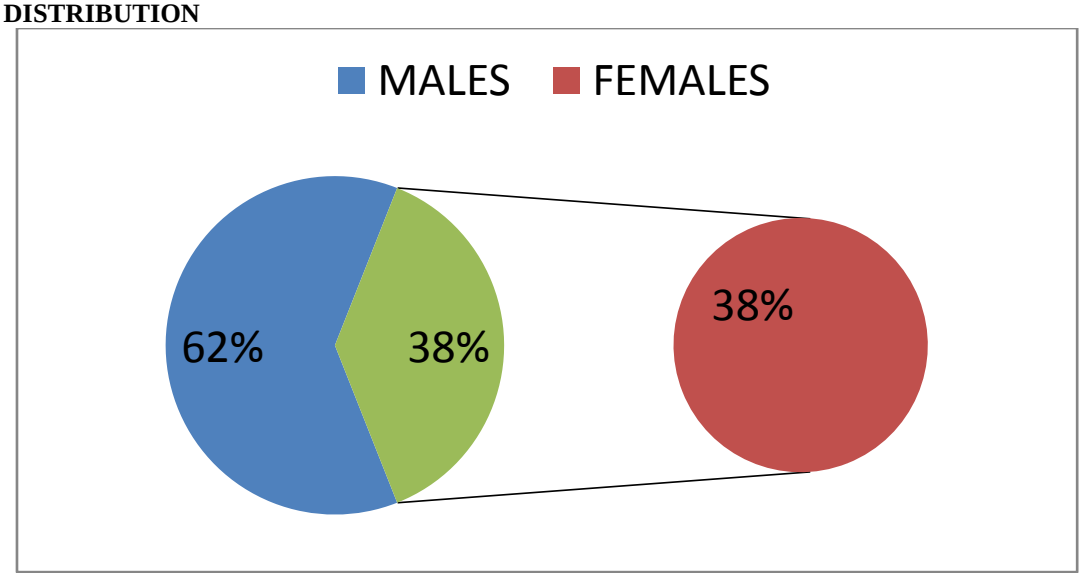

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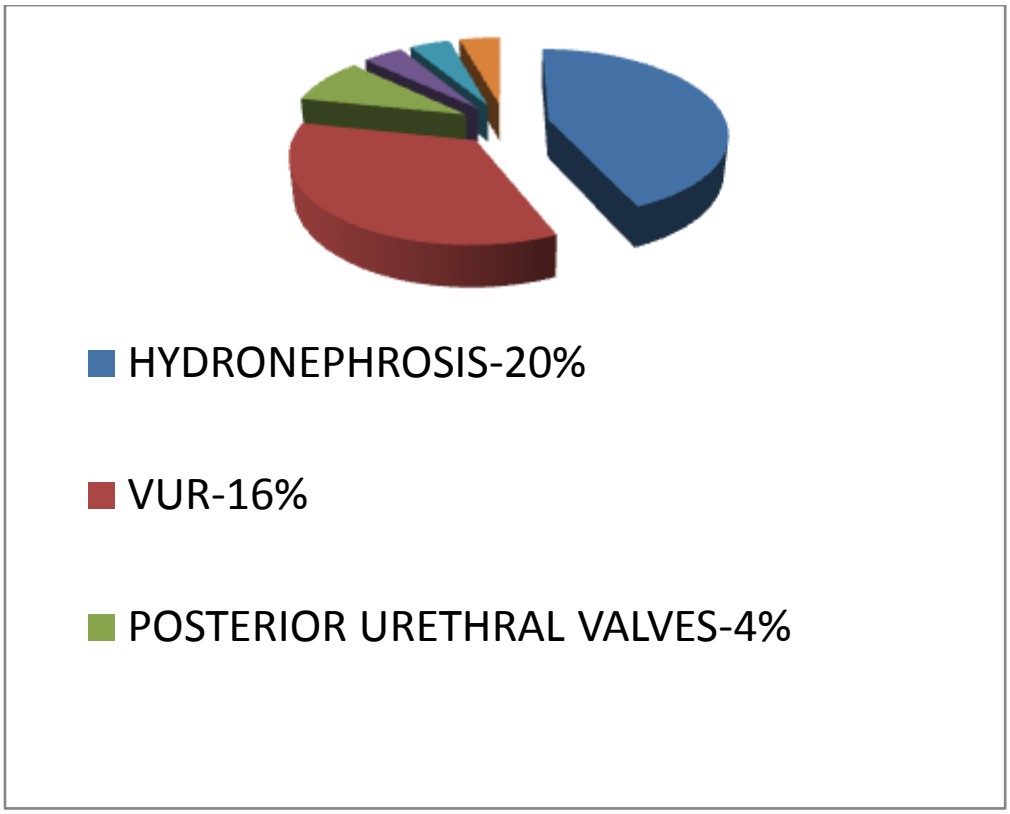
URINARY TRACT DISEASES



NUMBER AND DISTRIBUTION OF URINARY TRACT DISEASES

URINARY TRACT DISEASE	NUMBER	PERCENTAGE(%)
HYDRONEPHROSIS	10	20%
VUR	8	16%
POSTERIOR URETHRAL VALVE	2	4%
DUPLEX COLLECTING SYSTEM	1	2%
VESCICOURETERIC JUNCTION CALCULUS	1	2%
ABBERENT VESSELS CAUSING DILATATION OF LEFT RENAL PCS	1	2%

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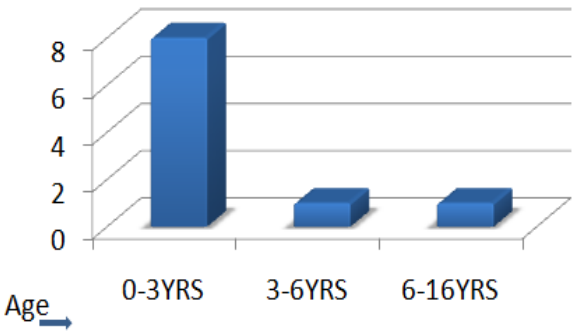
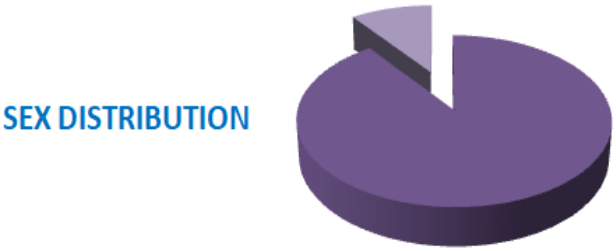
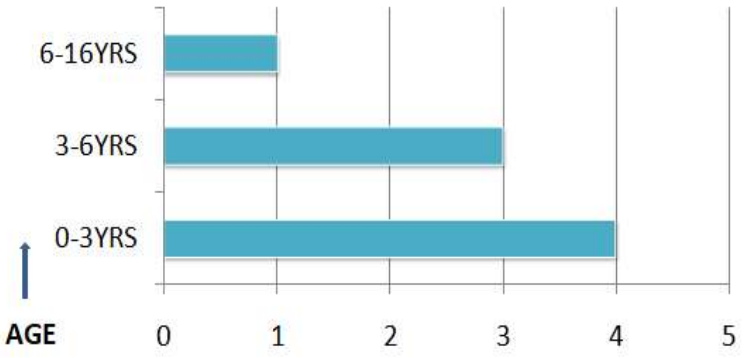
HYDRONEPHROSIS



AGE DISTRIBUTION



VESCICOURETERIC REFLUX



AGE DISTRIBUTION

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V. DISCUSSION:

Congenital malformations of the kidney and urinary tract represent 23% of all birth defects. These malformations account for 40%–50% of pediatric and 7% of adult end-stage renal disease worldwide. The pattern of clinical presentation of CAKUT in infants and children is extremely heterogeneous. Therefore, timely and precise clinical characterization of CAKUT both structurally and functionally is of utmost importance. Frequent familial and syndromic CAKUT among study patients indicates the crucial need for detailed family history and thorough clinical examination for proper clinical phenotyping of all CAKUT patients.

Hydronephrosis

Hydronephrosis is the dilation of the renal pelvis and calyces secondary to increased urine retention. In 50% to 75% of the cases, hydronephrosis is transient or physiologic. Other causes, such as UPJ obstruction and VUR, have an incidence of 10% to 30%. Less common causes include UVJ obstruction, MCDK, or posterior urethral valves (PUVs). A complete physical examination should be performed with particular focus on the lower abdomen for a distended bladder, genitalia for penile abnormalities and urine flow, and the back for signs of neural tube defects, which may be associated with a neurogenic bladder. Blood work assessing kidney function is generally withheld, except in bilateral hydronephrosis and severe cases. RBUS is useful in determining the severity of hydronephrosis, for which multiple classification systems exist. The urinary tract dilation classification system is widely used, which includes parameters on anteroposterior renal pelvic diameter, calyceal dilation, parenchymal thickness and appearance, and ureter and bladder abnormality. The Society for Fetal Urology classifies diseases on the anteroposterior renal pelvic diameter and the appearance of the kidney, ureter, and bladder. Postnatally in a low risk patient with unilateral hydronephrosis, RBUS can be performed 7 to 10 days after birth. Exceptions to delayed imaging include cases of oligohydramnios, urethral obstruction, bilateral high-grade dilation, and follow-up concerns. In bilateral hydronephrosis or a high-risk infant with bladder dilation, delivery at a centre with pediatric urology support is recommended. A high-risk maternal/ fetal medicine specialist should be involved when there are findings of oligohydramnios. If the lower urinary tract is involved and there is bladder distention and/or bilateral hydroureteronephrosis, voiding cystourethrography (VCUG) should be performed to rule out PUVs, and initiation of antibiotic prophylaxis is recommended.

Vesicoureteral Reflux

VUR is the most common pediatric urologic condition, affecting up to 30% of children with a febrile UTI and 0.4% to 1.8% of the general pediatric population. In infants with prenatal hydronephrosis, 10% to 20% will have VUR. It is seen in 50% of children of parents with VUR and 25% of siblings with VUR. Primary reflux is an embryonic anatomical defect and largely spontaneously self-resolves with elongation of the intravesical tunnel at the UVJ as the child grows. Secondary VUR occurs when increased intravesical pressures lead to retrograde urine flow past the normal UVJ. This can be due to disorders such as neurogenic bladder, PUVs, or bowel and bladder dysfunction in anatomically normal children. Correction of bowel and bladder dysfunction may resolve VUR. Management of VUR is controversial and may include antibiotic prophylaxis and/or surgical correction, taking into consideration patient age, severity, renal scarring, and parental preference. A meta-analysis that included the RIVUR (Randomized Intervention for Children with Vesicoureteral Reflux) and prevents (Prevention of Recurrent Urinary Tract Infection in Children with Vesicoureteric Reflux and Normal Renal Tracts) studies demonstrated that although antibiotic prophylaxis can reduce UTIs, it does not reduce kidney scarring. Furthermore, antibiotic-resistant bacteria increasingly cause infections while the patient is on prophylaxis. Complications of VUR include pyelonephritis, renal scarring, hypertension, and chronic kidney disease.

Posterior Urethral Valves

PUVs are characterized by abnormal mucosal folds at the prostatic urethra level that functions as a valve to obstruct urine flow. They are the most common cause of congenital urethral obstruction, affecting 1 in 5,000 to 1 in 25,000 live male births. Prenatal ultrasonography may show bilateral hydronephrosis, a thick-walled bladder, dilated posterior urethra, and/or oligohydramnios. If not diagnosed prenatally, PUVs can present in newborns with intrauterine growth retardation and a weak voiding stream. Older children can present with recurrent UTIs, urosepsis, renal failure, or incontinence. VCUG remains the gold standard for detecting PUV and will show the proximal urethra more dilated than the urethra distal to the valve. A urethral catheter should be placed in the bladder to relieve the obstruction. The treatment of choice is

transurethral valve ablation, with diversion of the obstructed bladder via vesicostomy as an alternative. PUVs continue to have high mortality and morbidity and are the most common cause of obstructive uropathy leading to ESRD. Eagle-Barrett syndrome, also known as prune belly syndrome, is a rare lower urinary tract malformation affecting 1 in 30,000 newborns, with 95% of patients being males. Prenatal ultrasonography reveals findings similar to PUVs. Diagnosis at birth is established clinically with pathognomonic findings of deficiency of abdominal wall musculature with loose and wrinkled overlying skin and bilateral cryptorchidism. RBUS reveals dilation of the urinary tract secondary to urethral obstruction. Nearly 50% of patients have associated cardiovascular, gastrointestinal, or orthopaedic malformations, and all patients have some degree of renal dysplasia. These patients have a high incidence of chronic kidney disease, with 40% to 50% of patients needing renal replacement therapy.

Duplicated Collecting System

Duplications of the collecting system are the result of abnormal embryonic origins. Complete duplication is a double ureter, each draining separately into the bladder, whereas partial duplication presents with a bifid ureter with a single drain into the bladder. VUR is usually present in the lower moiety of a duplicated collecting system, whereas the upper moiety is associated with an obstructive ectopic ureter, with or without a ureterocele. The prevalence of ureteral duplications is less than 1% of the general population and affects females 2 to 4 times more often than males. Complications of a duplicated collecting system include VUR, obstruction, ectopic ureteral insertion, and ureteroceles. Ultrasonography is the mainstay of diagnosis, both before and after birth, and is the most common modality for incidental findings of duplication. VCUG can help determine VUR and voiding patterns. Management differs widely, based on anatomical abnormality, function, and VUR severity.

VI. CONCLUSION

- Radiologic investigation continues to be one of the most important sources of clinical information in the evaluation of lower urinary tract disorders.
- The median age at clinical presentation for various subgroups of anomalies indicates delayed referral. We emphasize the need for prompt referral to initiate appropriate therapeutic strategies in children with congenital anomalies of the kidney and urinary tract.

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