PROFILE OF RENAL TRACT ANOMALIES IN CHILDREN PRESENTING WITH URINARY TRACT INFECTION

Dissertation submitted to

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(BRANCH VII)

INSTITUTE OF CHILD HEALTH AND

HOSPITAL FOR CHILDREN

MADRAS MEDICAL COLLEGE

CHENNAI

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CERTIFICATE

This is to certify that dissertation entitled "**PROFILE OF RENAL TRACT ANOMALIES IN CHILDREN PRESENTING WITH URINARY TRACT INFECTION"** submitted by **DR. PADMAVATHI.A** to the Faculty of Paediatrics, The Tamil Nadu Dr . M.G.R. Medical University, Chennai in partial fulfillment of the requirement for the award of M.D. Degree (Paediatrics) is a bonafide research work carried out by her under direct supervision and guidance.

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DECLARATION

I **DR. PADMAVATHI.A** solemnly declare that the dissertation titled "**PROFILE OF RENAL TRACT ANOMALIES IN CHILDREN PRESENTING WITH URINARY TRACT INFECTION**" has been prepared by me. This is submitted to the Tamil Nadu Dr. M.G.R. Medical University, Chennai in partial fulfillment of the rules and regulations for the M.D degree examination in Paediatrics.

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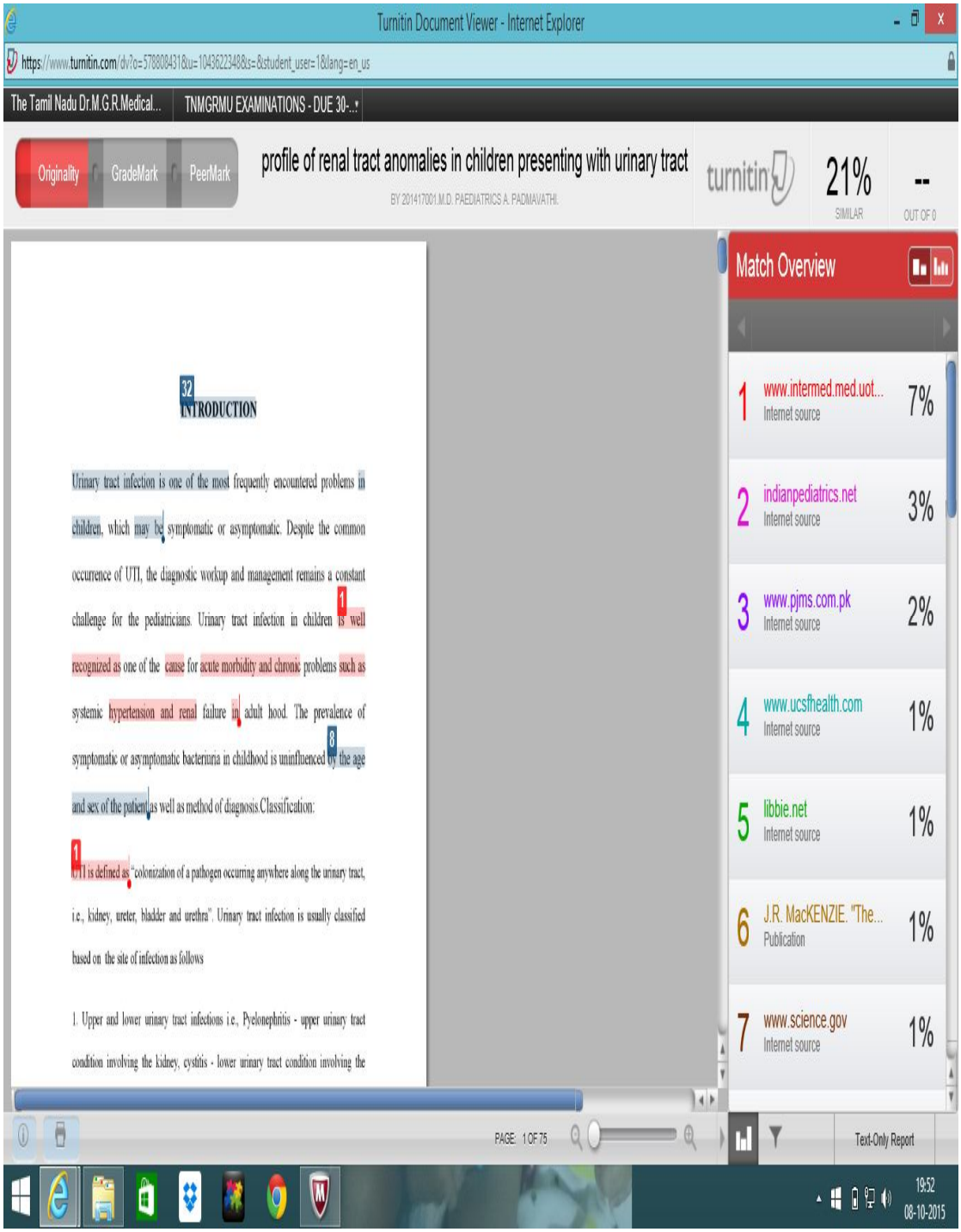
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INTRODUCTION
Urinary tract infection is one of the most frequently encountered problems in children, which may be symptomatic or asymptomatic. Despite the common occurrence of UTI, the diagnostic workup and management remains a constant challenge for the pediatricians. Urinary tract infection in children is well recognized as one of the cause for acute morbidity and chronic problems such as systemic hypertension and renal failure in adult hood. The prevalence of symptomatic or asymptomatic bacteriuria in childhood is uninfluenced by the age and sex of the patient as well as method of diagnosis.Classification:
UTI is defined as "colonization of a pathogen occurring anywhere along the urinary tract, i.e., kidney, ureter, bladder and urethra". Urinary tract infection is usually classified based on the site of infection as follows
1. Upper and lower urinary tract infections i.e., Pyelonephritis - upper urinary tract condition involving the kidney, cystitis - lower urinary tract condition involving the
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INTRODUCTION

Urinary tract infection is one of the most frequently encountered problems in children, which may be symptomatic or asymptomatic. Despite the common occurrence of UTI, the diagnostic workup and management remains a constant challenge for the pediatricians. Urinary tract infection in children is well recognized as one of the causes for acute morbidity and chronic problems such as refractory hypertension and renal failure in adult hood. The prevalence of symptomatic or asymptomatic bacteriuria in childhood is manifluenced by the age and sex of the patient as well as method of diagnosis (Clean/Catheter).

UTI is defined as "colonization of a pathogen occurring anywhere along the urinary tract i.e. kidney (renal, bladder and urethra)". Primary tract infection is usually classified based on the site of infection as follows.

1. Upper and lower urinary tract infections i.e., Pyelonephritis = upper urinary tract condition involving the kidney, cystitis = lower urinary tract condition involving the bladder.

2. Severely complicated and uncomplicated

Hospital and acute ambulant approach is to categorize UTI as first infection and recurrent infection.

1

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ABSTRACT

"PROFILE OF RENAL TRACT ANOMALIES IN CHILDREN PRESENTING WITH URINARY TRACT INFECTION"

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KEYWORDS: Renal tract anomalies, urinary infection, MCU, USG Kidney.

BACKGROUND:

Urinary tract infection is one of the most common problems in children. Despite the common occurrence of UTI, the diagnostic workup and management remains a constant challenge. UTI is well recognized as a cause of acute morbidity and chronic medical condition such as hypertension and renal insufficiency in adulthood.

METHODOLOGY:

This is a Non- randomized, Non-controlled prospective study during the period from April 2015 to Sep 2015, carried out in Institute of child health and hospital for children. Children presenting with features suggestive of urinary tract infection with culture positive infection with single species are included in the study. They are subjected to detailed history and thorough clinical examination. All cases are subjected to USG and voiding cystourethrography(MCU). History of fever, irritability, dysuria, frequency, dark urine and foul smelling urine were documented. Urinary tract infection was diagnosed when a single pathogenic bacillus was detected on culture.

RESULTS:

The proportion of children identified with renal anomalies in our study is 104 (38.4%). Females outnumber males in our study .The number of male children identified with renal tract anomalies is 49(47.1%) and female is 55(52.9%). The common anomalies identified are upper renal tract anomalies are 43(41.34%), lower tract anomalies 18(17.3%) and vesicoureteric reflux 42(40.38%). The most common symptom is fever .The most common organism found out to be E.coli .

CONCLUSION:

Around 13-15% of end stage renal diseases are due to unrecognised UTI in children. The congenital renal anomalies like VUR, PUJ can have devastating effects on the kidney. Therefore even a single documented UTI in children must be thoroughly investigated and managed appropriately. This will prevent children from developing chronic renal insufficiency.

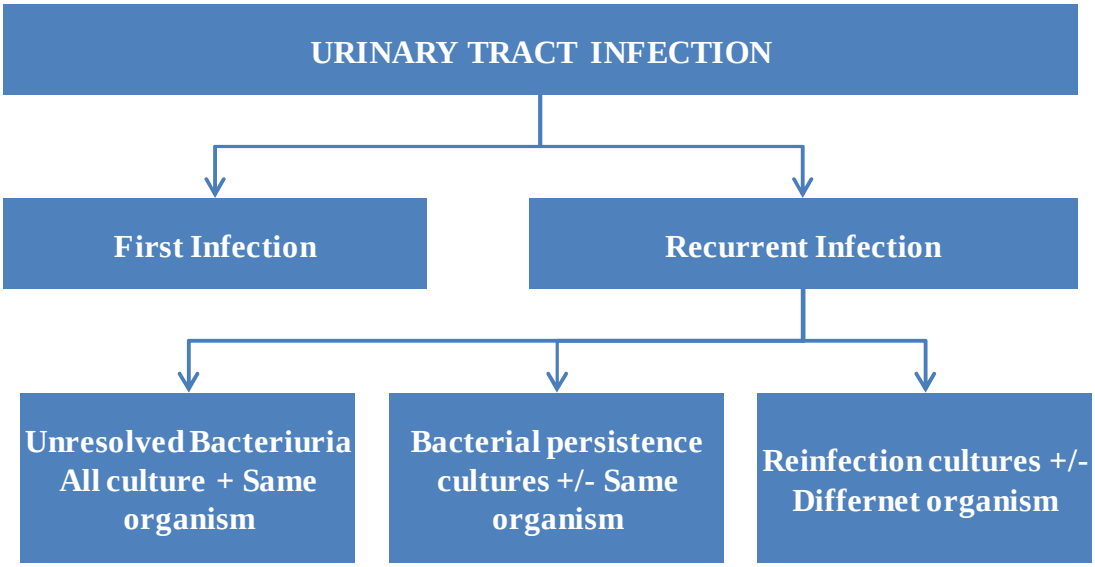
INTRODUCTION

Urinary tract infection is one of the most frequently encountered problems in children, which may be symptomatic or asymptomatic. Despite the common occurrence of UTI, the diagnostic workup and management remains a constant challenge for the pediatricians. Urinary tract infection in children is well recognized as one of the cause for acute morbidity and chronic problems such as systemic hypertension and renal failure in adult hood. The prevalence of symptomatic or asymptomatic bacteriuria in childhood is uninfluenced by the age and sex of the patient as well as method of diagnosis.

UTI is defined as “colonization of a pathogen occurring anywhere along the urinary tract, i.e., kidney, ureter, bladder and urethra”. Urinary tract infection is usually classified based on the site of infection as follows

1. Upper and lower urinary tract infections i.e., Pyelonephritis - upper urinary tract condition involving the kidney, cystitis - lower urinary tract condition involving the bladder.
2. Severely complicated and
3. Uncomplicated infection

Simpler and more practical approach is to categorize UTI as first infection and recurrent infection.



First infection is usually the first episode of urinary tract infection, which is diagnosed. In children, the first infection is usually considered as a complicated UTI because of the high prevalence of renal tract anomalies, that usually predispose to renal parenchymal damage. Unresolved and chronic infection is usually the result of inadequate antibiotic therapy. More often this is usually caused as a resistance to the selected antimicrobial agent. Unresolved infections are usually treated easily, once the proper culture growth and antimicrobial sensitivities are known. Bacterial persistence and re-infection means that the infection has occured after sterilization of the urine. Re-infection usually differs from the bacterial persistence in which the periodic infections are caused by a wide variety of infective microorganisms but in case of bacterial persistence, the infective microorganism is the same one isolated always.

Definition:

1. Significant bacteriuria-“colony count of more than 10^5 colony counts of a single species in a midstream clean catch sample”.
2. Asymptomatic bacteriuria-“Presence of significant bacteriuria in two or more specimens in a child with no symptoms”.
3. Recurrent UTI-“Second attack of UTI”.
4. Complicated UTI-“Presence of fever of more than 38.5^0c, toxicity, persistent vomiting, dehydration and renal angle tenderness”.
5. Simple UTI-“UTI with low grade fever, dysuria, frequency and urgency”.

Epidemiology:

The incidence of urinary tract infection in children is difficult to be determined with accuracy, because of the varying clinical manifestations that ranges from asymptomatic state to full blown fulminant urosepsis and renal failure. Infections of the urinary tract affect around 2.4 % to 2.8 % of the children worldwide yearly. Epidemiology of the pediatric UTI and its clinical presentation varies based on the age and gender of the child. During the first year after birth, male children have a increased incidence of UTI when compared with the female children. Whereas, in all other age groups after the first year the female children have more incidence of UTI .

Age (y)	Female (%)	Male (%)[1]
<1 yr	0.7	2.7
1-5 yr	0.9-1.4	0.1-0.2
6-16yr	0.7-2.3	0.04-0.2
18-24yr	10.8	0.83

Etiology:

The causative agent of urinary tract infection varies based on age and associated co morbidities. Although urinary tract infection can be caused by any pathogenic microorganism that colonizes the urinary tract (fungi, parasites & viruses),the most common causative microorganisms are the bacteria that is present in the gut. Escherichia coli is the most common and very frequently documented microorganism. The most common organisms causing UTI are listed in the given table below.[2]

URINARY PATHOGENS

Gram negative rods

- E.coli
- Pseudomonas aeruginosa
- Klebsiella sp
- Citrobacter sp
- Enterobacter cloacae
- Morganella morganii
- Proteus mirabilis
- Providencia stuartii
- Serratia sp

Gram negative cocci

- Neisseria gonorrhea

Gram Positive Cocci

- Enterococcus sp
- Streptococcus group B
- Staphylococcus aureus
- Staphylococcus epidermidis
- Staphylococcus saprophyticus
- Streptococcus group D
- Streptococcus faecalis

Other Pathogens

- Candida sp
- Chlamdia trachomatis
- Adeno virus

Pathogenesis:

UTI occurs via

1. Retrograde ascending infection from urethra. Bacterial clonal studies strongly support that “the entry in to the urinary tract by fecal-perineal-urethral route with subsequent retrograde ascent into the bladder”. Because the urethra is short in female children and for the differences in their anatomy, the female children are at an increased risk of urinary tract infection than the male children, after their first year of life. In the female children, the presence of the moist peri-urethral and vaginal areas, usually promotes the proliferation and growth of the pathogenic microorganisms. The shortened length of urethra in female children increases the chance that the infection can ascend into the urinary tract to cause UTI. The mechanism by which, the microbial pathogen enters the urinary bladder and its subsequent entry into the ureters and then to the kidneys remains as, yet undefined mechanism. Normally the ‘simple and compound papillae’ in the kidney have an anti reflux mechanism by which it usually prevents the urine from flowing back in ‘retrograde manner’ into the collecting tubule of the kidney. Some ‘compound papillae’ especially located in the upper and lower poles of the kidney allow ‘intrarenal reflux’. Infected urine then causes an immunologic and inflammatory response.
2. Hematogeneous route is the unusual and rarer mode of infection except for a period in the newborn period.

3. Direct extension of the infection caused by the presence of fistulae from the bowel or vagina.
4. Nosocomial infection through instrumentation.

The urinary tract is a “closed, normally sterile space lined with mucosa composed of epithelium known as transitional cells”. There are many defense mechanisms present in the intact urinary tract one of which is the constant ‘ante grade’ flow of the urine from the kidney to the ureter and to the urinary bladder with complete emptying of the bladder through the urethra. This is called as ‘washout effect of the urinary flow’ which always clears the urinary tract of pathogenic microorganisms. Other than this ante grade flow of urine, the urine also has certain specific characteristics that provide anti microbial properties, like low urinary pH, presence of polymorphonuclear cells and Tamm-Horsfall glycoprotein, which prevents the adherence of the pathogenic microorganism to the mucosal layer of the wall of the urinary bladder.

Urinary tract infection occurs with the introduction of the pathogenic microorganism into this closed space and is associated with the adherence of the microorganism to the mucosa of the urinary tract. If the microorganisms are not cleared adequately by the washout effect and ante grade flow of urinary voiding, then colonization by pathogenic microorganisms usually develops. Colonization of the urinary tract may be followed by the multiplication of uropathogens and severe inflammatory response associated with it.

The pathogenic bacteria that cause urinary tract infection in normal healthy individuals usually exhibits a distinctive property called as ‘virulence

factor’ to overcome the natural defense mechanism of the renal tract. When several serotypes of E coli were studied, the serotypes that are usually isolated in urinary tract infection, the adherence of the microorganism to the transitional uroepithelium is increased by adhesions, often ‘fimbriae’ (pili), which are bound to the specific receptors present in the uroepithlium. The interaction of ‘fimbriae’ with the receptor present in the mucosal layer of the urinary tract causes internalization of the microorganism into the epithelial cell, which triggers apoptosis, hyperinfection, and the invasion of the microbe into the surrounding epithelial layer or the establishment of a microbial focus for ‘recurrent UTI’. Uropathogenic strains, especially of E coli, have been identified to release certain ‘toxins’ including cytolytic distending toxin, ‘alpha hemolysin’, ‘cytotoxic necrotizing factor-1’, ‘secreted auto transporter toxin’ that initiates and causes lysis of the cell, promotes cell cycle arrest and changes in their morphology and cellular function. To prolong their survival, various uropathogens possess ‘siderophore systems’ capable of getting iron from heme which is an essential micronutrient for the proliferation and growth of the bacteria.

The pathogenic strains of E coli have a mechanism that consists of a presence of ‘glycosylated polysaccharide capsule’ that interferes with the phagocytosis and complement mediated bacterial lysis.

Risk Factors:

Although all the individuals are susceptible to urinary tract infection, most of them remain free from acquiring infection during the childhood by the presence of the above mentioned natural and innate ability to resist the attachment of infective urinary pathogen. There are specific subpopulations with an increased susceptibility to UTI, detailed in the box below.

RISK FACTORS FOR PEDIATRIC URINARY TRACT INFECTIONS

Neonate/infant

Gender

Foreskin

Fecal and perineal colonization

Urinary tract anomalies

Functional abnormalities

Immunocompromised states

Sexual activity

Pinworm infestations

Constipation

Diabetes mellitus

Uremia

Poor hygiene

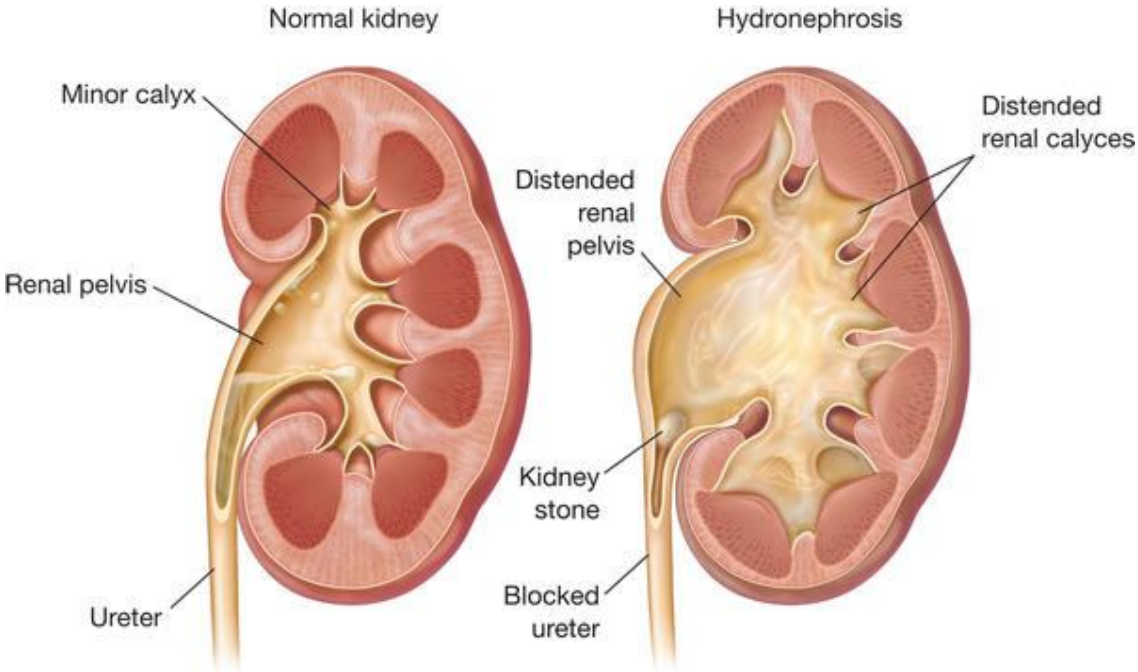
Voluntary deferral of micturition

Anatomic abnormalities

Anatomic abnormality of the renal tract usually predisposes the children to urinary tract infection mainly because of the inability to clear the infective microorganisms completely from the urinary tract. Infections associated with congenital malformations of the urinary tract generally appears in pediatric population lesser than 5 years old. It is most essential to identify the congenital abnormalities as early as possible because if the anomaly is left uncorrected, they can serve as a reservoir for persistence of infection and also result in recurrent urinary tract infection. Surgical intervention may be needed to correct the congenital anatomic abnormality. Usually 'Posterior urethral valves and Vesicoureteric reflux' do not predispose to colonization but can increase the possibility of inadequate washouts in the usual ways. The children with already known congenital renal anomalies may be started on routine chronic antibiotic prophylaxis. Consequently, this pediatric population is at a increased chance of acquiring 'multidrug-resistant uropathogens' and 'Non E.coli' uropathogens, including Pseudomonas and Enterococcus.

THE UROLOGICAL ANOMALIES IN CHILDREN

Hydronephrosis

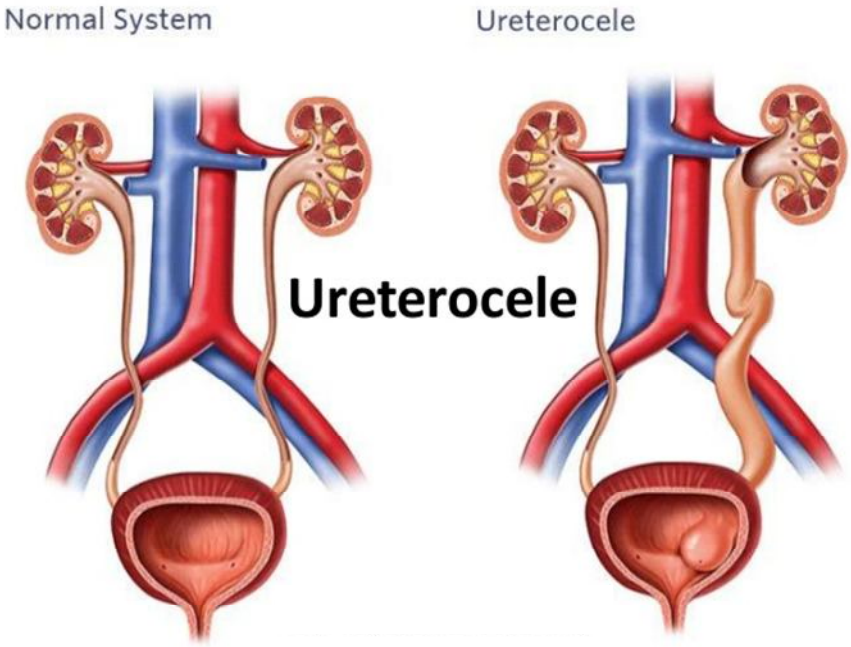


The kidney gets distended or swollen with urine, due to complete obstruction or partial obstruction due to narrowed ureter.

Three main conditions that cause hydronephrosis are,

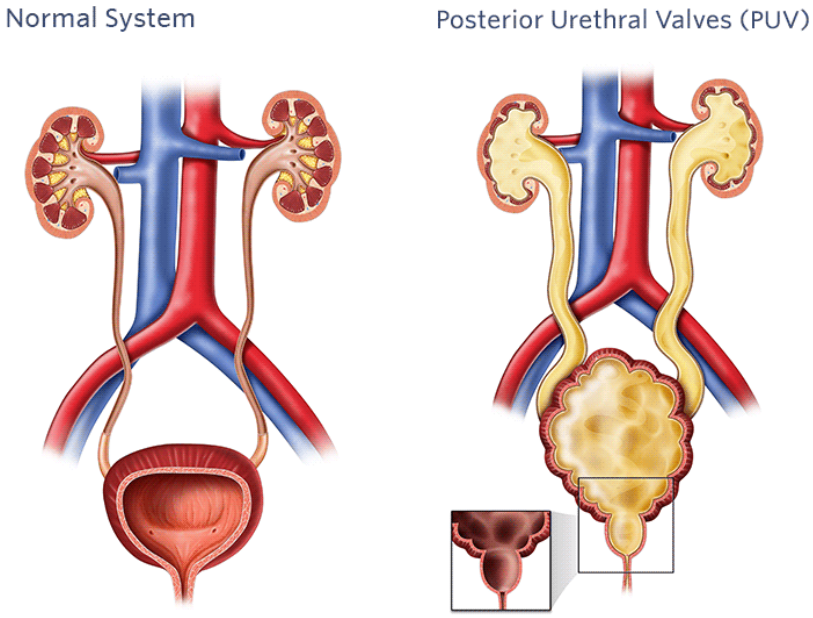
1. 'Vesicoureteric reflux' – Abnormal reversal of flow of urine from the urinary bladder into the ureter and even up to the kidney which is caused by an abnormality in the manner the ureter connects to the bladder or problems due to neurogenic causes.
2. 'Non obstructive' – Swelling in the kidney that has no effect on kidney function.
3. Ureteropelvic or Pelviureteric junction obstruction (PUJ) – Ureter is kinked or narrowed at a place where it joins kidney.

Uterocoele



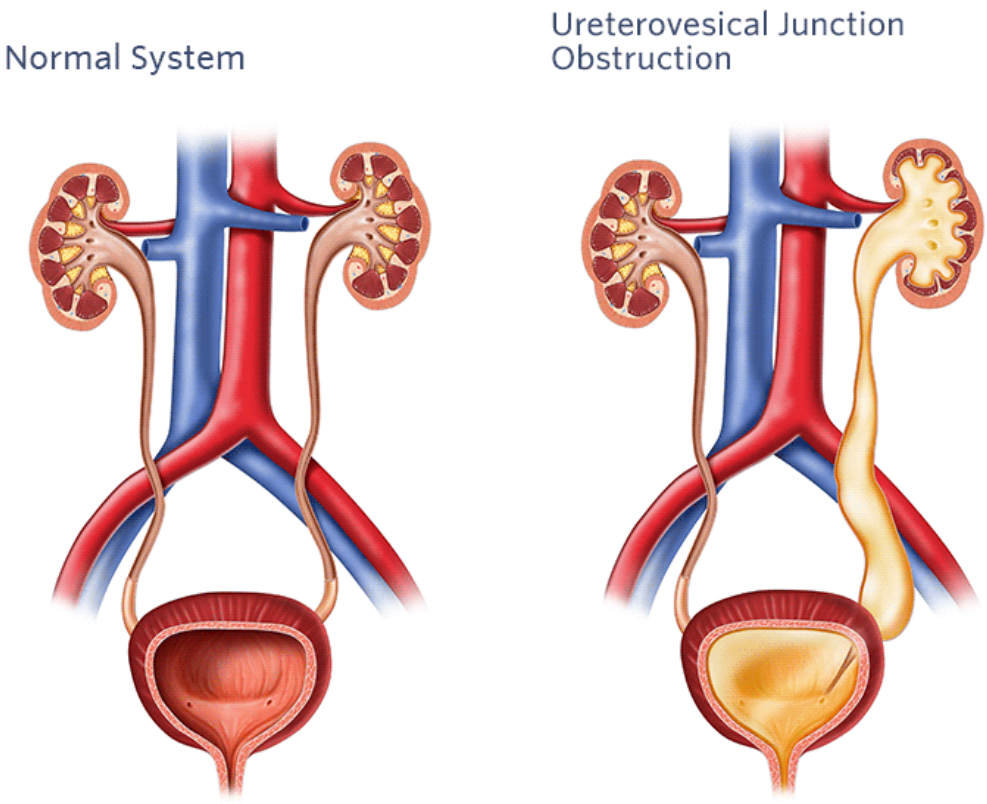
Urine swells the portion of ureter close to bladder because the ureter opening is too small for free flow of urine into the bladder.

Posterior urethral valves



Normal valve in the urethra is too narrow to allow free urine flow. Persistence of the urethral folds are called posterior urethral valves.

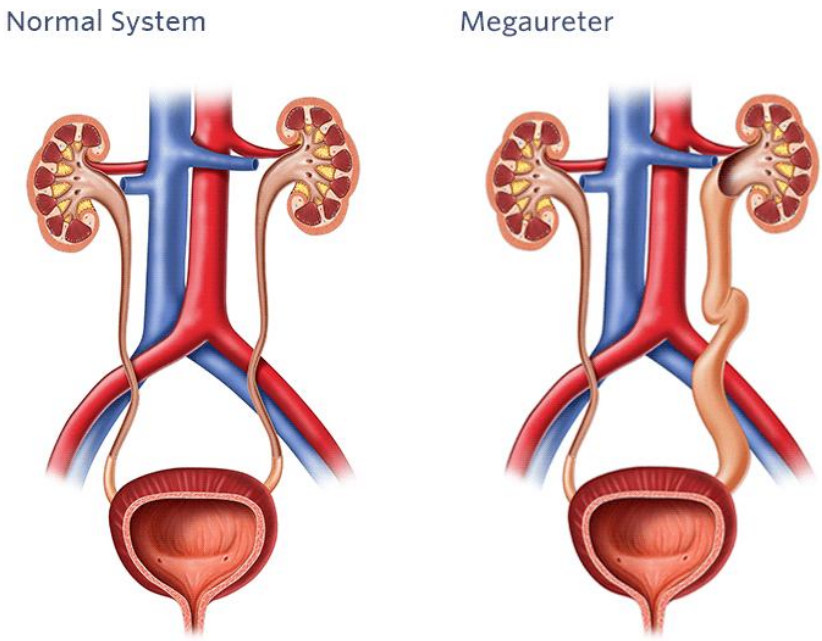
Ureterovesical junction obstruction



There is a absent valve or ‘non functional valve’ located at a place where ureter connects with bladder . The back pressure causes dilatation without mechanical obstruction.

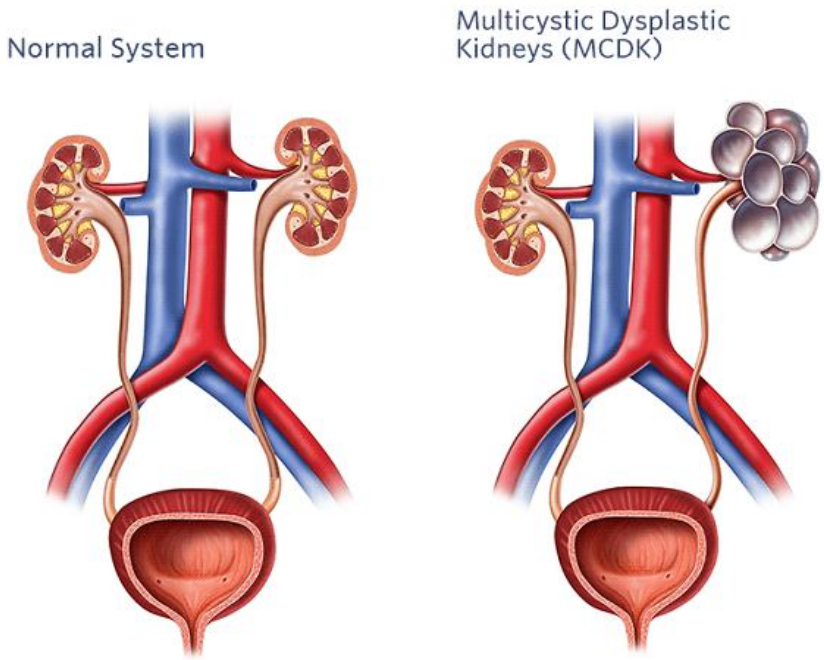
Megaureter:

One or both of ureters are too wide.

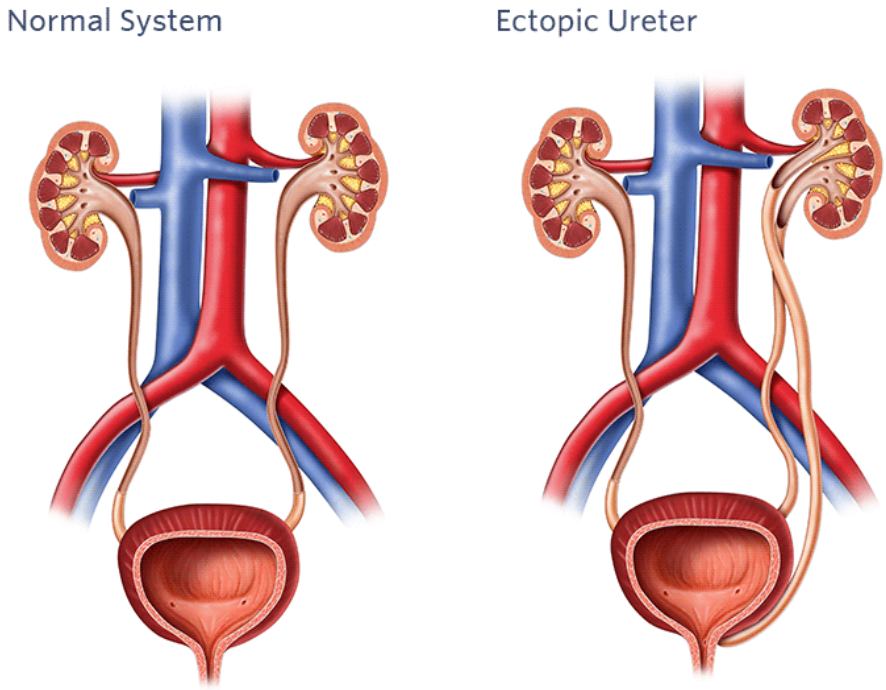


Multicystic dysplastic kidney:

Cystic tissue instead of normal tissue in kidney.



Ectopic Ureter



Ureter connects into wrong place.

Neurogenic bladder

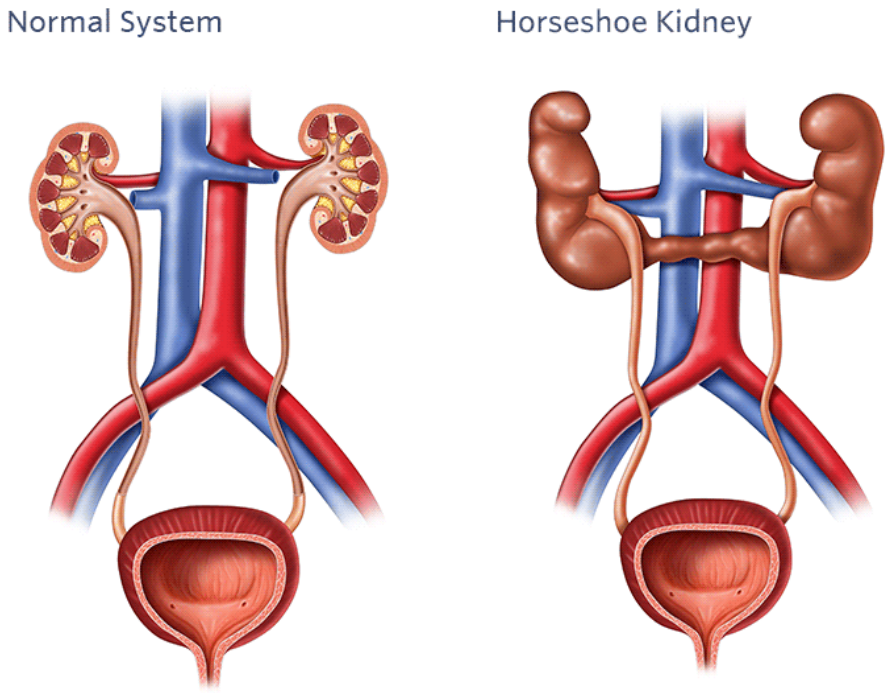
Normal ‘nerve pathways’ associated with urination do not function properly. Often associated spinal cord diseases

Non-neurogenic neurogenic bladder

‘Emotionally influenced form of urinary retention’

Horse- shoe kidney:

Fusion of both the kidneys



Functional abnormalities

Inability to empty the bladder as in the case of neurogenic bladder results in urinary retention, stasis and suboptimal clearance of bacteria from the urinary tract. Chronically elevated bladder pressure secondary to poor emptying also may cause secondary VUR, in which it increases the potential renal damage of pyelonephritis.

Bacterial Factors:

It is based on the presence of ‘P’ fimbriated E Coli. The fimbriae are classified into two types,

Type 1-fimbriae: - mannose sensitive and they do not play any role in pyelonephritis

Type 2-fimbriae: - mannose resistant. They cause agglutination of ‘P’ blood group antigens and hence they are called as ‘P fimbriae’. The bacteria that has P fimbriae are strongly associated with pyelonephritis. The receptor for type 2 fimbriae is a glycosphingolipid that is present on the uroepithelial cell membrane.

Clinical Presentation

Children who have urinary tract infection usually do not necessarily present with the characteristic signs and symptoms like the adult population. There are various clinical presentations for children with UTI based on age.

Infants:

- Failure to thrive.
- Diarrhoea.
- Irritability.
- Lethargy.
- Malodorous urine.

- Fever.
- Asymptomatic jaundice.
- Polyuria/Oliguria

OLDER CHILDREN: -

Less than 2 yrs of age: -

- Fever.
- Vomiting
- Anorexia.
- Failure to thrive.

2yrs to 5 yrs: -

- Abdominal pain and fever.

More than 5 yrs: -

- Urgency
- Urinary frequency
- Dysuria
- Renal angle tenderness.

COMMON NON-RENAL SYMPTOMS AND SIGNS IN RENAL DISEASES

Generalized symptoms

Failures to gain weight, weakness, fatigue, malaise, and recurrent fever are common with chronic renal failure, urinary tract infection or renal tubular acidosis.

Gastrointestinal symptoms

Nausea, vomiting and anorexia when persistent or recurrent without obvious cause should be investigated for renal diseases. Persistent vomiting is quite common with urinary tract infection, renal failure, or obstructive uropathy.

Diarrhoea

Common with urinary tract infection in infancy especially in diaper age and may be responsible for recurrent urinary tract infection.

Abdominal pain

Flank pain, loin pain or supra pubic pains are common with urinary tract infection with or without fever. Calculus disease may be suspected if pain is colicky. Renal malformation such as hydronephrosis, Polycystic kidney disease etc, may give dull ache or dragging pain.

Lump in abdomen

While bathing a child, mother may feel a lump in lumbar region, if unilateral or bilateral. Hydronephrosis with or without obstruction due to congenital malformation such as Pelvi ureteric junction obstruction, Posterior urethral valve, or high grade Vesicoureteric reflux is present. Subsequently the child may present with recurrent urinary tract infection, hypertension and renal failure.

Hepatosplenomegaly

Hepatic fibrosis or cysts in liver with polycystic kidney disease.

Respiratory

Breathlessness due to metabolic acidosis or pulmonary congestion is many times is mistaken for lower respiratory tract infection.

High blood pressure

High blood pressure in children often due to renal parenchymal or renovascular cause in 70-80% of cases. It may be an early sign and noted incidentally in otherwise well child.

EXTRA RENAL DEFECTS AS POINTERS TO RENAL DISEASE

Face: Dysmorphism, ear anomaly

Eye: Cataracts / lenticonus in Alports syndrome, diabetic or hypertensive retinopathy etc.

Skin: Purpura in HSP, malar rash in SLE. shagreen or ash leaf skin lesions in tuberous Sclerosis, etc.,

Limb deformities:

Unequal lower limbs with sacral agenesis and neurogenic bladder, hemi hypertrophy with nephroblastoma. Joint involvement in rheumatoid arthritis, lupus, HSP with renal involvement.

Urinary tract infection raises the possibility of underlying tract abnormalities. Evaluation of children with symptomatic or asymptomatic urinary tract infection detects anomalies of a variegated spectrum starting from mild Vesicoureteric reflux to bilateral renal diseases.

For example (a) Vesicoureteric reflux may present as Urinary tract infection with symptoms like dysuria, failure to thrive and fever. (b) Pelvi-ureteric Junction obstruction which is the most common obstructive lesion of childhood may present as febrile Urinary tract infection, failure to thrive and anemia. Obstructive and other severe malformation of the upper urinary tract often present clinically as infection and are obvious predisposing factors to renal damage.

Many authorities agree that there is a high prevalence of urinary tract anomalies in male children who present with Urinary tract infection.

Studies documented that Vesicoureteric reflux is present in significant number of culture documented urinary tract infection. Vesicoureteric reflux when present continues to be the most significant single host factor in the etiology of childhood pyelonephritis and subsequent renal scarring is related to severity of Vesicoureteric reflux.

Diagnosis

The definitive diagnosis of urinary tract infection usually requires the 'isolation of atleast one pathogenic microorganism' from urine culture[3].

Collection of urine Specimen

The easiest and less invasive method is by collection from bagged specimen that involves attaching the plastic bag to the perineum, but it results in unacceptably high 'false-positive rate' of 85% or even higher. Hence it has little diagnostic value in accurately documenting the presence of urinary tract infection. We can get 'clean catch midstream urine specimen' from older children. Unfortunately, the difficulty with this type of specimen is that, it is often contaminated with 'periurethral, preputial organism' that make a positive urine culture difficult to interpret. The widely used technique for obtaining urine for culture in young children is usually by catheterization of urethra. The catheterized specimen is generally considered as more reliable only if the initial

portion of the urine that has a possibility of getting contaminated by the periurethral microorganisms has been discarded. The main disadvantage of catheterization of the urethra is that it is a invasive procedure and most of the periurethral microorganisms gain entry into the sterile urinary tract. Suprapubic aspiration is generally considered as the gold standard method for accurately identifying the pathogenic bacteria causing UTI. The probability of a 'true infection' with a positive urine culture obtained by the method of suprapubic aspiration is 99%. The disadvantage with this method is that this is the most technically challenging method associated with the lowest success rate around 22-99%. The American Academy of Pediatrics recommends the 'suprapubic aspiration or urethral catheterization' for establishing a diagnosis of urinary tract infection in neonates and young children[4].

A clean catch specimen may be obtained from older children and young adults. After the collection of urine in the sterile container, the 'prompt plating' of the urine specimen obtained from the patient, within one hour of its collection is most important. If any delay is anticipated, then the urinary sample should be stored in a refrigerator at possibly 4^0 c up to a maximum period of 24 hours.

Interpretation of urine culture

Method of collection	Colony count	Probability of UTI (%)
Suprapubic aspiration	In any number	99%
Urethral catheterisation	$>10^3$ cfu/ml	95%
Mid stream clean catch	$>10^5$ cfu/ml	90-95%

The culture should be repeated without any hesitancy if there is a possibility of contamination has been suspected, for example mixed growth of 'two or more pathogens', or if there is a growth of microorganisms that usually constitute part of the periurethral flora ('lactobacilli in healthy girls & enterococci in infants & toddlers').The urine culture has to be repeated in situations, when urinary infection is strongly suspected in a case and the colony counts are found to be equivocal.

Urine Analysis:

A careful urine analysis is done on a fresh urine sample of the children with high possibility of UTI, can identify to enable presumptive treatment pending the results of the culture. Under high power magnification microscope, the presence of the pathogenic bacteria represents the amount equal to 3×10^4bacterias per ml of urine. Analysis may show the presence of mild proteinuria, presence of bacteria on the gram stain ('> 5 WBCs/Hpf in a

centrifuged sample or >10 WBCs/Hpf in an uncentrifuged sample'), and positive 'esterase' and 'nitrate reduction' by dipstick.

For predicting the value of positive urine culture, the mere presence of the bacteria in the freshly passed urine sample gives the best combination of 'sensitivity and specificity'. Dipsticks also perform equally well, when both 'esterase and nitrite tests' are combined together. But the sensitivity is low in infants for whom there is increased frequency of voiding and also they have a less marked inflammatory response.

Initial Evaluation:

During evaluation of patient when urinary tract infection is suspected, the children are examined thoroughly for presence of any complications and evaluate the possibility to develop recurrent infection in future. In every child examined, including infant or young child, the degree of toxicity should be assessed. The extent of dehydration and the ability of the child to retain oral intake should be assessed individually. Proper history about the bowel and bladder habits should be elicited. Blood pressure should be recorded in every case examined. History suggestive of straining while micturiting, dribbling of urine, poor urinary stream and the presence of preputial ballooning all mentioned above suggests the possibility of obstruction. The abdomen should be palpated for the presence of any abdominal lumps, particularly renal lumps. The genitalia examined for the presence of 'phimosis' which means tight prepuce. History regarding bladder habits like diurnal incontinence, urinary

frequency, urgency and squatting suggests the possibility of voiding dysfunction. Complete neurological examination needs to be done in such children, including examination for the presence of perineal sensation, brisk or absent deep tendon reflexes in the extremities and inspecting for the presence of sacral dimpling in lower back. Rectal examination needs to be done in every child presenting with severe constipation.

If both the clinical picture and urinalysis are clueless then certain additional tests such as 'CBC, ESR and CRP' may help to determine the presence of urinary tract infection and to decide whether the presumptive treatment should be initiated.

Diagnostic Imaging Studies

In the acute setting of a urinary tract infection, the diagnostic imaging modalities are usually not indicated in all cases unless the diagnosis of urinary tract infection is in doubt. If however the signs and symptoms of UTI continue to persist after 2 days despite appropriate antimicrobial therapy, then 'either ultrasonogram of the abdomen, CT scan abdomen can be used to rule out disease states that may require invasive therapy, including a renal abscess, pyonephrosis, urinary calculi or surgically correctable anatomic abnormalities'[5,6].

Imaging studies are usually done only after the resolution of the infection, in acute settings because the immediate treatment is typically based on the presenting clinical signs and history. After the treatment of initial febrile

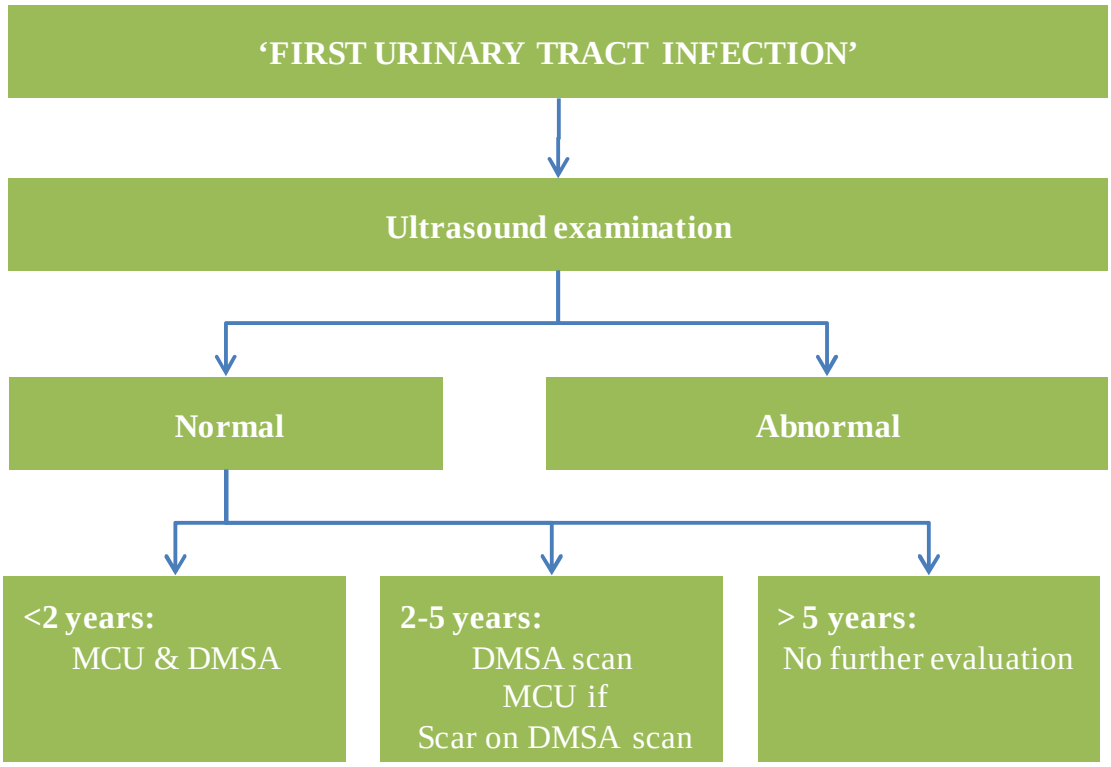
urinary tract infection, the infants and young children who have responded better to the appropriate antibiotic therapy, neds to be evaluated thoroughly at the earliest. And they are subjected to ultrasound of the kidney, urinary bladder and micturiting or voiding cystourethrogram (reflux studies) done to rule out renal tract anomalies. Further evaluation of the renal scarring may be done by 'Tc^{99m} labeled DMSA scan' (dimercapto succinic acid scientigraphy).Alternatively, there is growing evidence that "MRI is a rapid and accurate study for renal scarring that does not use ionizing radiation"[7].

Subsequent evaluation

Imaging of the entire urinary tract needs to be done to all children presenting with evidence of UTI. The aim of these imaging investigations is primarily to identify the children at higher risk of renal damage, that includes mainly children below five years of age, with vesico ureteric reflux or any urinary tract obstruction.

First episode

All patients with the 'first UTI' needs to be properly investigated which helps to identify those with an underlying renal tract abnormality. Guidelines for evaluation of patients vary. 'Recommendations of the expert group' are shown in figure given below.



*Detailed evaluation with ulrasound, MCU and renal scan is recommended for all children with recurrent UTI.

For children below the age of two years, an ultrasonogram and Micturating cystourethrogram (MCU) are always recommended. They will help in detecting the most cases of reflux nephropathy. They can identify those in 'at-risk' age group. Urinary tract ultrasonogram can identify the presence of 'hydronephrosis, bladder hypertrophy, ureteral dilatation, ureterocele' and 'post-void residual urine'. Ultrasonogram needs to be done within 2-4 weeks following the urinary tract infection. All children hospitalized for complicated urinary tract infection should be screened with an ultrasound examination before their discharge from the hospital.

The Micurating cystourethrogram is best tool for establishing the diagnosis and as well as for the grading of Vesico ureteric refux. The MCU also helps in detection of certain congenital anomalies like posterior urethral valve, ureterocele and diverticulum of urethra and urinary bladder. MCU is done only after completing the treatment for urinary tract infection, usually performed 4-8 weeks later. But it is possible that getting the micturating cystourethrogram done in the early phase following urinary tract infection can yield a very high false positive results. It is rare for vesico-uretericreflux to disappear immediately following the treatment for infection. In order to prevent the possibility of nosocomial infection introduced following urethral catheterization, the Micturating cystourethrogram ideally be done always under cover of antibiotics (prophylactic). For prophylaxis, drug amoxicillin is given per orally in a dose of 50 mg/kg, usually one hr before MCU and 25 mg/kg 6 hrs after. Otherwise, injection Gentamicin (2-3 mg/kg, intramuscular) can be given half an hour before the procedure.

When available, the renal scintigraphy using 'Tc^{99m} – radio labeled dimercapto succinic acid (DMSA)', which is a renal tubule transport tracer, needs to be performed in almost all the children below the age of two year to detect renal scarring. 'Renal scintigraphy' should be done ideally atleast 3 months after completing the treatment of the urinary infection. It is an excellent and gold standard method for detecting the degree of renal cortical scaring.

For children between the age of 2-5 years, the micturating cystourethrogram is not urgently required, unless there is an evidence of

underlying urinary tract obstruction is present. An ultrasound examination and a ‘DMSA renal scan’ are done, and MCU needs to be done only if any of the above investigations are found to be abnormal. By following this policy strictly, the number of MCU performed at this age group can be reduced to only the children found to be having renal anomalies. In places where facilities for ‘radionuclide scans’ are not available, the micturating cystourethrogram needs to be performed for all younger age children.

For evaluation of children of the age of 5 years and above, they can be easily screened with expert ultrasonography Imaging with micturating cystourethrogram and ‘renal scan’ are indicated only if any abnormalities have been detected by expert USG examination.

The ‘Direct Radionuclide Cystography’ (DRNC) can detect the presence of vesicoureteric reflux. But the disadvantage of this method is that the grading of vesicoureteric reflux is unreliable. DRNC cannot study the anatomy and morphology of the urethra and urinary bladder. For the same reason this is not useful for detecting posterior urethral valves or any other urethral anomalies. This technique of ‘Direct Radionuclide Cystography’ (DRNC) is not a suitable method as the initial procedure of choice for the detailed evaluation of the lower urinary tract.

Recurrent UTI

'Children with more than one episode of UTI', irrespective of age, are evaluated with ultrasound and MCU. A 'renal cortical scan' (DMSA) is suggested to detect scars.

Children showing hydroureteronephrosis without the evidence of vesicoureteric reflux should be studied in detail by 'diuretic renography' using 'TC^{99m}-labeled diethylenetriamine penta acetic acid' (DTPA). This DTPA acts as a glomerular filtration tracer. This technique gives better estimate of quantitative assessment of kidney function. The DTPA study also details about the drainage of the dilated collecting system (upper urinary tract).

Additional investigations

Digital radiograph of the spine should be done when possible to check for the presence of 'spinal dysraphism' when clinical suspicion is there. Plain radiograph of the kidney, ureter and urinary bladder region (KUB) an identify the presence of radiopaque stones. Both kidney and vesical stones can be detected. The availability of radio isotope studies reduced the importance of 'intravenous pyelography' (IVP), hence they are declined nowadays. In places where radio isotope studies are not available, an IVP can find out the degree of renal scarring. Cystoscopy is not indicated as a routine in all cases. They are not the choice for the evaluation of patients with urinary infection initially.

Computed Tomoraphic reconstruction study has a little role. They are used only for the 'diagnosis of renal, retroperitoneal and pelvic masses'. There

is growing evidence that ‘MRI is a rapid and accurate study for renal scarring that does not use ionizing radiation’[7].

Management

The treatment of urinary tract infection begins generally with the identification of the causative micro organism. The empiric treatment of urinary tract infection depends on the clinical status of the child and considering the pathogenic micro organisms of that age group of children. The choice of the antibiotic must be made taking into the consideration of antimicrobial sensitivities prevailing in that community under study, along with proper follow up of the child.

The treatment for healthy child with uncomplicated course of urinary tract infection, who is non toxic can be managed as outpatient. Care should be taken to see that the affected child takes adequate oral fluids. If possible the treating physician should be able to follow up the case on a daily basis. It is generally accepted that they respond better with oral antibiotics. The role of broad-spectrum antibiotic should be based on the results of culture and sensitivity. The generally accepted first line antibiotic agents are ‘amoxicillin, trimethoprim-sulfamethoxazole, nitrofurantoin and cephalosporin’.

The children admitted in the acute setting should be considered as ill child and all the infants less than two months old are taken to be suffering from acute pyelonephritis and treated as a complicated urinary tract infection. Such children should be hospitalized immediately. They should be started on broad-

spectrum antibiotic therapy. Parenteral therapy should be initiated for them. The pathogenic micro organisms usually show varying patterns of antibiotic sensitivity and resistance. Care should be taken when choosing antibiotic regarding the nephrotoxicity of the drug. The third generation cephalosporins are increasingly used, now days. The pediatric population in the age group of 2 months to 2 years, should be treated for a period of 7 to 14 days course, based on the protocol designed by the American academy of pediatrics. There is a scientific evidence suggesting better clearance of the pathogenic micro organisms from the renal tract when 7 to 14 days course of antibiotic therapy is given. The treatment of fungal urinary tract infection remains challenging and controversial. Such children are treated usually with 'bladder irrigations of amphotericin B or oral fluconazole'.

Prophylactic antibiotics

The main purpose of treatment of urinary tract remains to achieve complete eradication of the infection. This complete sterilization of the urine will prevent kidney damage and scarring.

Indications for prophylactic antibiotic are as follows,

1. a) "The first UTI in all children below 2 yrs of age.

   b) Complicated UTI in children less than5 yrs old, while awaiting imaging studies.

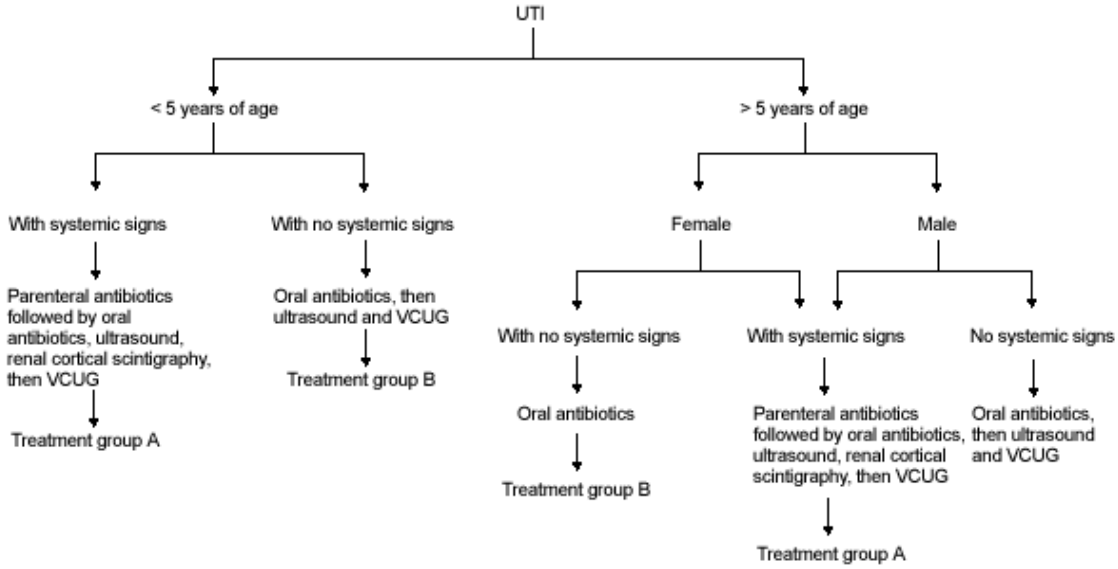
2. Children with Vesicoureteric reflux.

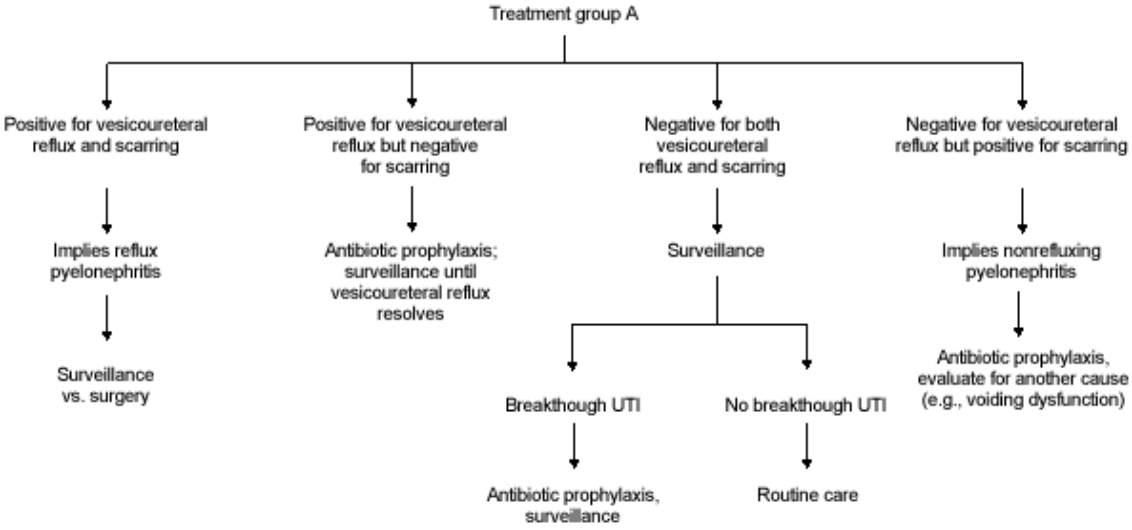
3. Patients showing renal scars following a UTI even if reflux is not demonstrated. Prophylaxis may be stopped if a radionuclide cystogram or MCU repeated 6 months later is normal.

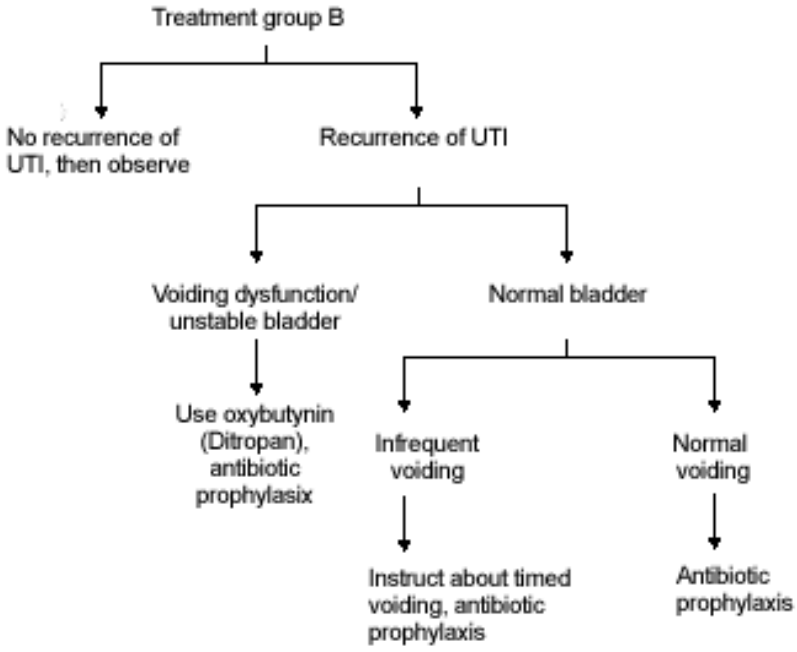
4. Children with frequent febrile UTI (3 or more episodes in a year) even if the urinary tract is normal.

5. Children with immunosuppression or partial urinary obstruction to decrease the potential for developing UTI".

Drug	Daily dosage (mg/kg/d)	Age limitation
Cephalexin	2-3	None
Nitrofurantoin	1-2	More than 1 month
Tremethoprim+Sulfamethoxazole	1-2	More than 2 month







Consequences of UTI

Children who develop upper renal tract infection (pyelonephritis) causes irreversible renal damage evidenced by alteration in renal parenchyma (renal scarring). About 10% to 30% of children affected by upper renal tract infection develop renal parenchymal damage evidenced by renal scarring in isotope

studies. The commonly used method of choice for detecting renal scarring is by 'Tc^{99m}-labelled dimercapto succinic acid scintigraphy' scan. The exact mechanism by which the urinary infection causes renal scarring remains unclear. The other risk factors which predispose to scarring includes underlying reflux disease or obstruction in the urinary tract and 'recurrent UTI'. The significant time delay in initiation of treatment for UTI always causes scarring. The recent study done by Orellana and colleagues found that "significantly higher incidence of renal damage in children with non-E coli UTI". Smellie and colleagues found "renal scarring more commonly in infants and young children and less frequently in older children and young adults, which suggests that younger kidneys are more susceptible to damage".

Hemorrhagic cystitis is a complication of infection caused by E.coli, which causes hematuria. The common symptoms of acute pyelonephritis include fever, chills , rigor and flank pain. Whereas, chronic pyelonephritis may sometimes present without any symptoms. Renal scarring usually predisposes to arterial hypertension. Reflux nephropathy, along with infection is thought to be responsible for 15 % of cases of ESRD in all children treated for UTI. Hyperammonemia and CNS manifestation is a rare complication of UTI due to proteus and is associated with urinary stasis or obstruction.

The implication is that "children with UTI should undergo complete urological evaluation because it may be an indicator of serious underlying anomalies or diseases, requiring early medical intervention or it may lead to irreversible renal damage to the renal systems".

REVIEW OF LITERATURE

Epidemiology and Etiology of Genito urinary tract anomalies

Wu CY et al[8] of Taiwan had analyzed 597 children with urinary tract infections to gain new insights into the epidemiology, genitourinary (GU) tract anomalies, etiologies, susceptibility of urinary pathogens to antibiotics in children with urinary tract infection. By reviewing medical charts for patients admitted to Kaohsiung Veterans General Hospital between January 1995 and December 2003, they identified and enrolled patients 14 years of age or less admitted due to UTI that was confirmed by positive urine culture. A total of 597 patients were studied. The pathogens were Escherichia coli, the most common (74.7%), followed by Proteus spp. (6.7%), and Klebsiella spp. (6.4%). E. coli was resistant to ampicillin in 82.0% of the cases, followed by sulfamethoxazole/trimethoprim (55.2%), gentamicin (24.9%), and cefazolin (24%). Resistance to ampicillin and sulfamethoxazole/trimethoprim tended to increase year by year. Forty point seven percent (164/408) of patients had GU tract anomalies, the most common being vesicoureteral reflux (VUR) (87/164, 53.0%).Thirty-three point two percent of the patients with acute pyelonephritis, confirmed by 99mTc dimercapto succinic acid (DMSA) renal scan, had VUR. This cohort was dominated by boys, especially in those less than a year old. E. coli, the most common pathogen, had a higher rate of resistance to ampicillin and sulfamethoxazole/ trimethoprim. The pathogens that cause UTI were found to be becoming increasingly resistant to the common antimicrobial agents used

in this study. The most common GU tract anomaly was VUR, yet the incidence was lower than that of other reports. A positive DMSA renal scan finding was a good indicator for prediction the possibility of VUR in UTI patients.

Ali Ahmadzadeh and Shahnam Askarpour [9] extract from their paper says "the review of 158 patients (aged one month to 15 years) who were hospitalized with symptomatic UTI during a 2-year period (2001-2003) studied. Ninety-seven (77%) were under 5 years. Confirmed cases of UTI underwent renal and urinary tract ultrasonography (US), voiding cystourethrography (VCUG) ,and 99mTc-dimercaptosuccinc acid (DMSA) scan. The most common presentation was fever (83%) followed by dysuria (48%). The commonest causative agent was E coli (88%). VUR was found in 50 (39.6%), 39 girls, and 11 boys. Other urinary tract abnormalities were renal stone in 10 (8%) patients, pelvic ureteric junction obstruction in 8 (6.3%), neurogenic bladder in two boys and one girl, double collecting system in 2 girls, posterior urethral valves in two boys and ureterocele in one girl, respectively. Forty percent of patients had VUR and 20% had other associated abnormalities in urinary tract. Fifty patients (39.6%), 39 girls and 11 boys were found to have VUR .VUR was bilateral in 18 (14.3%) and unilateral in 32 (25.3%). The grading of reflux was grade I in 6 (%4.7), grade II in 10 (7.9%), grade III in 25 (19.8%), grade IV in 7 (5.5%) and grade V in two (1.5%) respectively. Urinary tract abnormalities other than VUR were observed in 26 (21%) patients. DMSA scan was abnormal in 78 (62%) of patients. Renal scarring was unilateral in 49 (39%) and bilateral in 29 (23%) patients. The

causative agent was Escherichia coli in 111 (88%), Klebsiella in 8 (6%), Proteus in three, Staphylococcus saprophyticus in two and others in two patients. Thirty-eight (30%) patients were less than one year, 59 (47%) between one to 5 years, 24 (19%) 5 to 10 years and 5 (4%) 10 to 15 years old". They recommended that USG, VCUG and DMSA scan should be routinely performed on all patients after the first UTI.

The incidence of urinary tract infections during infancy and childhood is high and influenced by the age and sex of the patient. Riccabona M[10]had revealed that "breastfeeding has been shown to offer significant protection against urinary tract infection in infants. Any young child with an acute pyelonephritis should be evaluated by dimercapto succinic acid renal scan to confirm or rule out renal scarring. The voiding cystourethrogram can be performed within the first 7 days of diagnosis. Amoxicillin, trimethoprim-sulfamethoxazole and cephalosporin are the first-line antibiotics to treat children with uncomplicated urinary tract infection". Voiding cystourethrogram and dimercapto succinic acid renal scan are required for imaging. Short course treatment is sufficient for children with acute uncomplicated lower urinary tract infections.

Importance of early diagnostic modalities

Tapaneya et al[11]had done a retrospective study of One hundred and forty three pediatric patients with initial documented UTI. According to them "E. coli was the most common organism found in uncomplicated cases. Forty-six

per cent of 110 patients who had radiological evaluation had genitourinary tract anomaly with higher frequency in boys during the infancy period and girls during the early childhood period. Primary VUR was found in 11 per cent of patients mainly in infancy with an equal number among boys and girls". They conclude and strongly advise that radiological evaluation should be done in all children with UTI, especially if they are younger than 5 year old.

According to the paper published by Zmyslowska A et al[12] in which they have done the clinical analysis of children under three years of age with UTI. They say that "The most common pathogen was Escherichia coli. The obtained results demonstrate the necessity of early imaging diagnosis of the urinary system in infants and babies with UTI. Patients under three years of age with UTI require hospitalization and performance of early diagnostic examinations of the urinary tract".

Profile of renal tract anomalies

The presence of urinary infection may be an early indicator of a genitourinary anomaly needed to be evaluated in detail. Ayse BALAT and L.Leighton1[13] revealed that "the distribution of abnormalities showed some changes by age and sex. Lower urinary–tract abnormalities were common in children older than 3 years of age (43.5%). Vesicoureteral reflux was common in children below 3 years of age (51.6%). Lower urinary tract abnormalities were higher in boys (41.7%), whereas the percentage of vesicoureteral reflux was higher in girls (47.4%). The distribution of upper urinary tract

abnormalities or combined abnormalities was similar for both sexes. Renal scarring was found more often in children with reflux than in children without reflux (14%). The most common microorganism was Escherichia coli; the second common microorganism was Pseudomonas". There were no differences in the microorganism pattern in patients with and without GU abnormalities. They also add that "more than one fourth of the UTI patients in the study group had an underlying GU abnormality and is significant and provides support for early intervention to identify and treat these complications that could cause serious, irreparable kidney damage".

The profile of children with UTI was defined by Lizama CM et al[14]. They say that "UTI was 1.78 times more frequent in girls. The most common clinical presentation was fever and urinary tract symptoms. In older than 2 years, urinary tract symptoms and previous UTI, was a risk factor for UTI. The most frequent organism isolated was Escherichia coli causing around 86%".

Clinical presentation and organisms causing urinary tract infection was studied by Qureshi AM[15]. He says that "Fever was the commonest clinical presentation (92%) followed by dysuria (68%) and failure to thrive (31%). Urinary tract infection was common among females, except in the neonatal period. Escherichia coli was the most common organism isolated (71.0%), followed by Klebsiella (13%), Proteus (11%), Staphylococcus (4%) and Pseudomonas (1%)".

Various diagnostic modalities

Diagnosing symptomatic urinary tract infections in infants by catheter urine culture was studied by Cheng YW and Wong SN[16]. Their scientific paper says that "Unlike suprapubic tap urine, catheter urine culture has to be interpreted against the clinical context or pretest probability and in terms of probability. In the scenario of a febrile infant where the pretest probability of UTI was about 5%, UTI was highly likely if counts exceeded 10^5/mL, and unlikely if counts were below 10^4/ml in uncircumcised boys. In female infants, UTI was highly likely if counts were $>10^4$ CFU/ml, but lower counts cannot exclude UTI".

Garcia. Munoz MT et al[17] in 1996 had evaluated the utility and complication of suprapubic bladder aspiration in the diagnosis of urinary tract infection. The author says that "Suprapubic aspiration is the most reliable method with hardly any complications and was essential for accurate diagnosis of urinary tract infection. However it must be used with more restrictive criterion in neonatal period".

Role of radiological investigations

The role of radiological evaluation of the urinary tract in children with urinary infection was studied by Jothilakshmi K et al[18]. According to the paper published by them "Fifty-four patients had an underlying urinary tract anomaly; 42 were picked up by ultrasound and 12 by MCU. 22.9% of males and 15.9% of females had anomaly of the urinary tract. Children less than 2

years had the highest incidence of anomalies. Pelviureteric junction obstruction with hydronephrosis, vesicoureteric reflux and non-refluxing megaureter are the major anomalies picked up. 20% of children with urinary tract infections have an underlying structural abnormality of the urinary tract, three-fourth of which are picked up on ultrasound. An ultrasound abdomen is recommended in all children after the first UTI. In addition, an MCU is also indicated in all boys below 2 years with UTI, since one-third of anomalies will be missed if only ultrasound is done".

Role of Ultrasonogram in identifying renal anomalies

Mucci et al in 1994[19] had mentioned in their study regarding the role of ultrasonogram in the investigation of children with urinary tract infection. "The incidence of urological anomalies among urinary tract infection ranges from cortical defects to congenital anatomical abnormalities. And also significant number of children with urinary tract infection are having urological anomalies and ultrasonogram abdomen alone is not sufficient to diagnose these anomalies".

The yield of routine renal ultrasound (RUS) in the management of young children hospitalized with first uncomplicated febrile urinary tract infection (UTI) was studied by ZamirG et al[20]. All children underwent renal ultrasonography and voiding cystourethrography (VCUG) . they say that "The yield of RUS was measured by its ability to detect renal abnormalities, its sensitivity, specificity, and positive and negative predictive values for detecting

vesicoureteral reflux (VUR), and by its impact on UTI management. Results shows that the yield of RUS to the management of children with first uncomplicated UTI is questionable".

Mahant Set al[21] reviewed the ultrasound and voiding cystourethrogram(VCUG) results in children with a first UTI. The conclusion was renal ultrasound findings were neither sensitive nor specific.

The importance of VCUG

VCUG as an important tool in evaluating and managing children with UTI was proven by K.J.Kass et al[22]. In this study 152 children were evaluated had normal renal scans, of whom 101 had a normal renal ultrasonogram,23%of children who had both normal renal scintigraphy and ultrasonogram showed VUR on VCUG.

The importance of DMSA study

The role of DMSA scans in evaluation of the correlation between urinary tract infection, vesicoureteric reflux, and renal scarring was evaluated by Bhatnagar V et al[23] . The copy of their extract says " UTI was diagnosed on the basis of a positive urine culture, VUR was diagnosed and graded by micturatin cystourethrogram (MCU), and renal scarring was assessed by technetium 99 m dimercaptosuccinic acid (DMSA) scan. Ultrasonography (US) was done to evaluate renal tract dilatation and other structural abnormalities. A follow up DMSA scan was performed approximately 6 months after the initial

scan. Thus, there was a cause and effect relationship between UTI and renal scarring that is made worse by VUR. DMSA scans have been shown to be the most reliable method of assessing renal scarring, and an abnormal US scan showing upper tract dilatation or a structural abnormality may have a predictive value in the detection of renal scarring".

Nammalwar BR et al [24] had evaluated the use of DMSA in Culture Positive UTI and Culture Negative Acute Pyelonephritis. He says " An abnormal DMSA is a strong indication for work up for VUR. DMSA is the gold standard and sensitive investigation to diagnose acute pyelonephritis in febrile culture positive UTI and febrile culture negative acute pyelonephritis. DMSA followed by VCU to diagnose VUR. DMSA should form part of the protocol for evaluation of every child with fever of unknown origin".

In the year 2002, Tepmongkol S et al[25] had studied the Relationship between vesicoureteral reflux and renal cortical scar development and the significance of renal cortical scintigraphy and direct radionuclide cystography. The important findings summarized by them is "this study is aimed to determine the incidence of cortical scarring in Thai children presenting with upper urinary tract infection, the association between VUR with acute pyelonephritis and subsequent renal scarring, the use of DMSA and direct radionuclide cystography (DRNC) in children with UTI. In conclusion, there is a high incidence of acute pyelonephritis in the presence of VUR but acute pyelonephritis donot necessarily need VUR for its development. High grade reflux with upper UTI is a strong indicator for renal scarring. Children

presenting with UTI, irrespective of age, sex, or pathogen, should have both DMSA and DRNC scintigraphy performed to identify upper UTI and high risk patients who will develop subsequent renal scarring".

DMSA study is useful as a predictor of patient outcome in children with UTI was studied by Camacho V et al [26] Children with abnormal DMSA had a higher frequency of VUR than children with normal DMSA (48% vs 12%). It was concluded that children with normal DMSA during acute UTI have a low risk of renal damage. Children with normal follow-up DMSA and low-grade VUR have more frequent spontaneous resolution of VUR.

Aysun et al [27] had done a Comparison of direct radionuclide cystography and voiding direct cystography in the detection of vesicoureteral reflux. DRNC offered a high sensitivity in the younger age group whereas VCUG seem to be more sensitive in the older age group. DRNC also offered continuous recording during the study, ease of assessment and lower radiation dose to the gonads,which makes it a preferable method for the initial diagnosis and follow-up of VUR.

B Padmakumar et al[28]had detailed that study of the value of an intravenous urogram (IVU) in patients with abnormal differential ^{99m}Tc dimercaptosuccinic acid (DMSA) uptake without scarring or ultrasound abnormality. In the small selected group an IVU identified a significant number of patients with normal kidneys, unrecognized simple duplex systems, or scarring where the DMSA scan has been inconclusive which help in planning long term follow up.

MRI in vesicoureteral reflux

According to several studies presented at the 2006 American Academy of Pediatrics “MRI was superior to ultrasound in the detection of renal damage induced by Vesicoureteral reflux. Renal abnormalities typically are detected by ultrasound or nuclear scan”. The Stanford group[29], led by Linda D. Shortliffe, MD, sought to determine whether MRI would be a superior technique for detecting renal parenchymal atrophy. The study by them says “MRI showed that both refluxing and non-refluxing kidneys of VUR patients exhibited atrophy, indicated by a decrease in kidney volume on MRI. Degree of atrophy correlated with grade of VUR; patients with more severe VUR had a higher degree of atrophy. Risk for renal atrophy increased with age, and atrophy was most dramatic in children over the age of 10 years. MRI can detect traditional scarring in 6% to 58% of kidneys scanned, with increasing scars associated with a higher grade of VUR. In comparison, ultrasound detected scarring in only 7%”.

The study by the urosurgeons regarding the application of MRI at Shiga University of Medical Science, Japan, comparison of magnetic resonance voiding cystourethrography (MRVCUG) with standard VCUG done in the diagnosis and management of VUR. They say that “MRVCUG is an attractive alternative to VCUG because it does not require radiation or catheterization; however, it tends to provide false-positive results in cases where the ureter is dilated. Further, lower-grade cases of VUR can be missed by MRVCUG, providing false-negative results”.

The Spectrum of Vesicoureteric reflux

VUR is one of the major risk factor for recurrent urinary tract infection was studied by Panaretto K et al [30] the paper says “this study examines the risk factors that predispose to recurrent UTI in children and the role of recurrent UTI in renal scarring. The independent risk factors for recurrent UTI identified by the study are as follows as age of less than 6 months at the index UTI and grade 3-5 VUR. These findings suggest more selective targeting may minimize problems associated with prophylaxis and improve outcomes for children with urine infection”.

Ataei et al[31] had done a study to screen for vesicoureteral reflux and renal scars in siblings of children with known reflux. The extract says “The incidence of vesicoureteral reflux (VUR) in the general population is less than 1%, but it is high in families with reflux. The reported prevalence of VUR among siblings of index patients with reflux has ranged from 4.7% to 51%. Reflux carries an increased risk of pyelonephritis and long-term renal impairment. In conclusion, this study confirmed a significant overall incidence of VUR and renal parenchymal damage in the siblings of patients with known reflux. The prevalence of reflux in older siblings is similar to that in younger siblings. It suggested that all siblings over 6 years should undergo a screening cystogram, even in the absence of urinary tract infection. DMSA scintigraphy of asymptomatic siblings appears to be beneficial in preventing renal injury”.

Genetic predisposition in the occurrence of VUR and renal tract anomalies was studied by Murawski IJ and Gupta IR[32]. According to them "Vesicoureteric reflux (VUR) is a congenital urinary tract defect caused by the failure of the ureter to insert correctly into the bladder. It occurs in up to 1% of the general population and is associated with recurrent urinary tract infections and renal failure. Despite treatment of affected children for the past 40 years, the incidence of end-stage renal disease secondary to VUR has not decreased". Twin and family studies reveal that "VUR has a genetic basis. Some of the gene candidates that have been identified regulate the position of ureteric budding, a critical step in both kidney and urinary tract development. Analysis of data from humans and mice suggests that some of the renal damage associated with VUR is congenital and is due to a kidney malformation. Therefore, in these cases, the association of VUR and renal failure may be caused by a genetic defect affecting the formation of the kidney and the urinary tract".

Ecctes M R et al[33] in 1996, had mentioned in their study, about the genetics of Vesicoureteric reflux, that "primary vesicoureteric reflux is one of the most common genetic disorders, and Vesicoureteric reflux phenotype is associated with shortness of sub mucosal segment of ureter .Vesicoureteric Reflux is found in 30-50% of infants and young children with Urinary tract infection". They had also stated that "in families with affected parents approximately one half of siblings or off springs will be affected and half of these affected siblings could be asymptomatic. VUR if left untreated may

present later in life as hypertension, proteinuria or renal failure. It is the most commonest cause of end stage renal failure in children". In their study they had presented evidence that "VUR might be caused by mutations in the developmental pathway of which PAX-2 genes forms a part".

Complications of Renal anomalies

The presentation of posterior urethral valves in children was reviewed by Asinobi AO[34]. They say that "Even though 50% of the patients became symptomatic in the first week of life only 22.5% presented in the whole of the neonatal period. Thirty-seven and a half percent (37.5%) presented in the post-neonatal infancy period and the rest beyond the first year of life. The interval between the onset of symptoms and definitive therapy was up to three years in some patients. Only 2 patients had antenatal diagnosis of the PUV by ultrasonography. The major renal complications are: (1) Urinary Tract Infections in - 40%; (2) Acute Renal failure-10%; (3) Chronic Renal failure-7%; 4) Type IV Renal Tubular Acidosis-10% (5) Sustained hypertension-4.8%. The extra renal complications were anemia (30%) and malnutrition (10%)".

OBJECTIVE OF THE STUDY

To gain insights in to the

- Profile of various renal tract anomalies among the children aged 1 month to 12 years presenting with culture positive urinary tract infection
- Incidence of renal tract anomalies
- Age and sex distribution of renal anomalies
- Spectrum of various clinical presentations
- Prevalence of microorganisms causing urinary tract infection in these children
- Role of various imaging studies in the diagnosis

MATERIALS AND METHODS

STUDY DESIGN

Type of study	Non- randomized,Non-controlled,Prospective study
Setting	Out patient department, Pediatric ward, Laboratory services and Radiology department, Institute of childhealth and hospital for children, Chennai.
Study Period	6 months (April 2015 to September 2015)
Population	Total number of 271 children in the age group of 1 month to 12 years in the above mentioned study period who met the following inclusion criteria were selected.
Inclusion criteria	1. All children presenting with first time or recurrent urinary tract infections between the age group of 1 month to 12 years 2. All children presenting with culture positive urinary tract infections with single species. 3. All male children irrespective of whether circumcision done or not since the AAP task force on circumcision reports that existing scientific evidence does not support a recommendation for routine neonatal circumcision.

	4. All children with complete radiological investigations such as Ultrasonogram,and Micturating cystourethrogram to exclude the sampling bias.
Exclusion criteria	1. Children developing nosocomial urinary tract infection. 2. Immunosuppresed children 3. Culture negative infections where high index of clinical suspicion 4. Children with already known major renal anomalies 5. Children of parents who refuse to consent to include in the study.

DETAILS OF MATERIAL AND EXPERIMENTAL DESIGN

All children with suspected urinary tract infection from April 2015 to September 2015 were recruited from the outpatient department and from the wards. The study enrolled children aged one month to 12 years, who presented with first proven UTI and recurrent UTIs. They were subjected to detailed history and thorough clinical examination. Urine analysis, renal parameters such as blood urea, serum creatinine and serum electrolytes were taken in all children. Children who were toxic with high grade fever were evaluated completely with hemoglobin, total leukocyte count, differential count, ESR and Blood culture to rule out sepsis. All cases were subjected to Ultraosonography (USG) and voiding cystourethrography (VCUG).. A total number of 271 cases

of which 123 boys and 148 girls were studied. History of fever, irritability, poor feeding, anorexia or vomiting, dysuria, frequency, dark urine and foul smell urine were documented in the proforma. All patients were examined clinically. Blood pressure was recorded. UTI was diagnosed when a single pathogenic bacillus was detected on culture. The urine samples were collected, depending on age of patients, by suprapubic aspiration, catheterization, clean-catch or mid-urine stream.

COLLECTION OF URINE SAMPLE

Children above 3 years of age

Male children

After cleansing the prepuce with soap and rinsing it with water first, morning, mid stream urine sample was collected by clean catch method. The collected sample was immediately inoculated into the culture medium.

Female children

After cleansing the urethral orifice by separating the labia with soap and then rinsing with water first morning, mid stream urine was collected with clean catch method. The collected sample was immediately inoculated into the culture medium.

Children below 3 years of age

Urine samples were obtained either by suprapubic aspiration; catheterization or clean catch midstream urine. Bag samples were not collected for culture.

Interpretation of culture results

Method of collection	Colony count
Suprapubic aspiration	In any number
Urethral catheterization	$>10^3$ cfu/ml
Mid stream clean catch	$>10^5$ cfu/ml

All patients were treated with intravenous or an oral antibiotic according to the sensitivity pattern. Patients with abnormal imaging received antibiotics for 14 days.

Imaging studies

Renal and urinary tract ultrasound were performed for detecting abnormalities. All patients were evaluated for VUR by voiding cystourethrography (VCUG) 3-6 weeks after the UTI when urine culture proved negative or with adequate intravenous antibiotic coverage in emergent situations. VCUG was performed using urograffin 30%, which was instilled into the bladder through a pediatric feeding tube or Foley's catheter according to patient's age, by gravity until voiding occurred. A post-void film of the

bladder was taken to document bladder emptying and residual bladder volume. For male children, a view of the urethra was also obtained. VUR was classified according to the international reflux study classification.

Data collection

Clinical and biological data were prospectively reported based on the Proforma designed for the study. This was used as the primary data for further analysis and interpretation of results. The Proforma used for data collection is enclosed in Appendix.

Statistical analysis

Proportions of outcome measures were arrived as percentages. Data were analyzed with chi-square test. A P value < 0.05 considered significant.

Statement of limitations

In our study only children with culture proven urinary tract infection were analysed. Children with high index of clinical suspicion but culture negative UTI were excluded to decrease the comparison error and statistical inaccuracies. The long term prognosis and management in children with renal anomalies and decreased renal function were not studied, since the study period was only six months.

Ethical issues involved in the study

An informed consent was obtained from the parents before including into the study and before doing radiological investigations such as VCUG. The need of these imaging studies and the possibility of the allergic reactions which is very rare were explained in detail.

JUSTIFICATION OF THE STUDY

Approximately 13-15 % of end stage renal diseases are thought to be related to unrecognized UTI in children. Congenital anomalies of urinary tract are well known causes of UTI in children. These congenital renal anomalies like Vesicoureteric reflux, Pelviureteric junction obstruction, etc can have devastating effects on the kidney. If these anomalies are diagnosed earlier and managed appropriately we can prevent the renal insufficiency.

Some children, who present with an apparently uncomplicated first UTI, turn out to have a significant renal anomaly. Subclinical infections can sometimes lead to severe bilateral renal scarring. Hence even a single documented UTI in a child must be taken seriously. Therefore we want to study the proportions of renal anomalies in children presenting with UTI. This will help in preventing the children to develop chronic renal insufficiency.

DATA ANALYSIS

Interpretation of results

The total numbers of children included in the study were 271. Data were analyzed to arrive at proportions of various parameters of interest.

1. Sex Distribution of UTI.

In a total of 271 children, 148 girls (54.6%) and 123 boys (45.4%) had urinary tract infection. The proportion of girls with UTI was higher than boys.

2. Incidence of renal tract anomalies

In a total of 271 children, renal anomalies were detected in 104 children (38.4%)

3. Age and Sex distribution of children with renal tract anomalies

Total number of children with anomalies-104

Age	Male	Female	Total
1 Month – 3 Yrs	24 (23.07%)	31 (29.8%)	55 (52.9%)
3 Yrs – 12 Yrs	25 (24.04%)	24 (23.07%)	49 (47.1%)
Total	49 (47.1%)	55 (52.9%)	104 (100%)

In a total of 104 cases, 52.9% of children were in the age group of 1 Month to 3 Years and 47.1% of children were more than 3 yeas old. The

prevalence of renal anomalies was more in the girls; than boys according to chi-square test the p value was 0.65 for boys and girls.

4. Sex distribution of children with First and Recurrent UTI

Occurrence of UTI	Male	Female	Total
First UTI	95 (35.05%)	110 (40.6%)	205 (75.64%)
Recurrent UTI	28 (10.3%)	38 (14.02%)	66 (24.35%)
Total	123 (45.35%)	148 (54.62%)	271 (100%)

In our study the occurrence of first time UTI in children was higher than recurrent UTI. The incidence is higher in females than males.

5. Sex distribution of first and recurrent UTI with renal anomalies

Occurrence	Male	Female	Total
First UTI	38 (36.5%)	41 (39.4%)	79 (75.96%)
Recurrent UTI	11 (10.61%)	14 (13.5%)	25 (24.03%)
Total	49 (47.11%)	55 (52.9%)	104 (100%)

In our study we could able to identify 75.96% of children with renal anomalies when they presented as first UTI.

6. The incidence of various renal anomalies

Total number of cases – 104

Upper tract anomalies n-43 (41.34%)
PelviUreteric junction obstruction – 29 (27.88%) (Unilateral Pelviureteric junction obstruction – 27 (Bilateral Pelviureteric junction obstruction- 2) Ectopic kidneys - 2 (1.92%) Duplex collecting system - 2 (1.92%) Horse shoe kidney- 1 (0.96%) Bilateral congenital dysplastic kidneys - 4 (3.84%) Unilateral congenital dysplastic kidney - 2 (1.92%) Vesicoureteric junction calculus obstruction - 2 (1.92%) Primary obstructed megaureter - 1 (0.96%)
Lower tract anomalies n – 18(17.3%)
Neurogenic bladder - 8 (7.69%) Posterior vretral valve - 8 (7.69%) Urethrocoele - 1(0.96%) Urethral fistula - 1 (0.96%)
Combined anomaly n-1 (0.96%)
Vesicoureteric reflux n- 42 (40.38%)
Bilateral VUR- 7 Unilateral VUR – 35

In our study the prevalence of upper tract anomalies and Primary Vesicoureteric reflux were almost equal. The most common upper tract anomaly was Pelviureteric junction obstruction.

8. Age distribution of renal anomalies

Anomalies	**1 month – 3 years**		**3 years – 12 years**		**p-value***
	n	**%**	**n**	**%**	
Upper tract anomalies	14	25.5	29	59.1	0.00
Lower tract anomalies	7	12.7	11	22.4	
Combined	1	1.8	0	-	
VUR	33	60.0	9	18.4	

*Chi-square test

The incidences of renal anomalies were more in the 1 month to 3 years age group.

The incidence of Vesicoureteric reflux is more in the 1 month to 3 year age group comprising the 60% of the anomalies. In the 3-12 year age group upper urinary tract anomalies were more common comprising 59.1%. This study is statistically extremely significant.

9. Sex distribution of renal anomalies

Anomalies	Boys		Girls		p-value*
	n	%	n	%	
Upper tract anomalies	18	36.7	25	45.5	0.24
Lower tract anomalies	12	24.5	6	10.9	
Combined	0	-	1	1.8	
VUR	19	38.8	23	41.8	

* Chi-square test

The incidence of upper tract anomalies and VUR were almost equal in the boys than the girls. In the girls upper tract anomalies predominate the other anomalies. The ‘p’ value in this study was 0.24.

10.Clinical features of UTI with renal anomalies

Symptoms	1 month-3 year	3 year- 12 year	%
Fever	46	38	80.76
Irritability	2	1	1.92
Diarrhea	3	-	2.88
Poor feeding	1	-	0.96
Vomiting	1	-	0.96
Dysuria/screaming attacks	1	4	4.8
Increased frequency	-	1	2.88
Enuresis	0	1	0.96
Failure to thrive	2	-	1.92
Pyuria	1	2	2.88

About 80% of children presented with a predominant symptom of fever both in the 1month-3 year age group and 3 year- 12 year age group. About 2.9% of children in 1month- 3 year age group presented with diarrhea followed by failure to thrive. In 3-12 year age group dysuria was the most predominant symptom.

11. The distribution of microorganisms detected in the urine culture.

Microorganism	Children with renal anomalies. No & %	Children without renal anomalies. No & %
E.coli	57 (54.8)	94 (56.28)
Klbsiella	23 (22.11)	26 (15.56)
Pseudomonas	13 (12.5)	24 (14.37)
Staphylococcus	1 (0.96)	2 (1.19)
Enterococcus	1 (0.96)	4 (2.39)
Proteus	6 (5.76)	13 (7.78)
Candida	2 (1.92)	3 (1.79)
Citrobacter	1 (0.96)	1 (0.59)
Total	104 (100)	167 (100)

The most common micro organism causing UTI was the gram negative E.coli comprising more than 50% both in the children with renal anomalies and without renal anomalies followed by Klebsiella and Pseudomonas. Very few patients had gram-positive infection. Significant Candida infection occurred in 1.92% of patients with renal anomalies, which is often not considered as an opportunistic pathogen.

12. Role of imaging studies in the identification of VUR:

Total number of VUR cases =42

Number of VUR cases detected by MCU alone =26

Number of VUR cases detected by USG alone = 1

Total number of cases detected by MCU = 41(97.6%)

Total number of cases detected by USG = 17(40.5%)

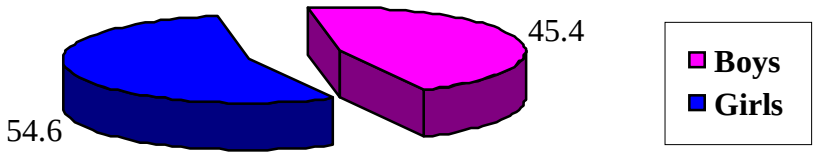
Ultrasonogram could identify the renal anomalies of less than 50% where as MCU detected 97.6% of VUR.

OBSERVATION

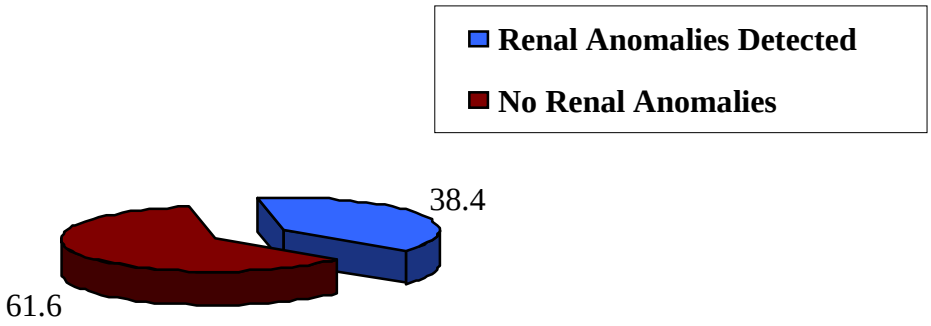
Analysis of Data

Total number of Children included in the study – 271

1. Sex distribution of Urinary tract infection



2. Incidence of Renal tract anomalies

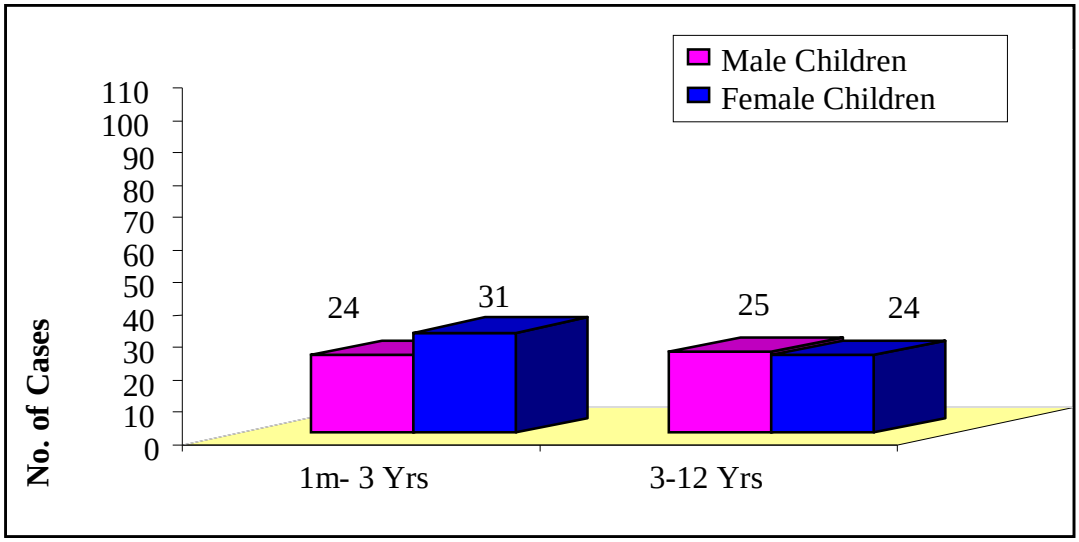


3. Age and Sex distribution of children with renal tract anomalies

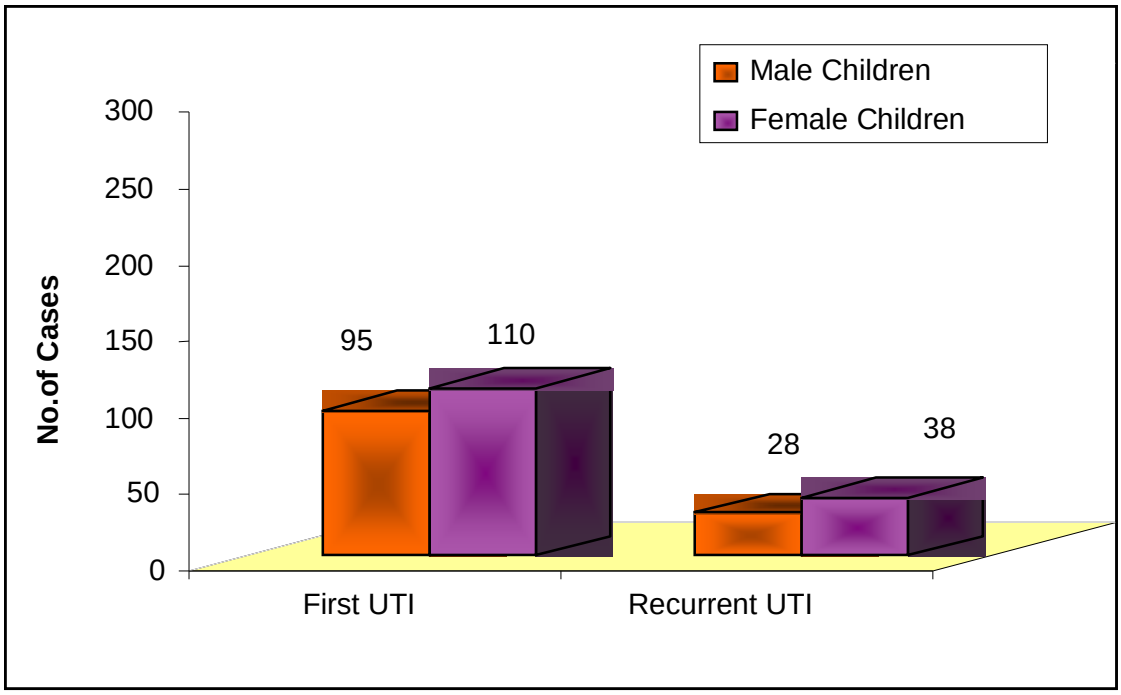
Age groups :

1 month to 3 years

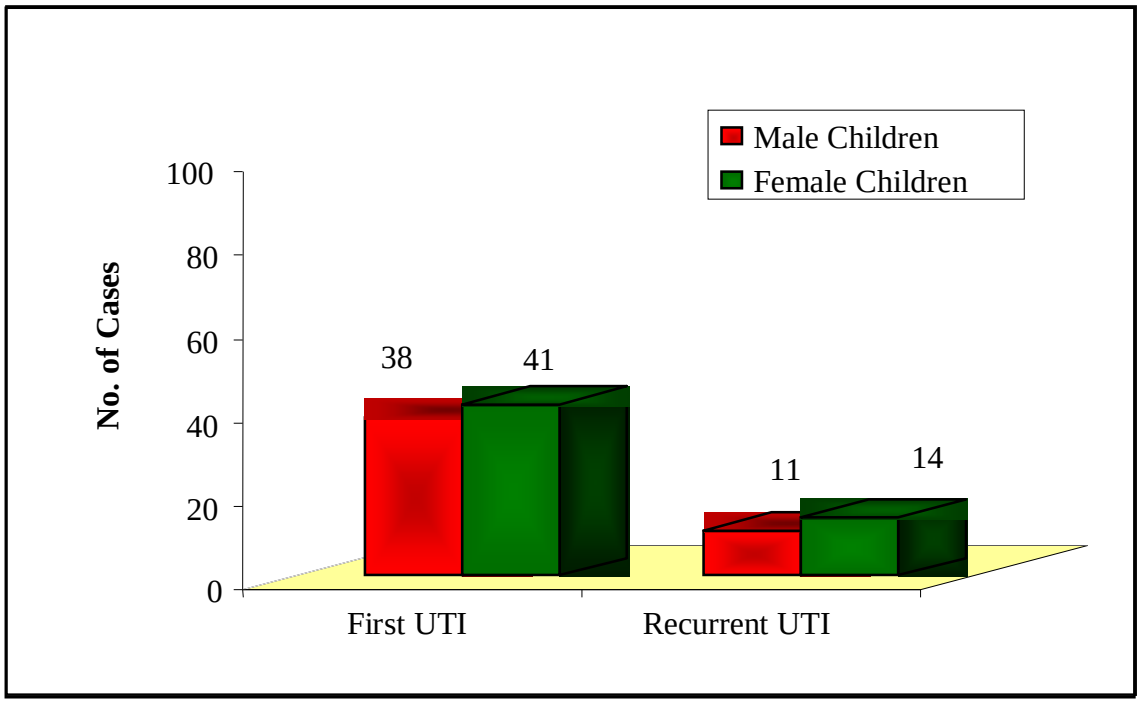
3 years to 12 years



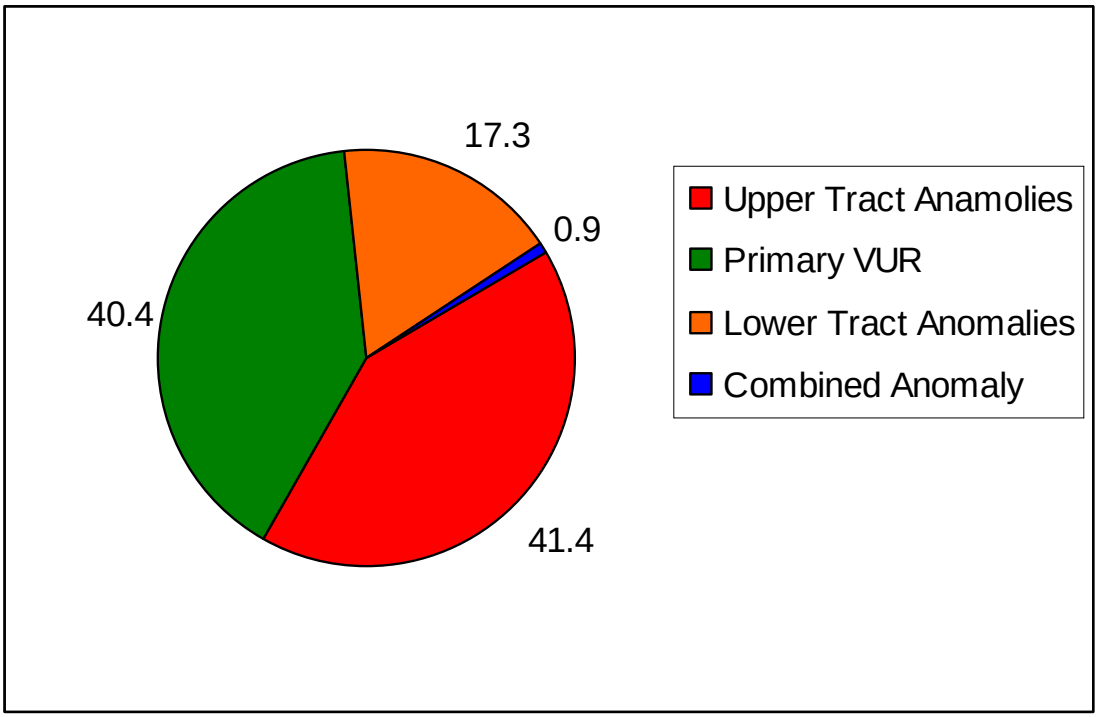
4. Sex distribution of First and Recurrent UTI



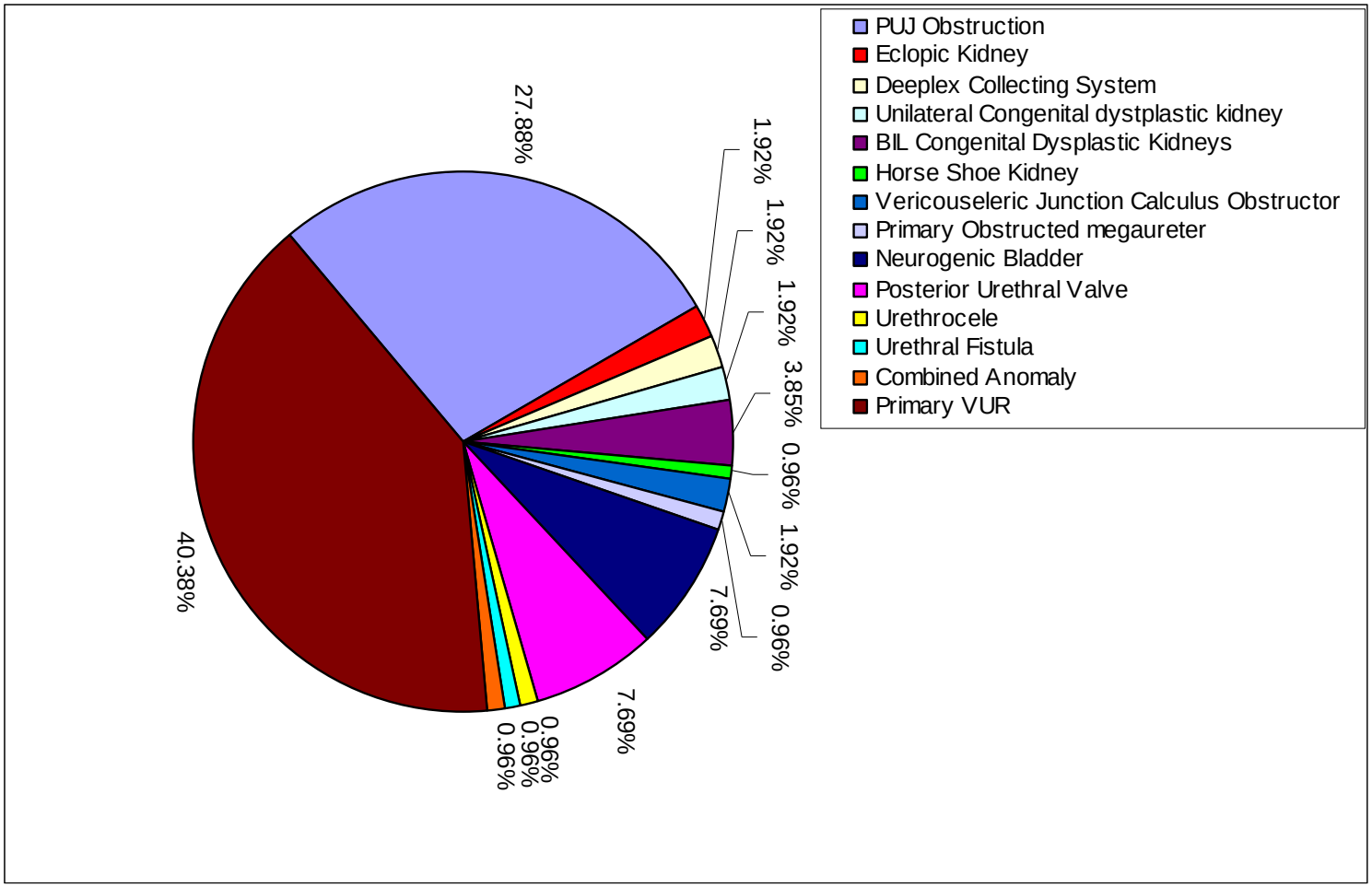
5. Sex distribution of First & Recurrent UTI with renal anomalies



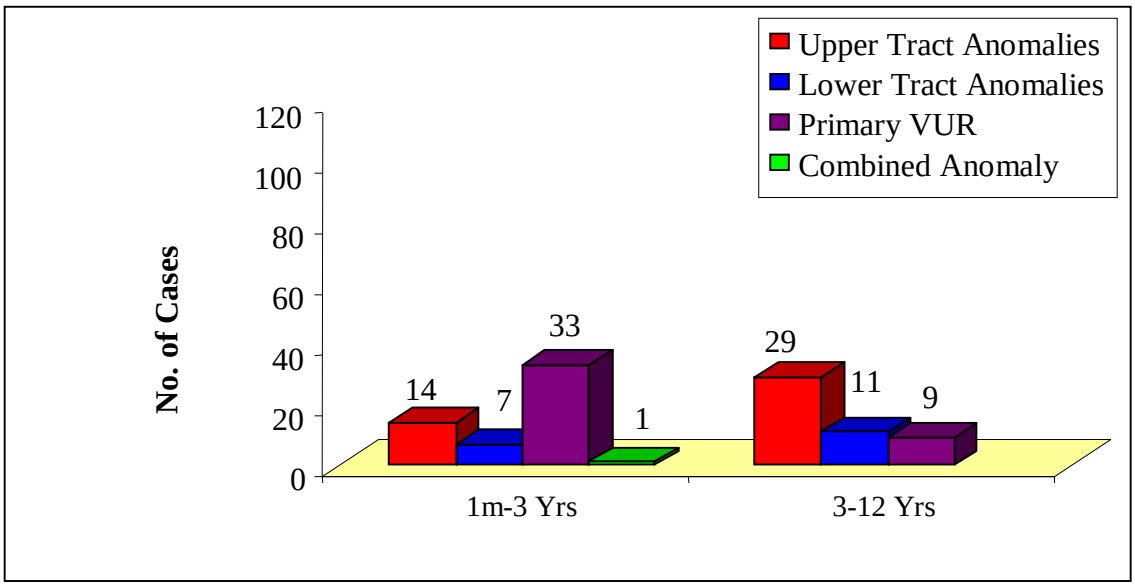
6. Distribution of Renal tract anomalies



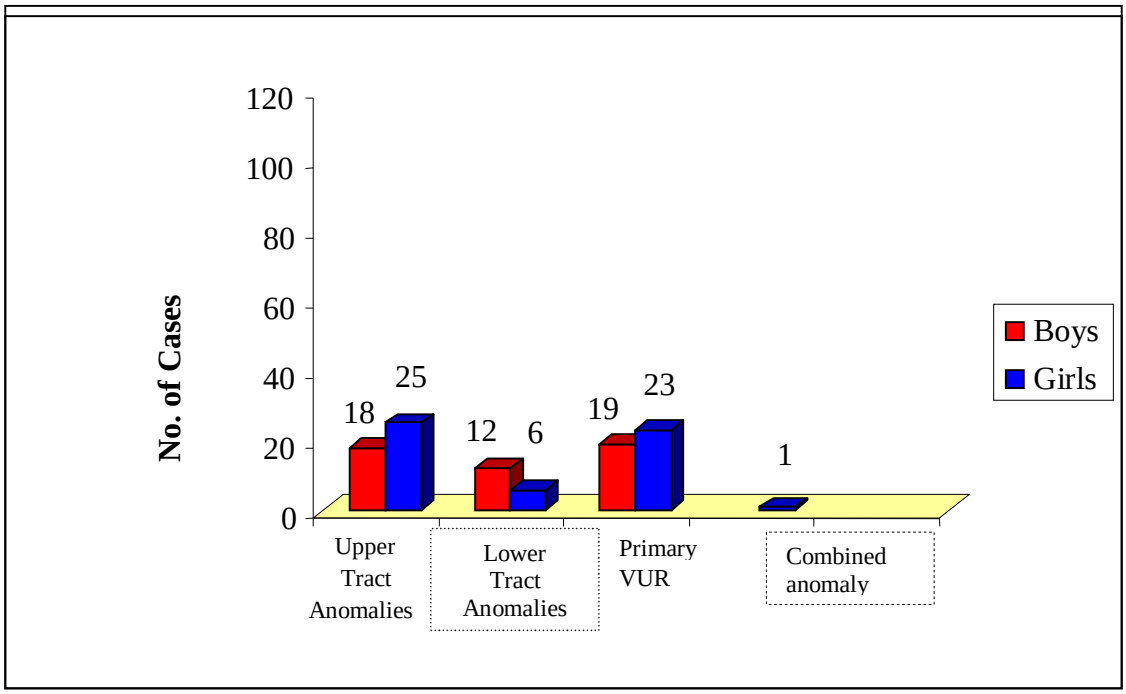
7. Pattern of Renal tract anomalies



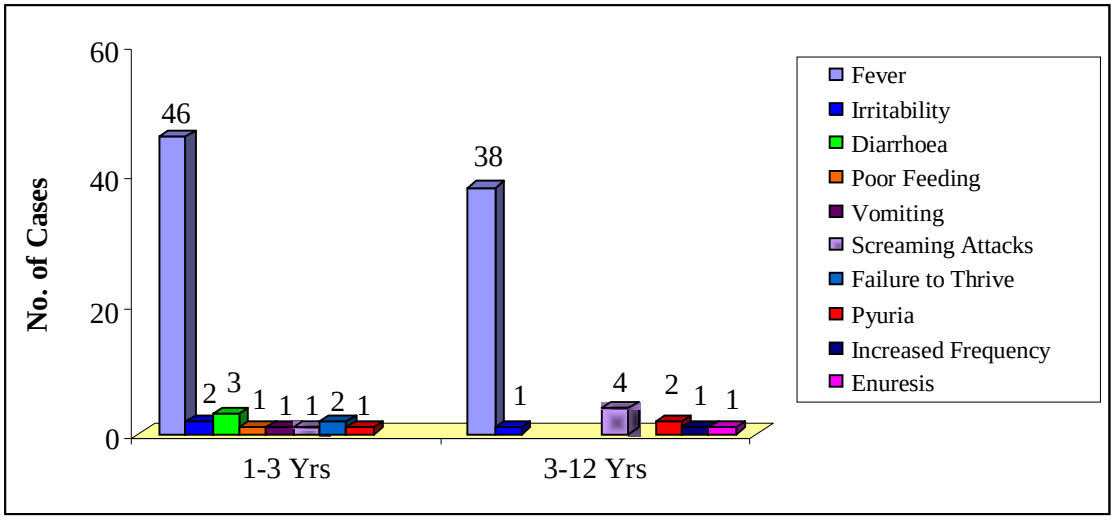
8. Age distribution of Renal anomalies



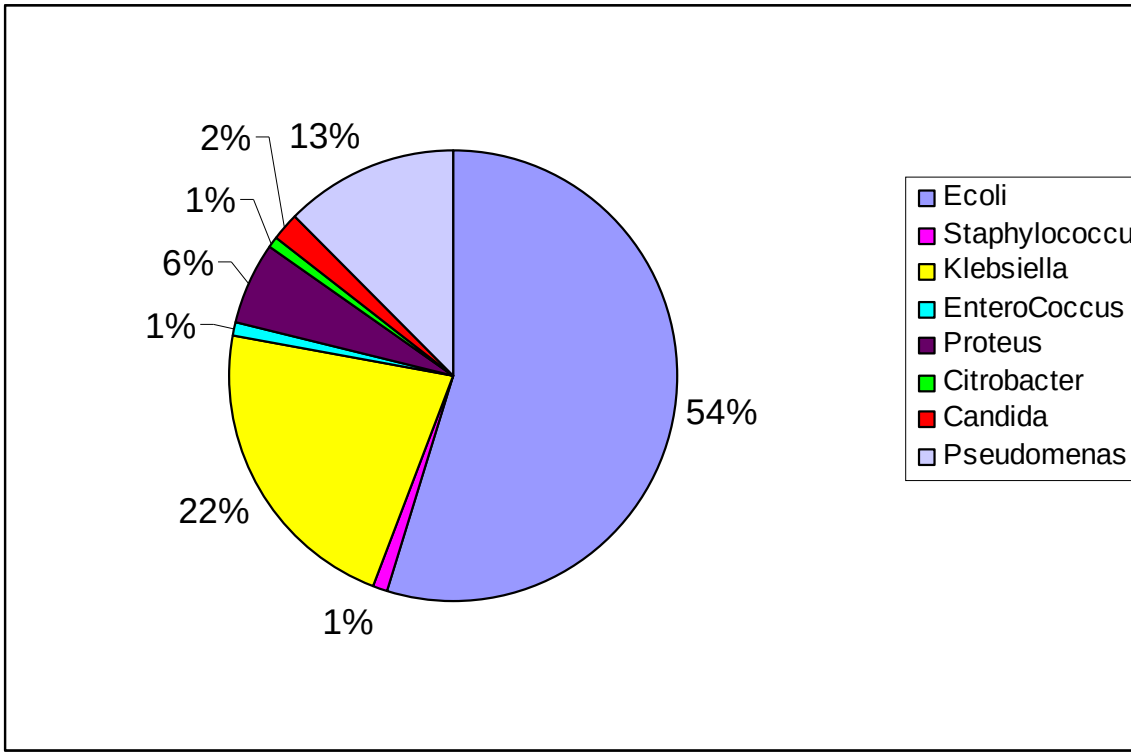
9. Sex distribution of Renal anomalies



10. Pattern of Predominant Clinical features in children with renal anomalies



11. Pattern of micro organisms in children with renal anomalies



DISCUSSION

Urinary tract infection is a common problem in pediatric practice with 3% of girls and 1% of boys suffering at least one episode. Approximately 10% of children will develop renal cortical scar and 1-2% will be at risk of developing hypertension at a later life. About 15% of cases of end stage renal failure are secondary to chronic Pyelonephritis. Ideally children who are at risk of developing cortical scarring should be identified early and preventive strategy should be instituted.

In our study, out of 271 children diagnosed to have culture positive urinary tract infection, the incidence of renal anomalies was high among the girls (54.6%) compared to the boys (45.4%). This observation concurred with the finding given in the literature.[9]

The incidence of renal tract anomalies detected in the study population was thirty eight point four percent which is almost equal to the incidence found in the study conducted by Wu Cy et al of Taiwan.[8]

Renal tract anomalies were detected more in the age of groups of 1months to 3years using appropriate imaging studies predominantly such as Ultrasonography and Micturating Cystourethrography. About 52.9% of children were more than 3years of age . The incidence of renal anomalies detected were more in the girls under age of 3years where as it was almost equal in the age group of children of more than 3years. These findings were

observed in the study done by Ayse Balat & L.Leigon Hell given in the literature.[13]

In our study the incidence of first time UTI presented to our institution was more than recurrent UTI (24%). It does not correlate with the study given in the literature.[12] The incidence of both first and recurrent UTI were more in females than males.

Among the various renal tract anomalies detected Primary Vesicouerteric reflux (40.38%) was the most common anomaly detected followed by the PUJ obstruction (22.88%). This is comparable to various studies given below.

Present study	40.38 %
Wy Cy et al[8]	53 %
Ali ahmadzadeh [9]	40%
Ayse Balat [13]	51.6%
Nammalwar BR et al [24]	82.1%

In children with initial diagnosis of UTI investigators diagnosed VUR in approximately 50% of children with UTI who are younger than 1year of age[35]. In our study the incidence of VUR was 60% in children less than 3 years age, which is coincidental.

In our study the incidence of upper tract anomalies were more than the lower tract anomalies. The incidences of upper tract anomalies are (59%) more in the 3-12 years age group than VUR (18%). This finding concurs with the given literature[13].

The incidences of renal anomalies were almost equal in both age groups of children less than 3years and more than 3years with an extremely significant P value. The over all percentage of anomalies found in boys and girls were also almost equal. The incidences of upper tract anomalies were more in female children in the age groups of 3-12 years. The incidence of VUR is equal in both the sexes and lower tract anomalies were more in boys[13].

In the upper tract anomalies hydroureteronephrosis with PUJ obstruction forms the major group. In the lower tract anomalies neurogenic bladder and Posterior urethral valve forms the equal incidence. The incidence of neurogenic bladder was more in female children in 3-12years age group.

Only one case of combined anomaly was identified in our study was a 12 year old girl with neurogenic bladder, ectopic right kidney, chronic pyelonephritis and operated meningomyelocoele. She presented with recurrent urinary tract infection and chronic constipation, who was trained in clean intermittent catheterization regularly.

Another interesting case of caudal regression syndrome with Bilateral VUR, Neurogenic bladder and acyanotic heart diseases- Atrial septal defect was identified in a 1-year-old male child. This child also presented with recurrent UTI. MRI spine revealed regression of the cord. There were 8 cases

of posterior urethral valve well seen in the MCU with Bilateral Hydroureteronephrosis.

The children with UTI most commonly presented with fever (80.76%) both in less than 3years and more than 3 years of age group. In children less than 3years of age group fever was followed by non-urinary symptoms like diarrhoea, failure to thrive and urgency. In children more common symptom was dysuria. This is comparable to the given studies in the literature[10, 15].

The most common organism causing UTI was E.coli(54.4%) followed by Klebsiella(22.1%) and Pseudomonas(12.5). This observation is very well comparable with other studies given in the literature[8, 9, and 11,13,14,15]. There were no differences in the microorganism pattern in patients with and without renal anomalies.

Various imaging studies such as Ultrasonography and MCU study were performed. The sensitivity of MCU in detecting VUR was more than Ultrasonography. Only 40% of VUR was detected by Ultrasonogram where as MCU detected 97% of VUR. About 26 cases of VUR were missed by the Ultrasonogram and only one case of VUR was missed by the MCU. Hence MCU had high predictive value which is supported by the study done by Zamir et al [20] and K.J. Kass[22].

SUMMARY & CONCLUSION

1. Our study has demonstrated that with appropriate history, clinical examination and investigations we can detect renal anomalies in young children, which will help in preventing renal damage.
2. The features of distal anomalies like dribbling, poor stream, straining and crying during urination warrant adequate evaluation.
3. Careful history regarding bowel and bladder habits is mandatory. One has to look for degree of systemic toxicity, renal and bladder mass, loaded colon as well as phimosis and vulval synechiae. Neurological evaluation of lower limbs is important in this group of children if child has spinal deformities.
4. For culture sensitivity of urine, midstream sample is usually used for convenience but suprapubic and catheter samples are better. Bag samples can be used for its negativity only.
5. USG and MCU should be done in every febrile infantile UTI. Though ultrasonogram the urinal screening investigation in all patients its yield in detecting VUR was low. USG needed even in recurrent afebrile UTI and of course MCU is done as per positive findings in USG . MCU was most helpful in identifying VUR and also for grading VUR
6. Always first treat the acute UTI and start chemoprophylaxis and then do VCUG with precautions after adequate period of chemoprophylaxis.

7. In infantile UTI the rule should be early diagnosis on suspicion and aggressive treatment on diagnosis followed by adequate chemoprophylaxis.
8. Complete evaluation is mandatory to document associated anomalies and hence their management. Essential follow-up should not be forgotten as we are treating an infant with UTI with a potential for renal damage in a growing kidney.

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INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE, CHENNAI-3

EC Reg No.ECR/270/Inst./TN/2013
Telephone No. 044 25305301
Fax : 044 25363970

CERTIFICATE OF APPROVAL

To
Dr.PADMAVATHI A
Postgraduate M.D.(Paediatrics)
Madras Medical College
Chennai 600 003

Dear Dr. PADMAVATHI A

The Institutional Ethics Committee has considered your request and approved your study titled **"Profile of Renal Tract Anomalies in Children Presenting with Urinary Tract Infection " No.09072015**

The following members of Ethics Committee were present in the meeting held on 07.07.2015 conducted at Madras Medical College, Chennai-3.

1. Prof.C.Rajendran, M.D.,	: Chairperson
2. Prof.R.Vimala, M.D., Dean, MMC, Ch-3	: Deputy Chairperson
3. Prof.Sudha Seshayyan, M.D., Vice-Principal, MMC, Ch-3	: Member Secretary
4. Prof.B.Vasanthi, M.D., Professor Pharmacology, MMC	: Member
5. Prof.P.Ragumani, M.S., Professor, Inst.of Surgery, MMC	: Member
6. Prof.Md.Ali, M.D., D.M., Prof. & HOD of Medl.G.E., MMC	: Member
7. Prof.Baby Vasumathi, Director, Inst.of O&G, Ch-8	: Member
8. Prof.K.Ramadevi, Director, Inst.of Biochemistry, MMC	: Member
9. Prof.Saraswathy, M.D., Director, Inst. Of Pathology, MMC	: Member
10. Prof.Srinivasagalu, Director, Inst.of Inter Med. MMC	: Member
11. Thiru S.Rameshkumar, B.Com., MBA	: Lay Person
12. Thiru S.Govindasamy, B.A., B.L.,	: Lawyer
13. Tmt.Arnold Saulina, M.A., MSW.,	: Social Scientist

We approve the proposal to be conducted in its presented form.

The Institutional Ethics Committee expects to be informed about the progress of the study and SAE occurring in the course of the study, any changes in the protocol and patients information/informed consent and asks to be provided a copy of the final report.

21/8/15

Member Secretary, Ethics Committee

MEMBER SECRETARY
INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE
CHENNAI-600 003

INFORMATION SHEET

Place of study: INSTITUTE OF CHILD HEALTH AND HOSPITAL FOR CHILDREN

Name of Investigator: DR. PADMAVATHI. A.

Name of Participant Age: Sex:

Hospital No:

Study Title : PROFILE OF RENAL TRACT ANOMALIES IN CHILDREN PRESENTING WITH URINARY TRACT INFECTION.

We are conducting a study on **Profile of renal tract anomalies in children presenting with urinary tract infection.**

- Urinary tract infection is one of the most common problem in children.
- Urinary tract infection in children is recognized as a cause of hypertension and renal failure in adulthood.
- We are conducting a study in ICH & HC regarding various renal tract anomalies in children with urinary tract infection.
- We request you to participate in the study.

1. The privacy of the patients in the research will be maintained throughout the study. In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared.

2. Taking part in this study is voluntary. You are free to decide whether to participate in this study or to withdraw at any time; your decision will not result in any loss of benefits to which you are otherwise entitled.
3. The results of the special study may be intimated to you at the end of the study period or during the study if anything is found abnormal which may aid in the management or treatment.

Signature of investigator Signature of participant

Date:

தகவல் படிவம்

ஆய்விடம் : அரசு குழந்தைகள் நல மருத்துவமனை மற்றும் ஆராய்ச்சி நிலையம்

ஆய்வாளர் : மரு.அ.பத்மாவதி

பங்கு பெறுபவரின் பெயர் : வயது : பாலினம் :

மருத்துவமனை எண் :

ஆய்வு தலைப்பு: சிறுநீர் கிருமி தொற்று உள்ள குழந்தைகளின் சிறுநீர் பாதையில் உள்ள கோளாறுகளை கண்டறிதல்.

தங்கள் குழந்தையும் இந்த ஆய்வில் பங்கு பெற கேட்டுக் கொள்கின்றோம்.

1. சிறுநீர் கிருமி தொற்று உள்ள குழந்தைகளின் சிறுநீர் பாதையில் உள்ள கோளாறுகளை கண்டறிதலே இந்த ஆய்வின் நோக்கமாகும்.
2. உங்கள் குழந்தையைப் பற்றிய தனிப்பட்ட விவரங்கள் யாருக்கும் தெரிவிக்காமல் பாதுகாக்கப்படும்.
3. இந்த ஆய்வில் பங்கு பெறுவதில் தங்களுக்கு தனிப்பட்ட விருப்பம் இல்லை என்றால் தாங்கள் விலகிக் கொள்ளலாம். அவ்வாறு விலகுவதால் தங்கள் குழந்தையின் சிகிச்சைக்கு எவ்வித பாதிப்பையும் உருவாக்காது.
4. ஆய்வின் முடிவுகள் ஆய்வு நடக்கும் போதோ (தேவை ஏற்படின்) அல்லது ஆய்வு முடிந்த பின்னரோ தங்களுக்கு தெரிவிக்கப்படும். அந்த முடிவுகள் தங்கள் குழந்தையின் சிகிச்சைக்கு பேருதவியாக இருக்கக் கூடும்.

ஆய்வாளரின் கையொப்பம் பெற்றோரின் கையொப்பம்

நாள் :

இடம் :

INFORMED CONSENT FORM

Study Place	INSTITUTE OF CHILD HEALTH AND HOSPITAL FOR CHILDREN
Title of the study:	"PROFILE OF RENAL TRACT ANOMALIES IN CHILDREN PRESENTING WITH URINARY TRACT INFECTION"
Name of the investigator:	DR. PADMAVATHI. A.
Name of the Participant:	Age: Sex:
Hospital number:	

1. I have read and understood this consent form and the information provided to me regarding the participation in the study.
2. I have had the consent document explained to me.
3. I have been explained about the nature of the study.
4. I have been explained about my rights and responsibilities by the investigator.
5. I have informed the investigator of all the treatments I am taking or have taken in the past including any native (alternative) treatment.
6. I have been advised about the risks associated with my participation in this study.*
7. I agree to cooperate with the investigator and I will inform him/her immediately if I suffer unusual symptoms. *
8. I have not participated in any research study in the past.
9. I am aware of the fact that I can opt out of the study at any time without having to give any reason and this will not affect my future treatment in this hospital. *
10. I am also aware that the investigator may terminate my participation in the study at any time, for any reason, without my consent. *

11. I hereby give permission to the investigators to release the information obtained from me as result of participation in this study to the sponsors, regulatory authorities, Govt. agencies, and IEC. I understand that they are publicly presented.
12. I have understand that my identity will be kept confidential if my data are publicly presented
13. I have had my questions answered to my satisfaction.
14. I have decided to be in the research study.

I am aware that if I have any question during this study, I should contact the investigator. By signing this consent form I attest that the information given in this document has been clearly explained to me and understood by me, I will be given a copy of this consent document. For adult participants:

Name and signature / thumb impression of the participant /parents/guardian

Name _____Signature_____ Date_____

Name and Signature of impartial witness:

Name _____Signature_____ Date_____

Name and Signature of the investigator or his representative obtaining consent:

Name _____Signature_____ Date_____

ஒப்புதல் படிவம்

1. இந்த ஆய்வை பற்றிய அனைத்து தகவல்களும் எனக்கு தெரிவிக்கப்பட்டது.

2. இதில் பங்கு பெறுவதற்கான ஒப்பந்த படிவமும் எனக்கு விவரிக்கப்பட்டது.

3. ஆராய்ச்சியின் தன்மையும் எனது உரிமைகளும் எடுத்துரைக்கப்பட்டது.

4. இந்த ஆய்வினால் எனது குழந்தையின் நலனுக்கு எந்த தீங்கும் இல்லை என்பதை தெரிந்து கொண்டேன்.

5. இந்த ஆய்வில் எனது குழந்தை பங்கு பெற எனது மணமார்ந்த ஒப்புதலை தருகிறேன்.

பெற்றோரின் கையொப்பம் சாட்சியின் கையொப்பம்

ஆய்வாளரின் கையொப்பம்

நாள் :

இடம் :

PROFORMA

Name:

Age: **Date of Birth:**

Sex:

Hospital no:

Symptoms:

Address:

Symptoms	**YES/NO**	**Duration**
1. Fever		
2. Fever with chills or rigors		
3. Vomiting		
4. Poor weight gain		
5. Lethargy		
6. Irritability		
7. Dehydration		
8. Jaundice		
9. Abdominal pain		
a. Flank		
b. Suprapubic		
10. Abdominal mass		

11. Urine-Frequency
    - Urgency
    - Dysuria
    - Dribbling
    - Weak or abnormal stream.
    - Excessive crying or straining during voiding
    - Oliguria
    - Polyuria
    - Hematuria
    - Enuresis after toilet trained.
12. Recurrence of infection – No. of episodes
13. Diarrhoea
14. Constipation

Past History

Ante natal/Natal/Post natal

Physical Examination;

General examination

Appearance

Pallor

Icterus

Clubbing

Cyanosis

Lymphadenopathy

Edema

Signs of sepsis and dehydration such as mucus membrane dryness and skin turgor.

Dysmorphic facies

Vital signs

Temperature

Pulse rate

Respiratory rate

Blood pressure

Anthropometry

Weight

Height

Head circumference.

Systemic Examination

Abdomen

Tenderness, mass,

Palpable kidney

Cardiovascular system

Respiratory system

Central nervous system

Spine Examination

Genital Examination

Phimosis

Pinhole meatus

Hypospadias

Circumcised or not

Vulval synechiae or labial adhesions

Investigations;

Urine Examination;

Collection of specimen

Urinalysis

The first morning specimen is preferred. Colour, Specific gravity, Albumin, Sugar, Deposits, RBC, WBC, Casts

Urine culture.

After local cleaning with soap and water a midstream sample is collected in a sterile container and transported immediately to the laboratory. Percutaneous suprapubic puncture is also used.After ensuring that the bladder is full ,the suprapubic area is cleaned and a sterile syringe with guage 21 or 22 needle used for aspirating urine.

Urine is also collected by catheterization of the bladder under strict aseptic precautions.

Blood investigations (according to the need)

Cell counts,

CRP,

ESR,

Blood culture

Urea, Creatinine and Electrolytes

Imaging studies (according to the need)

Ultrasonography,

Radiograph of Abdomen

Micturating cystourethrogram,

Urodynamic study

Cystoscopy

Diagnosis

Management

				SYMPTOMS*		IMAGING		Organisms					
SL.NO	OP/IP NO	AGE	SEX	U	NO U	USG	MCU	G+Ve	G-Ve	O	1UTI	R UTI	DIAGNOSIS
1	873187	2 YRS	M	-	+	-	+	-	+	-	+	-	B/L VUR-GR III
2	873152	1 YRS	F	-	+	-	+	-	+	-	+	-	LT.GR.IV VUR
3	872667	4 YRS	F	+	+	-	+	-	+	-	+	-	LT.GR.III VUR
4	873408	1 YRS	M	-	+	+	+	-	+	-		+	PUV+GR V REFLUX ON LEFT NON-FN RT-KIDNEY
5	873468	8 YRS	M	+	+	+	+	-	+	-	-	+	RT.PUJ OBS+PUV
6	873436	2 YRS	M	-	+	+	+	-	+	-	+	-	GR.4 VUR+RT HYDRONEPHESIS
7	873468	7 YRS	F	+	+	+	+	-	+	-	-	+	NEUROGENIC BLADDER I GR V VUR-LT MYELOMENINGOCOELE
8	873534	5 mnth	M	-	+	-	+	-	+	-	+	-	GR. III VUR-LT
9	873381	5 YRS	M	+	+	+	-	-	+	-	+	-	RT-PUJ OBSTRUCT
10	873306	8mnth	M	-	+	+	+	-	+	-	+	-	B/L VUR;LT>RT I PUB
11	872667	3mnth	M	-	+	-	+	-	+	-	+	-	GR III VUR-RT
12	872408	2mnth	F	-	+	+	+	-	+	-	+	-	RT.PUJ OBSTRUCTION
13	873391	5 YRS	F	+	+	+	+	-	+	-	+	-	LEFT PUJ OBSTRUCTION
14	871150	10yrs	M	-	+	-	+	-	+	-	+	-	LEFT-GR.IV VUR PARAURETERIC DIVERTICULAM
15	871511	5 YRS	F	+	+	+	+	-	+	-	+	-	RT HYDRONEPHROSIS DUE TO PUJ OBSTRUCT,
16	872995	7 YRS	M	+	+	-	+	-	+	-	-	+	LEFT PUJ OBSTRUCTION
17	872867	4 YRS	M	-	+	+	-	-	+	-	+	-	LEFT PUJ OBSTRUCTION
18	872890	10 YRS	F	+	-	+	-	-	+	-	-	+	RT PUJ OBSTRUCTION
19	871997	7 YRS	F	+	+	+	-	-	+	-	-	+	RT PUJ OBSTRUCTION RT HYDRONEPHOSIS
20	871513	8mnth	M	-	+	+	+	-	+	-	+	-	RT.GRIII VUR
21	872611	1mnt	M	-	+	-	+	-	+	-	+	-	LEFT GR IV VUR
22	871510	10 YRS	F	+	+	+	+	-	+	-	-	+	ECTOPIC LT KIDENY ECTOPIC INSERTION LEFT URETER INTO BLADDER NECK
23	872881	6 YRS	F	+	+	+	-	+	+	-	+	-	B/L GR.III VUR+ECTOPIC LEFT KIDNEY
24	872905	6mnth	M	-	+	+	+	-	+	-	+	-	GR IV VUR
25	872668	3 YRS	F	+	+	+	+	-	+	-	+	-	B/L CONG DYSPLASTIC
26	872447	1 YRS	F	+	-	+	+	-	+	-	+	-	GR II VUR RT
27	872351	1mnt	M	-	+	-	+	-	+	-	+	-	OBSTRUCTION AND RT PUJ GR.III VUR-LT HYDROURETERONEPHROSIS
28	871769	2 YRS	F	+	+	-	+	-	+	-	-	+	GR III VUR RT
29	872447	3 YRS	M	-	+	-	+	-	+	-	-	+	GR IV VUR
30	870033	2 YRS	M	-	+	+	+	-	+	-	+	-	GR V VUR
31	872457	9 mnth	F	-	+	-	+	-	+	-	+	-	GR IV VUR -LT
32	872356	1 YRS	M	-	+	+	+	-	+	-	+	-	PUV+V/L GR IV VUR
33	873368	12 yrs	F	+	-	+	+	-	+	-	-	-	ECTOPIC KIDNEY NEUROGENIC BLADDER MENGOMYELOCELE
34	872234	1 YRS	M	-	+	+	+	-	+	-	+	-	PUV+V/LG GR.III VUR
35	872008	2mnth	F	-	+	-	+	-	+	-	+	-	RT GR II VUR

36	872239	1 YRS	M	-	+	+	+	-	+	-	-	+	V/L GR III VUR
37	871020	2 YRS	M	-	+	+	+	-	+	-	-	+	LT GR III VUR
38	871217	9mnth	F	+	+	-	+	-	+	-	+	-	GR IV VUR
39	872040	12 YRS	M	+	-	-	+	-	+	-	-	+	NEUROGENIC BLADDER
40	871588	3mnth	M	+	+	+	-	-	+	-	+	-	LEFT PUJ OBSTRUCTION
41	871973	10mnth	M	-	+	-	+	-	+	-	+	-	SAGITTAL URETHRAL DUPLICATION LEFT VUR -II
42	872020	1month	F	-	+	+	+	-	+	+	-	+	GR III VUR
43	871866	1YRS	F	-	+	+	-	+	+	-	+	-	RT HYDRONEHROSIS I PUJ OBSTRUCTION
44	802088	12 YRS	F	+	-	+	-	-	+	-	+	-	RT HYDRONEHRSIS I RT PUJ OBSTRUCTION
45	871202	4mnth	M	-	+	+	-	+	+	-	+	-	LT PUJ OBSTRUCTION
46	871801	1 YRS	F	-	+	-	+	+	-	-	-	+	GR I VUR
47	871858	9mnth	F	-	+	-	+	-	+	-	-	+	GR III VUR
48	871788	3 mnth	F	-	+	-	+	-	+	-	-	+	GR II VUR
49	871730	2 YRS	F	-	+	-	+	-	+	-	-	+	GR IV VUR
50	871892	4 YRS	F	+	+	+	+	-	+	-	-	-	NERUROGENIC BLADDER,SPINA BIFIDA,,GR IV VUR
51	871802	6YRS	M	+	-	-	+	-	+	-	+	-	RT VUR II
52	870202	6mnth	F	-	+	-	+	-	+	-	+	-	DUPLICATE COLLECTING SYSTEM
53	868745	2 YRS	F	-	+	+	+	-	+	-	+	-	RT PUJ OBSTRUCTION
54	871624	3 YRS	F	-	+	-	+	-	+	-	+	-	PUV + GR.I REFLUX
55	871506	10 YRS	M	+	-	+	-	-	+	-	+	-	LEFT PUJ OBSTRUCTION
56	871629	3 YRS	F	-	+	+	-	-	+	-	+	-	LEFT PUJ OBSTRUCTION
57	871757	11 YRS	F	+	-	+	-	-	+	-	-	+	OBSTRUCTED MEGA URETER
58	871690	12 YRS	M	+	-	+	-	-	+	-	-	+	LEFT PUJ OBSTRUCTION
59	871568	8 YRS	M	+	+	-	+	-	+	-	+	-	URETHROCELE
60	871308	5 YRS	M	+	+	+	+	-	+	-	+	-	PUV + B/L VUR
61	871478	4 YRS	M	-	+	+	-	-	+	-	+	-	CONG.MEGAURETER ECTOPIC MALROTATED RT.KIDENY + DORV
62	871361	10 mnth	F	-	+	+	-	-	+	-	+	-	DYSPLASTICECTOPIC RT.KIDNEY
63	869220	1 YRS	M	-	+	+	+	-	+	-	+	+	CAUDAL REGRESSION.ASD, NEUROGENIC BLADDER B/L VUR
64	869359	10 mnth	F	-	+	+	-	-	+	-	+	-	RT.VUJ CACULUS
65	868219	1 YRS	F	-	+	-	+	-	+	-	+	-	GR.V VUR
66	868528	3 YRS	F	-	+	-	+	-	+	-	+	-	GR.III VUR
67	869490	2 YRS	F	+	+	+	-	-	+	-	+	-	RT.PUJ OBSTRUCTION
68	866906	12 YRS	M	+	-	+	-	-	+	-	-	+	B/L CONG. DYSPLASTIC
69	867518	2 YRS	F	-	+	+	+	-	+	-	+	-	B/L VUR
70	868002	10 mnth	F	-	+	-	+	+	-	-	+	-	GR.I VUR+ SACRAL AGENCIES

71	869574	12 YRS	M	+	-	+	-	-	+	+	+	-	LT.PUJ OBSTRUCTION
72	869764	2 YRS	F	-	+	+	-	-	+	-	+	-	B/L CONG. DYSPLASTIC
73	869673	5 mnth	F	+	+	-	+	-	+	-	+	-	GR.III VUR LT
74	869648	12 YRS	M	+	-	+	-	-	+	-	-	+	URETHRAL FISTULA + HYDRONEPHROSIS
75	869251	12 YRS	M	+	-	+	+	-	+	-	+	-	B/L VUR - PUV
76	869555	4 mnth	F	+	+	+	+	-	+	-	+	-	LT. PUJ OBSTRUCTION
77	867889	9 YRS	M	+	-	+	-	-	+	-	+	-	B/L CON DYSPLASTIC KIDNEYS,CRF
78	869170	12 YRS	F	+	-	-	+	-	+	-	+	-	NEUROGENIC BLADDER
79	869548	8 YRS	M	+	+	-	+	-	+	-	+	-	GR.IV VUR
80	869678	11 YRS	F	+	-	+	-	-	+	-	+	-	B/L PUJ OBSTRUCTIONS
81	869491	1YRS	M	-	+	+	+	-	+	-	+	-	PUV/B/L VUR B/L HYDRONEPHROSIS
82	870077	7 YRS	M	+	-	+	-	-	+	-	+	-	HORSE SHOE KIDNEY
83	868967	7 mnth	F	-	+	-	+	-	+	-	+	-	GR. I VUR
84	868520	8 mnth	F	-	+	-	+	-	+	-	+	-	GR. III VUR'
85	870183	8 YRS	F	+	+	-	+	-	+	-	+	-	NEUROGENIC BLADDER
86	869629	2 YRS	M	-	+	-	+	-	+	-	+	-	GR. II VUR
87	869490	12 YRS	F	+	+	+	+	+	+	-	-	+	NEUROGENIC BLADDER + MYELOMENINGOCOELE
88	870193	9 mnth	M	-	+	+	+	-	+	-	+	-	GR IV VUR + PUV
89	868818	9 YRS	F	+	-	-	+	-	+	-	+	-	GR.III VUR
90	870651	6 YRS	M	+	+	+	+	-	+	-	+	-	LT PUJ OBSTRUCTION
91	870193	12 YRS	M	+	-	+	+	-	+	-	+	-	LT PUJ CALCULUS
92	868818	12 YRS	F	+	-	-	+	-	+	-	-	+	B/L GR.IV VUR
93	870366	5 YRS	M	+	+	+	-	-	+	-	+	-	LT PUJ OBSTRUCTION
94	869419	2 mnth	F	-	+	+	-	-	+	-	+	-	RT PUJ OBSTRUCTIONS
95	870651	12 YRS	F	-	+	+	+	-	+	-	+	-	B/L CONG.DYSPLASTIC KIDNEY
96	870629	12 YRS	M	+	-	+	+	-	+	-	-	+	RT. KIDNEY DUPLEX SUSTEM VUR
97	870651	11 YRS	F	+	-	+	+	-	+	-	+	-	B/L PUJ OBSTRUCTIONS
98	870689	9 YRS	F	+	-	+	+	-	+	-	+	-	LT PUJ OBSTRUCTION
99	870699	4 YRS	M	+	+	+	+	-	+	-	+	-	RT PUJ OBSTRUCTIONS
100	870813	5 YRS	F	+	+	-	+	-	+	-	+	-	GR. IV VUR LT
101	869052	9 YRS	F	+	-	-	+	-	+	-	+	-	NEUROGENIC BLADDER
102	870511	12 YRS	M	+	-	+	-	-	+	-	+	-	LEFT PUJ OBSTRUCTION
103	870903	8 YRS	F	+	-	+	-	-	+	-	+	-	RT DYSPLASTIC KIDNEY
104	868734	7 YRS	M	+	+	+	+	-	+	-	+	-	B/L HYDROURETERNEPHROSIS / B/L VUR

U-Urinary symptoms, NO U-Non urinary symptoms, NUCL-Nuclear scan, 0-Others, 1UTI-First UTI,R UTI-Recurrent UTI