EVALUATION OF URINARY TRACT INFECTION IN CHILDREN

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Certificate

This is to certify that the dissertation titled **'Urinary Tract Infection In Children'** is a bonafide work of **Dr. V. Muthulingam,** submitted for the qualifying examination in M. Ch paediatric surgery, branch - V, to be held in august 2008 by the Tamilnadu Dr. M. G. R. Medical University.

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Evaluation of Urinary Tract Infection in Children

CONTENTS

INTRODUCTION

Controversy continues to exist regarding when and how a child with urinary tract infection should be evaluated. Urinary tract infections are common at the extremes of age - in children and elderly. Symptoms of urinary tract infections are vague and generalized[1]. Recognition and evaluation of urinary tract infection and genitourinary anomalies associated with the infection and subsequent management prevents long term complications of progressive parenchymal and functional loss.

In infants UTI is the most common cause of parenchymal loss. 5% to 10% of children with UTI have obstructive urinary tract infection and an additional 21% to 57% have vesicoureteric reflux[2]. Children with voiding dysfunction, neurogenic bladder, bowel dysfunction have associated urinary tract infections[3,4]. Hence evaluation of the index infection may be worth evaluating to detect anomalies in the urinary tract and helps in prevention of morbidity of recurrent infections and renal damage.

AIMS OF THE STUDY

1. To detect the abnormalities of the urinary tract associated with urinary tract infection in children.

2. To find out the most common organism associated with urinary tract infection.

3. To find out the most useful drug in treating UTI.

4. To evaluate the yield of the various diagnostic modalities.

MATERIALS AND METHODS

After approval from the Ethical committee and permission from the collaborating departments of this institution, the prospective study on evaluation of urinary tract infection in children was conducted at Coimbatore Medical College Hospital.

Period of study

The period of study was from March 2006 to March 2008. The study was carried out at the Department of Paediatric Surgery in collaboration with Departments of Microbiology and Radiodiagnosis.

Study design

The children who reported at or were referred to our out patient department with symptoms and signs of urinary tract infection were evaluated with urine culture. Children with positive urine culture were included in the study and further evaluated with ultrasonogram (USG) of kidney and bladder.

The urinary tract infection is treated with appropriate antibiotics as dictated by antibiogram. Once the urine culture became negative, these children were subjected to voiding cystourethrogram with antibiotic prophylaxis.

Cystocopy, renal scintigrapy, urodynamic study and other relevant investigations were performed based on the individual merits of the condition.

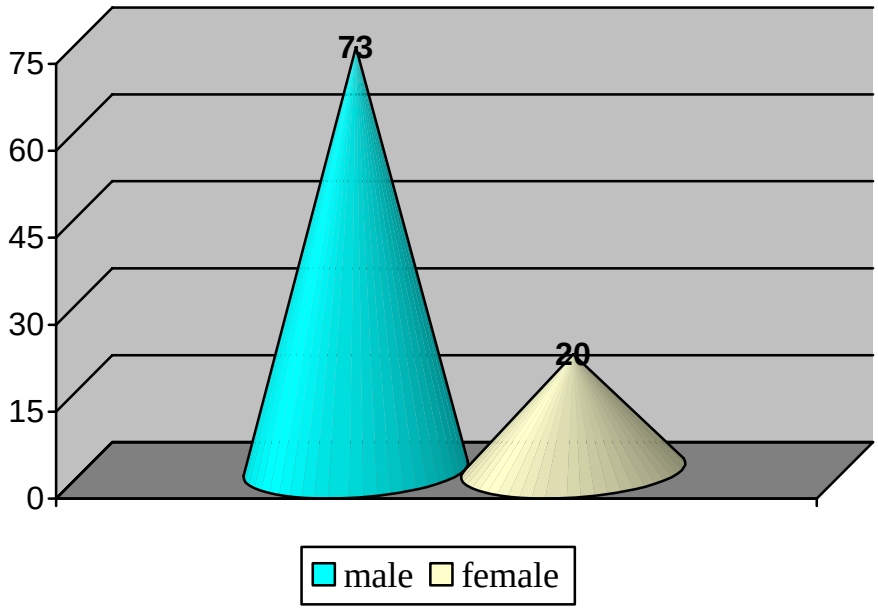
The results were compiled and analysed.

RESULTS

During the study period ninety three children with documented urinary tract infection were prospectively evaluated. The data collected for analysis and the results are as follows.

There were seventy three males and twenty female children. The male female ratio is 3.4: 1

Sex distribution



Male children -73

Female children -20

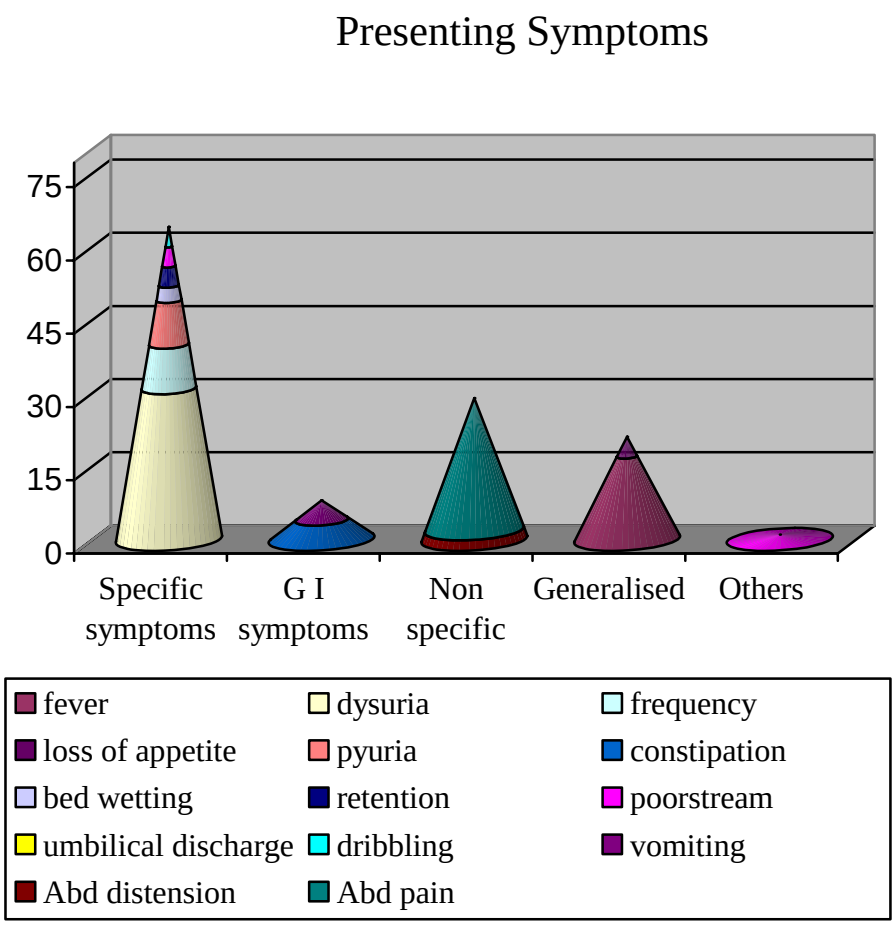
Age distribution

The age distribution of the children was between 15 days to 12 years. There were seven children in the age group of 0 -1 year, forty one children in the age group of 1 -5 years, forty five children in the age group of > 5 years.

Age group	No. of children
0 - 1 yr	7
1 – 5 yrs	41
> 5 yrs	45

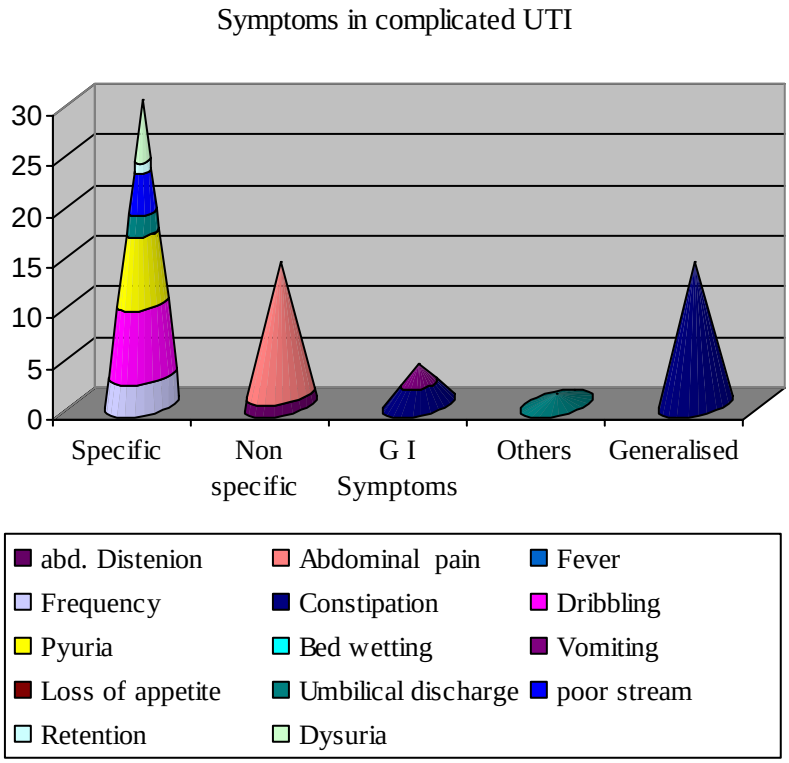
Presenting symptoms

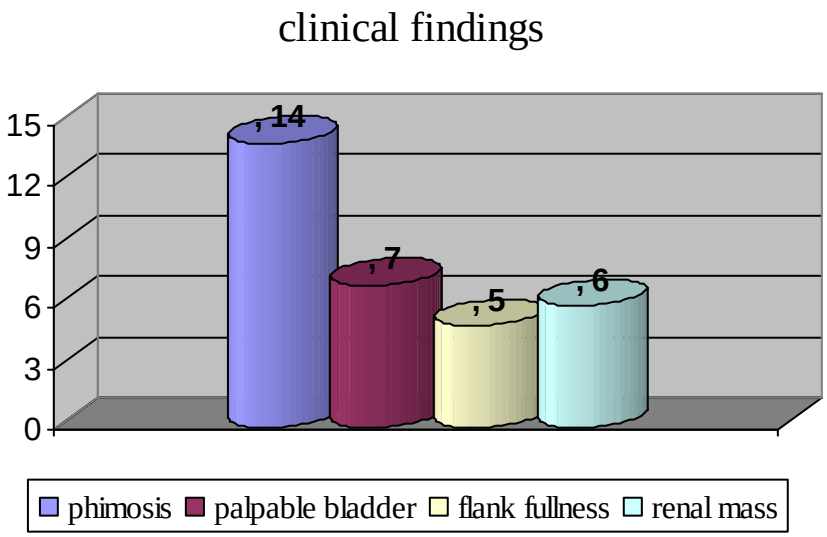
Our children presented with combinations of symptoms. The symptoms specific to urinary tract include dysuria, increased frequency, dribbling, pyuria, bed wetting, retention and poor stream. The nonspecific symptoms were abdominal pain, fever, vomiting, loss of appetite, constipation, umbilical discharge, abdominal distension etc.



Among the complicated urinary tract infection fever was the most frequent symptom followed by abdominal pain.

The clinical findings in our children were phimosis in fourteen, palpable bladder in seven, flank fullness in five, palpable kidney in six. In the complicated UTI group four children had phimosis – two children with voiding dysfunction, one child with PUV, one child with VUR.



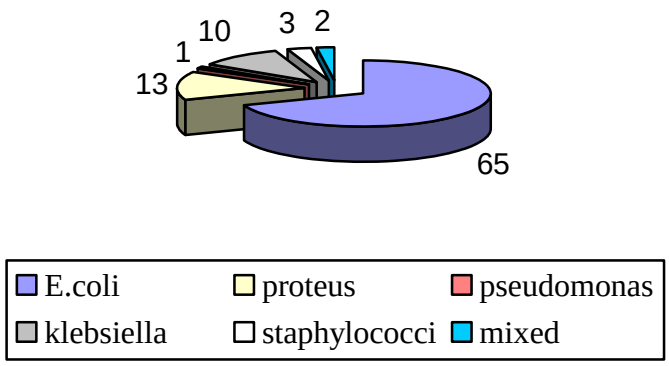


Culture characteristics

The causative organisms in our children include E.coli, Proteus, Klebsiella, Pseudomonas and Staphylococci. E. coli grew in 65, Proteus in

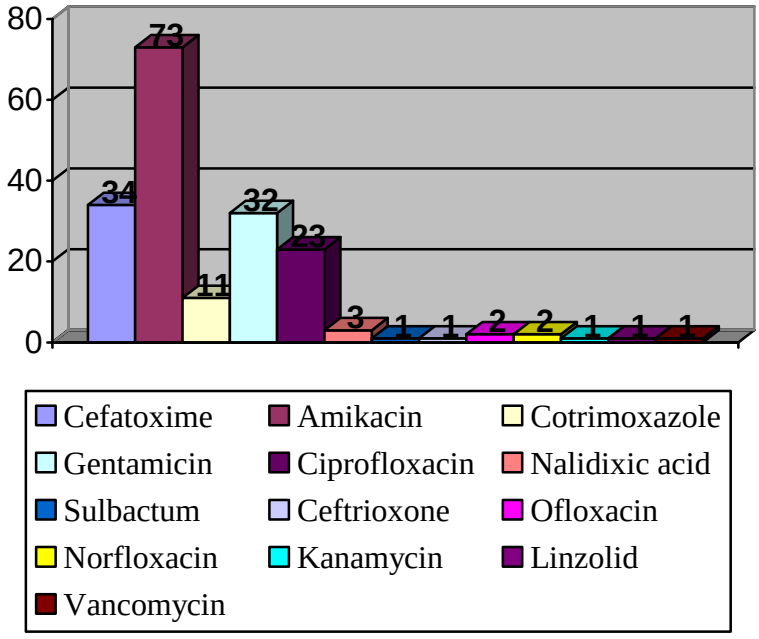
13, Klebsiella in 10, Staphylococci in 3, Pseudomonas in 1 and mixed growth in 2 culture. E.coli was the commonest pathogen and accounted for 69.8% of the infections.

Organisms



In the antibiotic sensitivity pattern observed in our study, most

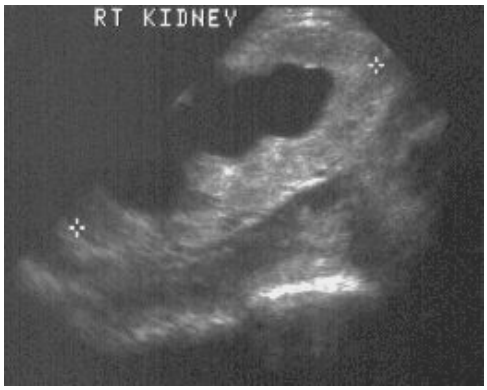
sensitivity pattern



organisms were sensitive to amikacin followed by cefatoxime and gentamicin

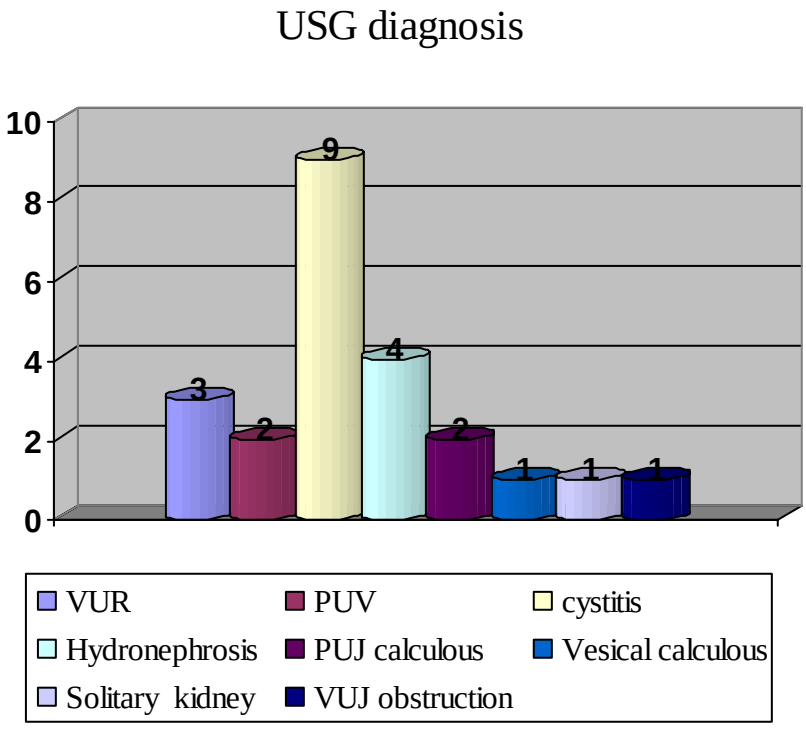
Ultrasonogram

The ultrasonogram of the kidney and bladder detected abnormalities in twenty four children in the evaluated population of ninety three children.



USG Hydronephrosis

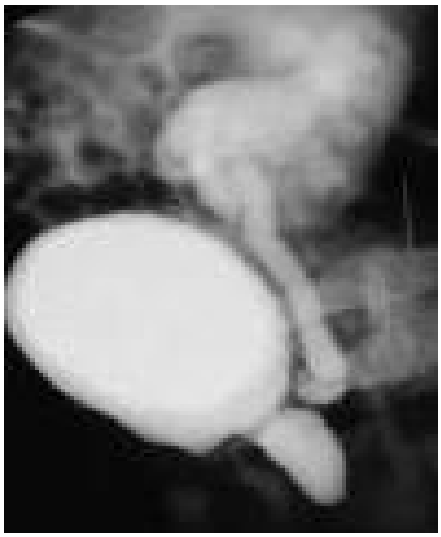
The diagnostic yield of ultrasonogram in our children were cystitis in nine children, vesicoureteric reflux in three children, posterior urethral valve with hydronephrosis in two children, hydronephrosis due to pelviureteric junction obstruction in four children, obstructive megaureter with hydronephrosis in one child, PUJ calculous with pyonephrosis in two



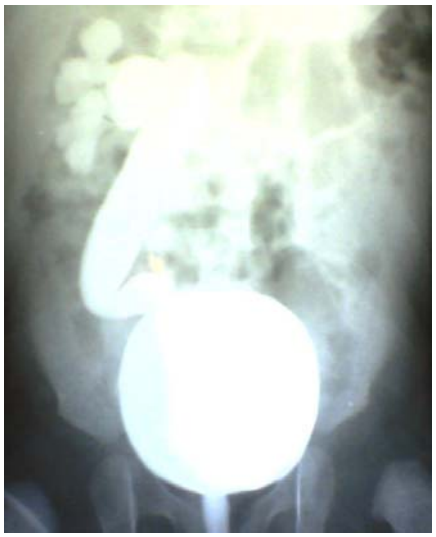
children, vesical calculus in one child, contracted kidney due to chronic pyelonephritis in one and unilateral renal agenesis in one.

Voiding cystourethrogram

In our study ninety one children underwent voiding cystourethrogram and diagnosis was arrived at in seventeen children. VCUG was done by single shot method after filling the bladder to its capacity. Two exposures were taken, anteroposterior and oblique views.



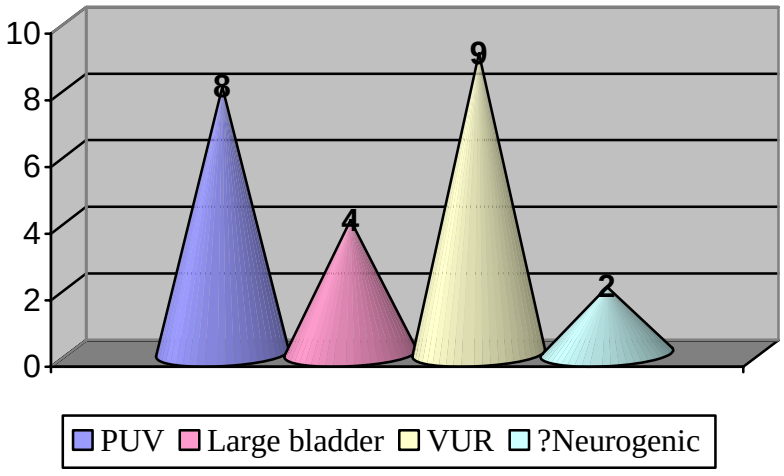
Posterior urethral valve



Vesicoureteric reflux

The results of VCUG were posterior urethral valve with reflux in

VCUG



eight children, vesicoureteric reflux in nine children, large capacity smooth contoured bladder in four and irregular asymmetrical bladder in two children.

Intravenous pyelography

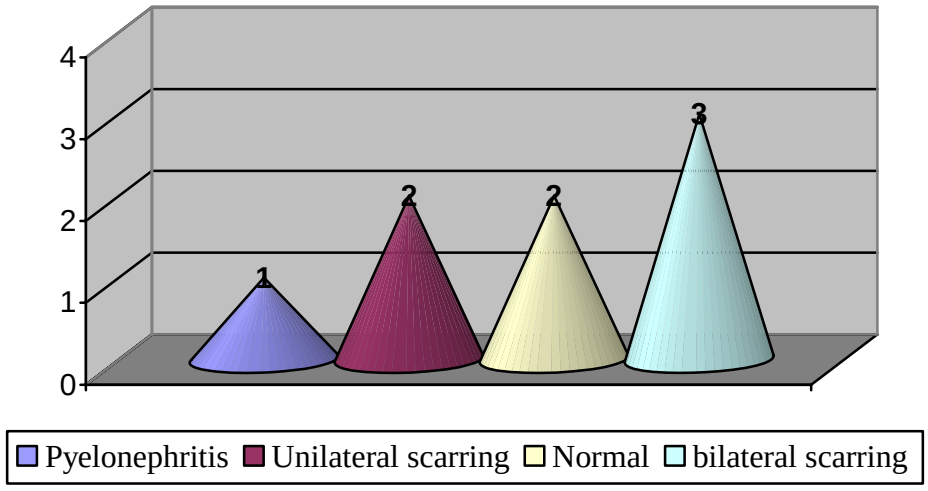
Intravenous pyelography was done in two occasions. Once to evaluate a solitary kidney and another for assessing a case of moderate hydronephrosis due to pelviureteric junction obstruction. In both cases it confirmed the ultrasonogarm findings.

DMSA scan

Those children with documented vesicoureteric reflux on VCUG ,we suggest DMSA to assess the parenchymal damage. Among them eight children underwent DMSA study, four children with PUV with VUR and four children with primary VUR. Among the four PUV children acute pyelonephritis was diagnosed in one, bilateral scarring in one, unilateral scarring in one and in one child the kidneys were normal.

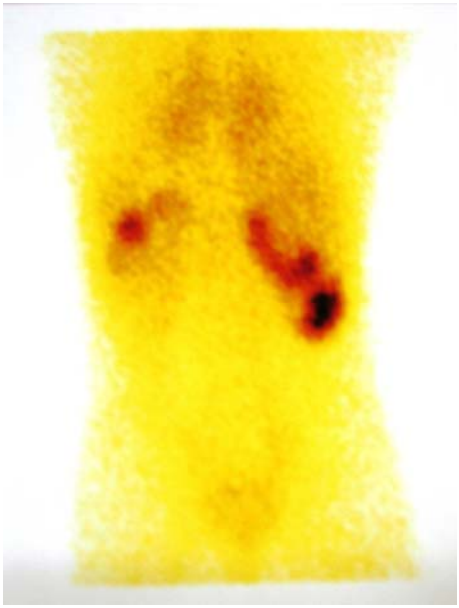
In VUR group bilateral scarring was detected in two children, unilateral scarred contracted kidney with 3% function in one child who ultimately underwent nephrectomy and normal kidneys in one child.

DMSA RESULTS



DTPA scan

Those children with sonographic evidence of PUJ obstruction, we suggest DTPA scan to assess the function of the kidneys. DTPA scan was done in

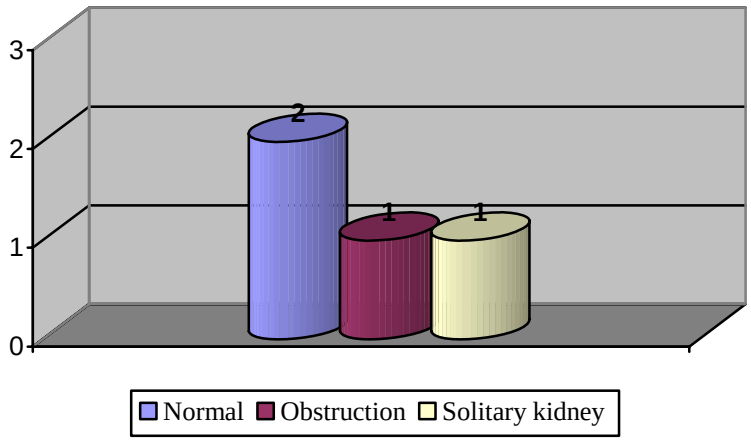


Scars on DMSA

Hydronephrosis on DTPA

four children. One child with obstructive megaureter with hydroureteronephrosis had normally functioning kidneys. One child with recurrent PUJ calculous with pyonephrosis found to have adequately functioning kidneys. One child with pelviureteric junction obstruction with hydronephrosis was found to have adequate function with features of obstruction and one child found to have solitary kidney on DTPA.

DTPA RESULTS



Due to various factors we could not evaluate all the indicated children with nuclear renogram. Among the evaluated children majority of them (75%) had abnormalities and helped to manage the children appropriately.

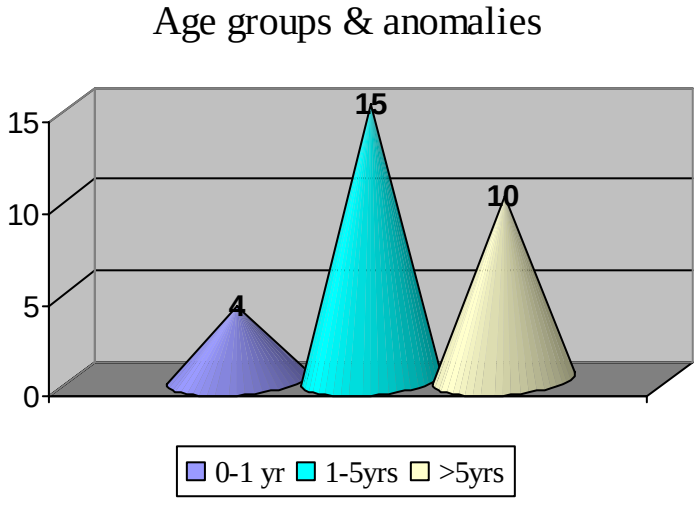
Cystoscopy

Cystoscopy was done for diagnostic and therapeutic purposes. The diagnostic cystoscopy was done in four children. They include two cases of

suspected neurogenic bladders one case of suspected bladder diverticulum and one case of ectopic ureter. In one suspected neurogenic bladder there were trabeculations, there was ectopic ureterocele in one child and two studies were normal. Diagnostic and therapeutic cystoscopy was done in eight cases of posterior urethral valve and primary fulguration was done.

Genitourinary abnormalities

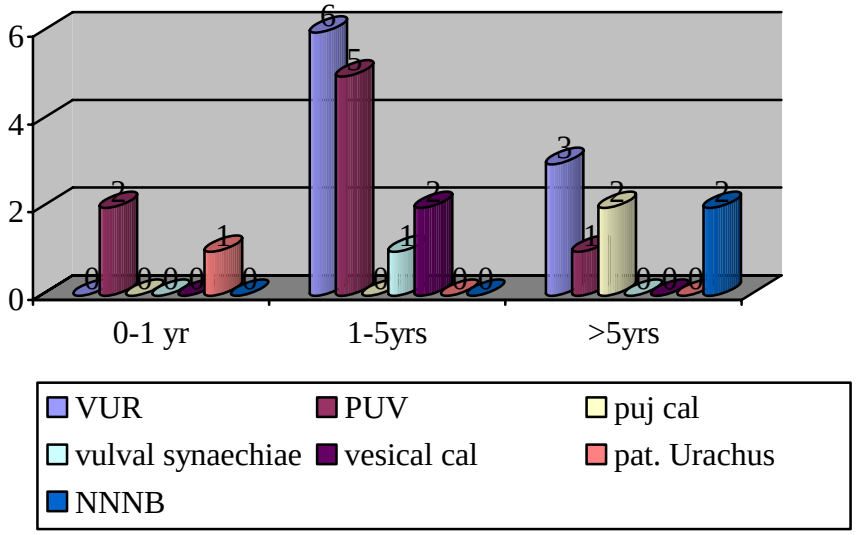
The genitourinary abnormalities associated with urinary tract infection in the study include vesicoureteric reflux, posterior urethral valve, hydronephrosis due to pelviureteric junction obstruction, pyonephrosis due to pelviureteric junction calculous, vesical calculous, vulval synaechiae and patent urachus.



There were 4 anomalies in 0-1 age group, 15 in 1-5yrs age group and 11 in the age group of >5 years.

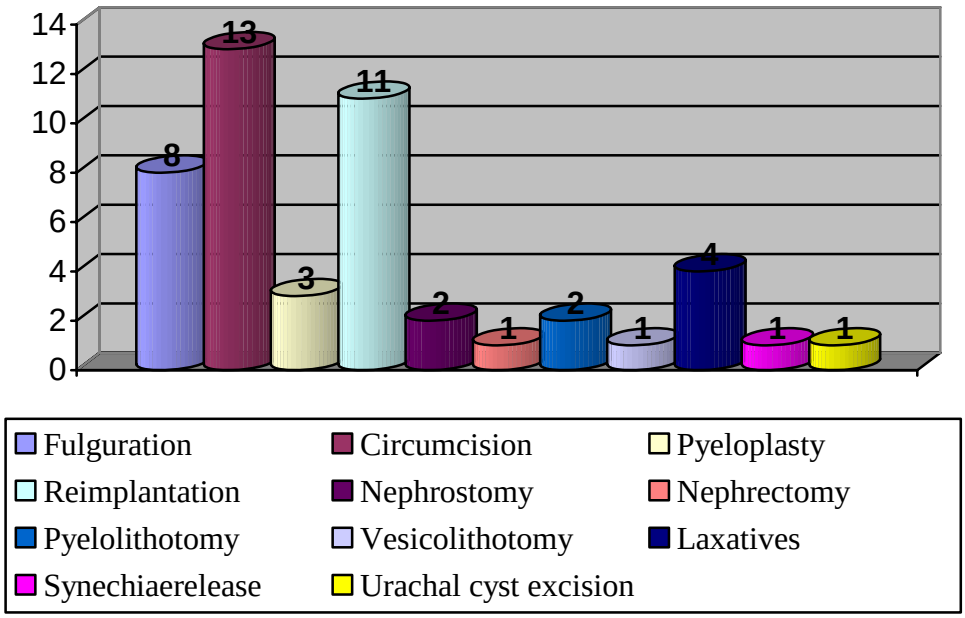
Diagnosis	0 – 1 yr	1 – 5 yrs	>5yrs	Total
VUR	--	6	3	9
PUV	2	5	1	8
Hydronephrosis	1	1	3	5
PUJ calculus	--	--	2	2
Vulval synechiae	--	1	--	1
Vesical calculous	--	2	--	2
Patent urachus	1	--	--	1
NNN bladder	--	--	2	2

Age groups & anomalies



TREATMENT

All the patients were treated with appropriate antibiotics and rest of the treatment plan was tailored according to the individual problem. So the treatment include observation with antibiotic prophyalaxis in two children, circumcision in thirteen children, cystoscopic fulguration in eight children, pyeloplasty in three children, ureteric reimplantation in eleven units,



nephrostomy in two children, lap nephrectomy in one child, pyelolithotomy in two, vesicolithotomy in one, laxatives in four children, vulval synechiae release in one child and urachal cyst excision in one child

REVIEW OF LITERATURE

Over the past few years, there have been advances in the understanding of the pathogenesis of urinary tract infection and identification of risk factors that predispose children to renal damage.

UTI often serves as a marker for anatomical abnormality of the genitourinary tract. It is important to identify these abnormalities early because if untreated, they may lead to recurrent infections and possible loss of renal parenchyma.

Obstructive malformations such as ureteropelvic junction obstruction, posterior urethral valve, ureterocele, ectopic ureter, urethral diverticulum can increase the risk of UTI. Renal abnormalities such as papillary necrosis, nonfunctioning kidney, unilateral medullary sponge kidney, double renal moiety also predispose to urinary tract infection.

Children with vesicoureteric reflux may have significant post void residual urine which predisposes to urinary tract infection and subsequent scarring of the renal parenchyma. Functional abnormalities such as voiding

dysfunction, bladder instability, infrequent voiding, Hinmann syndrome, neuropathic bladder are associated with increased incidence of urinary tract infection.

EPIDEMIOLOGY

The urinary tract is the second commonest site of infection in children. UTI may be symptomatic or asymptomatic and the true incidence is difficult to determine. Age, gender, race, circumcision status, method of detection and presentation influence the prevalence of UTI. The overall incidence of neonatal bacteriuria is about 1 – 1.4%[6,7,8].

More boys than girls get UTI during the first year of life[1,2] . Uncircumcised boys have as high as 10 times the risk of UTI[3] than circumcised boys. By 1 year of age 2.7% of boys and 0.7% of girls have had bacteriuria[4]. The incidence falls below 1% in school age boys and in girls it raises to 1 – 3%[5].

The risk of bacteriuria in school children is reported to be 0.7 – 1.95% of girls and 0.04 – 0.2% in boys[9].

Prevalence of Urinary Tract Infections by age and gender		
Age (Yr)	Girls (%)	Boys (%)
<1	6.5	3.3
1 - 2	8.1	1.9

American academy of paediatrics, committee on quality improvement, subcommittee on urinary tract infection:practice

The incidence of UTI in infants is about 26% in the first 3 months of follow up of bacteriuria. In the older girls it is as high as 40 – 60% within 18 months[10]. Febrile UTIs were more prevalent than nonfebrile UTIs during first 10 months of life[11].

BACTERIOLOGY

The organisms that colonize the urinary tract are specifically adapted towards this purpose. Specific virulence factors that determine an organism's pathogenic potential are the presence of surface molecules important for adhesion and toxins that assist invasion.

Virulence factors

The virulence factors include

1. Adherence to uroepithelial cells

2. High quantity K antigen in the capsule of the bacteria

3. Haemolysin production

4. Colcicin production

5. Ability of bacteria to acquire iron and

6. Resistance to serum bacterial activity.

1. Adherence to uroepithelial cells

Bacterial adherence is an essential initial step in all infections utilizing special structures called adhesins. By virtue of attachment, the bacteria ascends into upper tract even in the absence of VUR .

Fimbriae are a form of adhesin which attaches to a receptor in the uroepithelial cells. They may be mannose resistant or sensitive. Uropathogenic bacteria rely on both. Fimbriae protect the bacteria from antibiotics[12]. Fimbriae increases the ability to persist in the urinary tract and stimulate inflammation[13]. P fimbria in E.coli causes upper urinary tract infection.

2. K - antigen

K - antigen shields bacteria from complement lysis and phagocytosis and enhances the persistence of bacteria in the kidneys[14].

3. Haemolysins & Endotoxin

Haemolysins are cytotoxic proteins capable of damaging renal tubular cells. Haemloytic strains of E.coli produce more severe experimental pyelonephritis in mice[15]**.** Endotoxin is a lipopolysaccharide that initiates acute inflammatory response common to all gram negative infection .

4. Colcicin

Colcicin, a protein that promotes the survivial and pathogenicity of colcicin producing organisms[16]

5. Iron binding capacity

Iron binding capacity of the bacteria is associated with increased virulence[17].

6. Serum resistance

Serum resistance implies resistance to complement mediated killing and this property is related to the virulence of gram negative bacteria in UTI and bacteremia[18].

Host factors

The host factors include

1. Perineal colonization
2. Prepuce
3. Urethral length
4. Dysfunctional elimination & Neurogenic bladder
5. Vesicoureteric reflux
6. Urinary tract obstruction and
7. Abnormalities of urinary tract.

1. Perineal factors

Haematogenous infection is uncommon in children. Ascending or retrograde entry of bacteria is the source of UTI[20,21]. The usual organisms are from faecal flora that colonise perineum[22]. Since the infants are exposed to uropathogenic bacteria at birth, infants of bacilluric mothers have 4 fold greater risk of UTI.

2. Prepuce

Prepuce acts as a reservoir of uropathogenic bacteria[23]. Uncircumcised boys have increased risk for UTI than circumcised boys and girls. Over 90%

boys with febrile UTI during first year of life are uncircumcised[24] . Before circumcision 52% of boys are colonized by potential uropathogenic bacteria as opposed none after circumcision[25].

3. Urethra

Girls have short urethra and it appears to be the most obvious explanation for the relatively increased incidence of urinary tract infection in girls. The larger urethral diameter favours increased risk for UTI in girls[26].

4. Dysfunctional elimination

Dysfunctional elimination is one of the most important risk factor for urinary tract infections. Dysfunctional elimination syndromes are a group of functional disorders that cause urinary obstruction and produce significant uropathology in the absence of anatomic urinary defects or neurological abnormality in otherwise normal children. Nocturnal enuresis and diurnal incontinence are common in children with recurrent UTI. Urodynamic study in neurologically normal children with recurrent urinary tract infection shows abnormal cystometry and voiding patterns[33].

Disturbed voiding dynamics predisposes to recurrent urinary tract infection and an acquired VUR. The predisposition to recurrent UTI and VUR in children with dysfunctional elimination is related to the

Dysfunctional elimination syndromes
Non Neurogenic Neurogenic Bladder
Unstable baladder
Urgency incontinence syndrome
Small capacity hypertonic bladder
Continent bladder instability
Infrequent voiding syndromes
Functional bowel disturbances
Constipation or faecal retention
Giggle incontinence
Post void dribbling
Daytime urinary frequency syndrome
Nocturnal enuresis

presence of residual urine resulting in inadequate emptying and increased intravesical pressure created by uninhibited bladder contractions and bladder distension from infrequent voiding[26].

Recurrent bacteriuria is associated with increased residual volume[27]. There is a definite correlation between constipation and urinary incontinence, VUR and recurrent UTIs in children[28,29]. This may be the result of mechanical factors related to the compression of bladder and bladder neck by hard faecal mass. Constipation may provoke an abnormal detrusor sphincter activity. Treatment of constipation and voiding abnormalities reduces the frequency of UTI [34].

Children with neurogenic bladder with abnormally elevated bladder pressures are at increased risk of renal damage from UTIs because of their lack of ability to spontaneously clear the bacterial load. Since these children need frequent instrumentation and catheterisation, it further increases the risk for urinary tract infection. A neurogenic bladder with chronically or intermittently elevated bladder pressures may cause secondary VUR from decompensation of vesicoureteric junction[33] and may also cause obstruction at VUJ. The back pressure and obstruction leads on to renal damage.

5. Vesicoureteric reflux

VUR occurs in approximately 1% of the general population and is

estimated to occur in 25% - 50% of children with culture documented UTI[30]. VUR continues to be the most significant risk factor in the etiology of pyelonephritis. The pyelonephritis and subsequent scarring is directly related to the severity of VUR. Kidneys associated with moderate or severe reflux are likely to have 80 – 90% abnormal studies in DMSA scans[31].

6. Urinary tract obstruction

Urinary obstruction may occur at ureteropelvic junction, vesicoureteric junction or at the urethra. Patients with obstruction may present with severe infection. 1% of children presenting with febrile UTI have significant urinary tract obstruction[32]. This is partly due to early USG detection prior to the clinical infection to set in. The predisposition to infection presumably results from impairment of urinary flow with resultant stasis that compromises bladder and renal defense mechanism.

Obstruction inhibits mechanical flushing out effect associated with ureteral peristalsis. All these factors result in increased susceptibility of parenchyma to infection and damage.

7. Genitourinary abnormalities

Historically urinary tract infections have been a marker for genitourinary tract anatomical abnormalities in children. Specific

Surgically correctable causes of bacterial persistence
Calculus
Nonfunctioning renal segments
Retained ureteral stumps after nephrectomy
Vesicointestinal fistula
Vesicovaginal fistula
Papillary necrosis
Infected urachal cyst
Urethral diverticulum

abnormalities especially nonfunctioning segments may serve as a nidus of bacterial infection and causes bacterial permanence because of the difficulty in achieving urinary antimicrobial concentrations adequate to treat UTI in a poorly concentrating renal segment. Similarly partial urinary obstruction or reduced renal function may create an increased risk of renal damage because of poor or inadequate drainage.

ORGANISMS

Many organisms invade the urinary tract – gram negative, gram positive, aerobic and anaerobic bacteriae. A large family of gram negative, aerobic bacteria known as enterobacteriaciae causes majority of urinary tract infections.

Pathogens associated with urinary tract infections	
Organisms	Comment
Escherichia coli	Accounts for 70% - 90% of infections
Pseudomonas	Most common nonenteric gram -ve organism seen in immunocompromised
Enterococcus	Most common gram +ve pathogen
Group B Streptococci	Occasionally seen in neonates
Staph.aureus	Suggests additional foci of infection
Proteus mirabilis	Boys >1yr old
Candida & coagulase negative staphylococci	Seen after instrumentation
Klebsiella	Occasionally seen in immunocompromised

Handel LN ,CaldamoneAA;urinary tract infection in paediatric population .LebaneseMed J 2000;52:194

The organisms included in the family are Escherichia, Klebsiella, Enterobacter, Citrobacter, Proteus, Providentia, Morgenella, Serratia and Solmenella The bacteriological trend in UTI varies according to the environmental conditions prevailing in the host which vary with the age and

sex[20]. Proteus infection is common in older boys. Staphyloccal infection is more likely in adolescent girls. E.coli infection is common in neonatal boys than in girls.

Majority of uncomplicated infections are caused by a single organism. Patients on long term catheterization and complicated UTI are likely to have multiple organisms. Sometimes the organism suggests the pathology such as proteus is associated with struvite stones.

PATHOGENESIS

The urinary tract infection is the result of complex interaction between the bacterial virulence and complex mechanical, hydrodynamic, antiadherent, receptor dependent immunological competence of the host. A complicated urinary tract infection is defined as urinary infection occurring in the setting of underlying anatomical, functional abnormalities of the urinary tract.

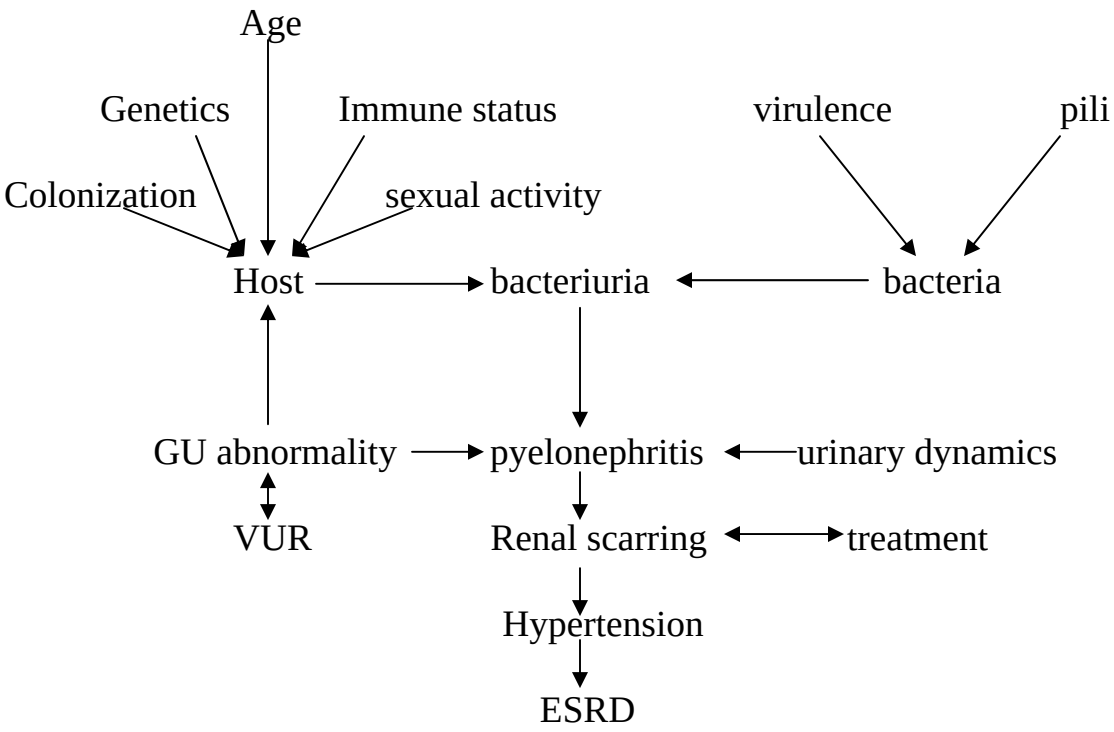
The natural history of the paediatric urinary tract infection is unpredictable and incompletely understood. Bacterial studies have shown that common entry of organisms is through the faecal perineal urethral route

with retrograde ascent of periurethral organisms[41,42]. Once the bacteria reached the bladder, the ascent to the kidney is affected by factors such as impaired ureteral peristalsis,VUR and the virulence of the bacteria. Haematogenous infection may occur in children with immunodeficiency.

Risk factors for UTI
Anatomical abnormalities
VUR
Obstruction
Other: diverticulum ,labial adhesion
Female gender
Uncircumcised male
Voiding dysfunction
Constipation
Instrumentation
P fimbriated bacteria
Toilet training
Sexual activity

The infection in collecting system causes ureteral and bladder inflammation that alters the dynamics of the entire urinary tract[42,43]. The ureteral dilatation observed during acute inflammation is partly related to

effect of bacterial toxins and reduced smooth muscle compliance and partly due to elevated renal pelvic pressure associated with infection[44].



Pathogenesis of urinary tract infection

The clinical course of the pyelonephritis depends on the severity of the disease and rapidity of the treatment. In the natural course of the uncomplicated UTI, the chidren may become afebrile with antimicrobials or at times it may further detoriate into pyonephrosis and it is often associated with obstruction of the system. The infection may persist as chronic pyelonephritis with resultant pyelonephritic scarring.

Renal scarring in children

The renal scarring appears to be influenced by multiple factors. They include

1. Intra Renal Reflux
2. Urinary Tract Pressure
3. Host Immunity
4. Age
5. Treatment
6. Reccurrent Infections.

Renal infection stimulates both humoral and cellular immune responses leads on to renal suppuration and exudation with inflammatory infiltration, collagen deposition and scarring[45,46] resulting in the impaired renal growth.

Children with gross pyelonephritogenic scarring have atleast a 10% - 20%risk of future hypertension[47] with risks of later progressive detoriation in renal function and other complications of hypertension and end stage renal failure [48].

The young children are greatest risk of developing renal scarring from bacterial pyelonephritis and the likelihood of scarring correlates with the number of UTIs[49]. The neonate responds to water hammer effect of back pressure with intrarenal reflux into renal papillae at as low as pressures of 2 mm of Hg. Intrarenal reflux occurs in all papillae at 50 mm of Hg in children younger than 12yrs of age[50]. Scarring occurs in when infected urine refluxes into the pappilla[54]. In children with high voiding pressures such as in partial urethral obstruction renal scarring occurs in the absence of infection[55]. Renal scarring is a risk factor for complications such as hypertension, renal insufficiency, progressive renal scarring and renal functional detoriation[53].

The very young children have an incompletely developed immune and neurological system. This allows easier colonization of the bladder and kidney by bacteria because of decreased local and systemic defenses. Neurological immaturity of the bladder allows uninhibited bladder contractions and transmits this high pressure to upper tracts even in the apparently normal child[51]. Bacteria combined with reflux in such a child may result in greater susceptibility to renal scarring.

Neonatal symptoms of UTI and pyelonephritis are often vague and nonspecific resulting in delayed or inadequate treatment. This results in bacterial invasion with inflammatory response with subsequent scarring and loss of renal parenchyma[52].

CLINICAL PRESENTATION

Urinary tract infection in infants may be vague and without localization. Young children may show only signs of generalized illness such as fever, irritability, poor feeding, vomiting, and diarrhea. In severely

Symptoms	Prevalence(%)
Fever	67
>38*c	100
>39*c	57
Irritablity	55
Poor feeding	38
Vomiting	36
Diarrohea	36
Abdominal distension	8
Jaundice	7

ill infants and young children one may suspect UTI[1]. Older children may describe symptoms such as dysuria, suprapubic pain, intermittent voiding dysfunction and incontinence. Children with pyelonephritis may have fever, flank pain, abdominal pain.

Physical examination may reveal a distended bladder, renal mass, phimosis, vulval synechiae, ectopic ureteric orifice, a prolapsed ureterocele, loaded rectum and signs of spinal dysraphism such as naevi, tuft of hair etc.

DIAGNOSIS OF UTI

Rapid and early diagnosis of UTI is essential to initiate prompt antimicrobial therapy and prevent renal damage. UTI in infants may be vague and without localization. Among infants and young children who have no source for their fever from history and physical examination, more than 5% have UTI[36].

On physical examination there are no signs specific for UTI in infants. If there is gross anatomical abnormality a renal mass, distended bladder may be palpable. Suprapubic and flank tenderness may be positive. Perineal

examination may show an ectopic ureteral opening, ureterocele, or discharge per urethra. Scars, sacral fat pads, sacral dimples or pits may suggest a neurogenic bladder and warrants evaluation. Epididymoorchitis, epididymitis in boys and labial adhesions and vaginal abnormalities may give a clue.

Urine analysis

Analysis of a properly collected urine sample is the corner stone of diagnosis of UTI. Urine culture is the only method to accurately diagnose UTI.

Although culture is most accurate, it may take 24 hrs or longer before bacterial colony forming units (CFU) and the culture is complete. So indirect urinary tests may be performed with routine urinanalysis to detect the presence of bacteria or by products for rapid diagnosis. There are 4 determinants from the urine analysis have been advocated to support the diagnosis. They include

Microscopic identification of bacteria &WBC

Microscopic identification of bacteria & WBC in the urine is more sensitive and specific than pyuria[37] especially in uncentrifuged gram stained

urine. Catheter collected specimen has a positive predictive value of 84.6. In catheterized specimens any number of bacteria and at least 10 WBC/cmm[36] is diagnostic of urinary tract infection. UTI in children is best defined by an urinary leukocyte count of at least 10wbc/cmm and at least 50,000cfu/cc bacteria in culture[38].

Urinary leukocyte esterase

Urinary leukocyte esterase is a by product of WBC breakdown in the urine. It is dependent on the presence of WBCs which may or may not present with infection. The test is less reliable.

Urinary nitrite test

Dietary nitrates are reduced to nitrites by many gram –ve bacteria and are measured by urinary nitrite test. The reduction process takes many hours hence first morning specimen should be used. This test is not useful in gram +ve infections.

Urinary catalase test

Catalase is produced by the bacteria infecting the urinary tract. This test is sensitive but it is having too high false positive rate.

In general the combination of urinary nitrite, leukocyte esterase, presence of bacteria and WBC on microscopy yields a sensitivity of 99.8% and specificity of 70%[36,37].

Urine culture

Quantitative urinary culture is the gold standard for the diagnosis of urinary tract infection. This requires a known quantity of urine to be plated and the number of bacterial colony forming units that grow is counted and determined as number of units per ml. The technique by which the urine collected determines its reliability.

1,00,000 cfu/ml of voided urine is the traditional definition for a clinically significantly UTI[38]. In febrile children younger than 2yrs of age 50,000cfu/ml or more in catheterized specimen constitute a significant UTI[4]. Any number of bacteria on suprapubic aspiration is significant. The number of colony forming units may be affected by hydration, voiding frequency and bacterial growth characters.

Specimens

The reliability of the diagnosis is related to the quality of specimen and it is hard to obtain good specimen in children. The techniques of specimen collection include

Bagged specimens

Bagged specimens are obtained by attaching plastic bag to the perineum. It reflects the perineal and rectal flora even after extreme cleaning and often it yields intermediate results.

Midstream voided specimen

Midstream voided specimen reflects reliable bacteruria in circumcised boys, older girls or older circumcised boy who can retract his foreskin. It usually reflects periurethral and prepucial organisms.

Catheterized specimen

Catheterized specimen is reliable if the first portion of the urine that may contain urethral organisms is discarded and the specimen is taken from the later flow through the catheter. The disadvantages are it is traumatic and potentially introducing urethral organisms into the bladder[39].

Criteria for diagnosis		
Method	Colony count	Probability(%)
Suprapubic aspiration	Gram –ve bacilli any no.	>99
	Gram +ve cocci > few thousand	
Catheterized	>1,00,000	95
	10,000 – 1,00,000	infection likely
	1000 – 10,000	suspicious,repeat
	<1000	less likely
Clean voided(boy)	>10,000	infection likely
Clean voided(girl)	3 samples >1,00,000	95
	2 samples >1,00,000	90
	1 sample >1,00,000	80
	50,000-1,00,000	suspicious,repeat
	10,000- 50,000	if symptomatic
		suspicious,repeat
		if asymptomatic
		infection unlikely
	<10,000	infection unlikely

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Suprapubic aspiration

The most reliable specimen is obtained by suprapubic bladder aspiration. It can be performed safely in children and in infants. Since the urine does not cross the urethra, urethral and periurethral organisms are

absent. Organisms that are present in the suprapubic aspirate are pathognomonic of bacteriuria. The main drawback is the discomfort.

In a child who is not toilet trained, catheterized or needle aspirated specimen is acceptable for the diagnosis, because bagged specimens have an unacceptably high false positive rate. A bagged or diaper specimen showing no growth may be useful in eliminating bacteriuria[39].

Imaging

The culture documented UTI is evaluated with imaging modalities to 1.Localise the acute infection 2. Detect the renal damage 3. Identify the genitourinary anomaly that increases the risk of future renal damage. 4. Evaluate the changes in the urinary tract over the time. All children requiring hospitalization should be screened with sonogram before discharge. The imaging modalities of the urinary tract include

Ultrasonogram of kidney and bladder

Voiding cystourethrogram

Nuclear renography

Intravenous pyelogram and

Urodynamic study

Renal and bladder ultrasonography

Renal and bladder ultrasonography is used to assess the presence of congenital structural abnormalities. The current guidelines for renal and bladder USG[56] are all boys with their first UTI, girls younger than 5 yrs with their first UTI and older girls with pyelonephritis or recurrent UTIs. It detects the presence of hydonephrosis, renal parenchymal thickness, perinephric collection, ureteral dilatation, duplication, polyps, calculi, bladder wall thickness,cystitis, diverticulum, ureterocele etc.

USG identifies surgically correctable causes of UTI. High resolution USG is as sensitive as DMSA in detecting pyelonephritic scarring[57]. USG may show enlarged swollen kidneys or with focal enlargement, oedema and ureteral dilatation. In PUJ obstruction it may reveal fluid, debris levels, air in the collecting system and perinephric collection.

Voiding cystourethrogram

Studies on voiding cystourethrogram demonstrated 5-10% of patients have obstructive lesions and 20 – 50% has VUR associated with UTI[58]. VCUG delineates bladder and urethral abnormalities and VUR. It can be performed as soon as the urine is sterile and the compliance is greater when

it is performed within 1 week after diagnosis[59]. VCUG is recommended in all boys with first UTI and girls younger than 5 yrs with first UTI and girls above 5yrs with recurrent UTI. American association of paediatrics recommends VCUG as the initial study of choice in VUR and in males to rule out PUV.

Intravenous urogram

Intravenous urogram is the traditional means of evaluating the upper tract. It defines renal morphology and collecting system abnormalities. Since the advent of high resolution ultrasonography and scintigraphy it is rarely used nowadays.

Nuclear renography

Nuclear renography accurately detects areas of acute renal inflammation and chronic scarring. DMSA is the common agent when cortical definition is needed[60]. SPECT provides greater anatomical detail, resolution and scar detection[61]. When cortical definition with function and drainage is needed MAG3 is used and it is as effective as DMSA in detecting changes of acute pyelonephritis[62]. In acute pyelonephritis, scintigraphy usually shows either uptake defect or renal swelling[63].The

uptake defects appear as wedge shaped polar or lateral renal defects or scattered uptake defects within the kidney. To differentiate between old and new scars serial studies have to be performed[64.]

Urodynamic study

Many children with voiding dysfunction require urodynamic study to determine whether their urinary problems are neurologic or functional in origin. Majority of the urodynamics involve the assessment of the lower tract function and there are select patients who need upper tract urodynamic study. In addition urodynamics are performed when other diagnostic studies such as USG, VCUG are abnormal. As urodynamic study needs cooperative child it is very difficult in very young and uncooperative children.

The urodynamic study evaluates voiding sensation, storage, emptying of the bladder, coordination and function of the outlet, storage pressure and competence of bladder neck or proximal urethra. Urodynamic study is less reliable in the presence of reflux.

DISCUSSION

Urinary tract infections have been considered an important risk factor for the development of renal insufficiency and end stage renal disease. The risk of developing renal insufficiency is directly proportional to the number of episodes of UTIs and associated anatomical and functional abnormalities of the system.

Early evaluation and management minimizes the renal damage, reduces the risk of damage from subsequent infections and helps in improvement or revival of renal function.

Though studies[4] reveal that the prevalence of urinary tract infection is more in girls compared to boys after the neonatal period, our study is not in line with the findings of others and there is reversal of the ratio with male dominating the female with 3.4 : 1. Our study is conducted on symptomatic children and moreover being a referral centre, most of the uncomplicated urinary tract infections might have been treated at peripheral centres. These may be the possible reasons for the reversal of the ratio.

In our study urinary tract infection is more prevalent in those children of more than 5 yrs and this account for about 47%. The 1-5 yrs age group accounts for 44.6% and it is 7.4% in 0-1 yr age group. Winberg et al in 1974[2] study states that urinary tract infection is more prevalent in the 0-1yr age group and followed by 2-4 yrs of age. Another study in Saudi Arabia[65] also differs in our findings that UTI is 71% more common in 0-1yr followed by 18% in 1-5 yrs and 11% in >5yrs. The difference may be due to smaller study population and partially due to reduced attention of nonspecific symptoms & signs of these noncommunicable children by the caregiver and poor reporting of our low economic group who constitutes major population of this study.

Dysuria is the most common presenting symptom in our study. In those with less than 5 yrs of age and in children with complicated urinary tract infection fever is the most common symptom followed by abdominal pain. Ginsberg CM et al[24] study fever is the most common symptom in acute urinary tract infections. In toilet trained verbalizing children dysuria is the commonest presenting symptom[66]. Our study also confirms it.

Palpable bladder and renal mass were the common findings in children with complicated urinary tract infections. Among the ninety three children fourteen children had phimosis. None of our children exhibited any sign of neurological abnormality. Hence it is important to evaluate the children presenting with palpable kidney or distended bladder.

Fourteen children had phimosis in the studied population of seventy children and thirteen of them underwent circumcision. According to studies children with phimosis are having three to seven times increased risk of developing urinary tract infection because the prepucial sac acts as a reservoir for bacteria and the mucosal surface also aids in bacterial adherence. Though four children had phimosis - two children with voiding dysfunction, one child with PUV, and one child with VUR- in the complicated group, we could not assess the relevancy or efficacy of circumcision due to short follow up.

We at our institution collect clean voided midstream specimen for documenting UTI. The pathogens associated with urinary tract infection in our children are E.coli, proteus, klebsiella, pseudomonas and staphylococci. E.coli is the most common species of uropathogenic organism cultured and

accounts for about 69.8% of the infections. Proteus was grown in thirteen specimens and it is associated in five cases of complicated UTI. Klebsiella was grown in ten specimens and it was associated in only one case of complicated UTI infection. In Winburg et al [67] study, E.coli causing urinary tract infection amounts to about 81- 91%. And proteus group of organism is the pathogen in 3-5%. Multiple organisms grown in two specimens and it was associated with complicated infection. Hence in cases of proteus infection and multiple growths of organisms should be investigated further.

In the antibiotic sensitivity pattern observed in our study, most organisms were sensitive to amikacin followed by cefatoxime and gentamicin. This finding prompts us to use amikacin empirically in children with severe urinary tract infection while awaiting culture reports.

The purpose of evaluating urinary tract infection with imaging is to detect anatomical as well as abnormalities like VUR and dysfunctional elimination. Ultrasonogram is sensitive in identifying the abnormalities in majority of conditions associated with urinary tract infections. Though operator dependent, high resolution and colour Doppler ultrasonography is

as sensitive as detecting small areas of inflammation or hypoperfusion that are seen in DMSA.

In our study we first evaluated the children with USG and then subjected them for further studies. Mac kenzie et al[68] suggested that a documented urinary tract infection should be evaluated initially with VCUG and if it is negative for reflux ultrasonogram is advised to find out any surgical causes for UTI. Blickman et al[69] suggested a tailored approach by beginning with a VCUG. If no reflux is found, a renal USG is done to exclude hydronephrosis and other upper tract anomalies and reflux is found a nuclear scan is advised.

In our study ultrasonogram detected abnormalities in 24 children among the 93 children. We used regular utrasonography equipment for our study. Ultrasonogram is sensitive in detecting subtle changes in mucosa and muscle thickness and debris in the collecting system in cases of pyonephrosis. The ultrasonogram may prompt to do VCUG as it happened in six cases of our study when the ultrasonogram detected

hydroureteronephrosis but was not able to document VUR. Subsequently VCUG detected VUR in those cases.

The sensitivity of ultrasonogram in detecting VUR in our study is 33%. Meticulous examination by ultrasound allows detection of 87% VUR- E F Arwi, F Rypens et al 1997[70] study. The ultrasound detected hydronephrosis always. Ultrasonogram detected only two cases of posterior urethral valve out of 6 cases amounting to 33%. At our institution we used regular ultra sonogram equipment with 5 Mhz probes for this study that may be the reason for the low detection rate.

Voiding cystourethrogram was done in ninety one children with the exception two children who were diagnosed as vulval synechiae and vesical calculus with clinical examination and ultrasonogram alone. The aim of VCUG is to detect vesicoureteric reflux, posterior urethral valve and other bladder and urethral abnormality. Though it was done by single shot method the procedure diagnosed nine cases of vesicoureteric reflux including 6 cases of vesicoureteric reflux which were not diagnosed by ultrasonogram. The other findings include large capacity smooth contoured bladder in four and irregular asymmetrical bladder in two children.

In our study VCUG detected VUR and PUV which are the common urogenital anomalies to be corrected surgically and having more risk for pyelonephritis and its complications. The detection of these anomalies by USG is poor. The USG is useful in detecting anomalies like hydonephrosis . Hence it is more reasonable to approach a documented urinary tract infection with VCUG and if it is necessary an USG to rule out other anomalies.

Based on voiding cystourethrogram findings suggestive of neurogenic baldder one child underwent urodynamic study and revealed an abnormal cystometry and in another child we could not do the study for financial constraints. Both the child did not have any neurological abnormality clinically.

Vesicoureteric reflux is seen in 50% of cases with posterior urethral valve[71]. In our study eight cases of PUV detected. Two of them were at less than one year of age and six of them were between 1 and 5 years. All of them children presented with VUR probably due to delayed reporting. Voiding cystourethrogram is useful in evaluating the children with PUV. VCUG diagnosed posterior urethral valve in eight cases including two cases of PUV diagnosed by ultrasonogram.

The most frequent diagnosis in our study is cystitis followed by vesicoureteric reflux and posterior urethral valve. Jodal et al 1994[66] study also states that cystitis is most common in 2-5yrs age group. On evaluation of culture positive urinary tract infection in 93 children, 27 cases of complicated urinary tract infection were diagnosed. They include vesicoureteric reflux - 9 Posterior urethral valve - 8, PUJ obstruction with hydronephrosis - 4 VUJ obstruction - 1, PUJ calculous - 2, Vesical calculous - 1, NNN bladder – 2. In this study 29% of the urinary tract infection in children is complicated with anatomical or functional abnormalities of the urinary system.

In the children with complicated urinary tract infection vesicoureteric reflux is the commonest anomaly and accounts for about 35% of the diagnosis. According to studies the estimated incidence of vesicoureteric reflux in UTI is about 40% and it is the most common genitourinary anomaly associated with urinary tract infections. Our study also confirms it.

In Hadi sorkhi et al[72] study, 35 -40% of the urinary tract infections were associated with vesicoureteric reflux. Another study by Jonathan H Ross et al[73] states that 30-50% of the urinary tract infection is associated

with vesicoureteric reflux and James larcombe et al 1999[74] described, vesicoureteric reflux in urinary tract infection is 8- 40%and our study also confirms the same.

Hydronephrosis due to pelviureteric junction obstruction accounts for about 17% of the complicated UTI in our study. A recent study conducted by Lee J H et al[75]conclude that the prevalence of UTI in nonrefluxing hydronephrosis is about 19%. In Chandrasekaran et al[76] study the association of hydronephrosis in UTI is upto 69% . Our study also reflects the results of the above studies.

Due to various factors we could not evaluate all the indicated children with nuclear renogram. Among the evaluated children majority of them (75%) had abnormalities. Nuclear renogram was done in twelve children. It identified defects in nine children and excluded defects in three children and thus it helped to manage efficiently especially in three occasions when a chilld developed recurrent pyonephrosis despite pyelolithotomy. To rule out non functioning kidney DTPA was done and the DTPA showed normally functioning kidney and it avoided nephrectomy. In another child

with moderate hydronephrosis the dtpa showed normally functioning kidney without obstruction and it is on observation. One child had only 3% function with scarred and contracted kidney on DMSA and underwent nephrectomy.

CONCLUSION

1. Twenty nine percent of the UTIs are associated with genitourinary anomalies hence it is worth evaluating the child with UTI.
2. Vesicoureteic reflux is the commonest anomaly associated with UTI.
3. E.coli is the commonest organism causing UTI.
4. Voiding cystourethrogram is the tool for the diagnosis of VUR and PUV.
5. It is reasonable to approach a UTI with VCUG and if it is necessary an USG to rule out other anomalies.
6. Amikacin may be useful for empirical treatment for UTI in our children.
7. Since the study is conducted on a select and small population it needs further study.

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PROFORMA

Evaluation of urinary tract infection In children

Sl.no : ☐☐ Date: ☐☐☐☐☐☐

Name : _____ Age/sex: ☐☐☐☐

Address: _____ IP/OP No ☐☐☐☐☐☐☐

_____

_____

☐ Presenting complaints ◯ H/O

☐◯ Fever ☐◯ Abdominal pain

☐◯ Vomiting ☐◯ loss of appetite

☐◯ Dysuria ☐◯ Frequency

☐◯ Retention ☐◯ Pyuria

☐◯ Urgency ☐◯ Flank pain

☐◯ Dribbling ☐◯ Poor stream

☐◯ Failure to thrive ☐◯ Haematuria

☐◯ Constipation ☐◯ Diarrhoea

☐◯ Instrumentation

H/O PREVIOUS EPISODES Yes ☐ No ☐ No of previous episodes ☐

Examination

Fever ☐ dehydration ☐

Toxicity ☐

Penis normal ☐ circumcised ☐

Phimosis ☐ hypospadiasis ☐

Epispadias ☐

Vulval synechiae ☐ ARA ☐

P/A distended bladder ☐ flank fullness ☐

Tenderness ☐ ascites ☐

Renal mass nil ☐ R ☐ L ☐ Both ☐

Spine N ☐ others _____

Neurological abnormality _____

Investigatijons urine alb ☐ sug ☐ dep - pus cells ☐ bact ☐ casts ☐

Urine clean voided ☐ catheterized ☐ aspirated ☐

Culture positive ☐ negative ☐

Organism _____

Sensitive to septran ☐ amikacin ☐

Cipro ☐ cefatoxime ☐

Gara ☐ cephalexin ☐

Nitrofur ☐ OTHERS _____

BLOOD Urea _____mg% creatinine _____mg%

ELECTROLYTES Na _____ K _____ HCo3_____ Cl _____

USG Abdomen

MCU

IVP AUG

DMSA/DTPA

Diagnosis _____

UTI SIMPLE ☐ COMPLICATED ☐

TREATMENT FOLLOW UP

Sl. No	Name	Age	Sex	Ip /Op. No	Organism	Sensitivity	USG	VCUG	Diagnosis
1	Manikandan	9	M	48326	E .coli	Cefatoxime	Cystitis	N	Cystitis
2	Praveen kumar	6	M	163391	,,	Amikacin	N	N	Simple UTI
3	Soundarya	11	F	924/06	,,	Gentamicin	N	N	,,
4	Srikanth	4	M	3667	,,	Amikacin	N	N	UTI-phimosis
5	Gowtham	6	M	65682	Proteus	Gentamicin	N	?Neurogenic	Neurogenic bladder
6	Arivuselvan	6	M	147/06	E .coli	Amikacin	Hydroureternephrosis	B/L gIV VUR	B/L gIV VUR
7	Usha	11	F	2670/06	,,	,,	N	N	Simple UTI
8	Diana	10	F	2862	Klebsiella	Cefatoxime	N	N	,,
9	Ragupathy	3	M	28321	E .coli	Amikacin	(R) G III HUN	(R) gIIIVUR	(R) g III VUR
10	Mohanraj	12	M	3478	,,	,,	N	N	Simple UTI
11	Pechiappan	4	M	4032	,,	,,	N	N	,,
12	Noufia	7	F	374156	,,	Cefatoxime	N	N	Void. dysfunction
13	Palanisamy	8	M	413026	,,	Septran	N	N	SimpLe UTI
14	Siva	2	2	4074	Proteus	Cefatoxime	N	N	,,
15	Surya	4	M	3122/07	,,	Amikacin	N	N	,,
16	Sathyapriyan	10	M	470467	E .coli	,,	N	N	,,
17	Sibika	2	F	476432	Proteus		N		Vulval synachiae
18	Vikram	8	M	103651	E .coli	Septran	(L)Hydronephrosis	N	(L)Hydronephrosis
19	Manikandan	9	M	64444	,,	Amikacin	B/L HUN	B/L g IVreflux	B/L g IV VUR
20	Arun kumar	7	M	66380	Klebsiella	Cefatoxime	N	N	Simple UTI
21	Gobika	2	F	42594	E.coli	Amikacin	N	(L) gIIIVUR	(L) gIIIVUR
22	Lavanya	8	F	121107	Klebsiella	,,	N	N	Simple UTI
23	Bharath	11	M	503858	E.coli	,,	Cystitis	N	Cystitis
24	Raghavan	6	M	77154	,,	,,	N	N	Simple UTI
25	Ayyappan	9	M	541882	Klebsiella	Ciproflox	N	N	,,

Sl. No	Name	Age	Sex	Ip /Op. No	Organism	Sensitivity	USG	VCUG	Diagnosis
26	Askash	1	M	3912	Prot&kleb	Gentamicin	PUV	PUV B/Lreflux	PUV B/Lreflux
27	Deepak	3	M	4018	E. coli	,,	N	B/L gIIIVUR	(B/L)gIIIVUR
28	Kanjimalai	2	M	49682	,,	Amikacin	B/L HUN	B/L GivVUR	(B/L)Giv VUR
29	Aswinth	7m	M	4119	Staph,Eco	,,	H UN R>L	PUV B/Lreflux	PUV B/Lreflux
30	Kaleeswaran	6	M	57385	E.coli	Amikacin	Cystitis	N	Cystitis
31	Satheesh kumar	1	M	41944	,,	,,	H UN R>L	PUV B/Lreflux	PUV B/Lreflux
32	Laven kishore	5	M	76087	,,	,,	PUV B/Lreflux	PUV B/Lreflux	PUV B/Lreflux
33	Jeeva	6	M	30948	,,	Amikacin	Cystitis	N	Cystitis
34	Linga moorthy	3	M	316/08	,,	Kanamycin	PUV B/Lreflux	PUV B/Lreflux	PUV B/Lreflux
35	Santhosh kumar	4	m	409	E.coli	Amikacin	Cystitis	N	Cystitis
36	Jegan	12	M	688	Klebsiella	Cafatoxime	(L)Hydronephrosis	N	(L)Hydronephrosis
37	Malini	8	F	3984	E.coli	Amikacin	N	N	Simple UTI
38	Vishnu	11	M	1432	,,	,,	N	N	,,
39	Kingsley Joshua	2	M	3790	,,	,,	H UN R>L PUV	PUV B/Lreflux	PUV B/Lreflux
40	Priyanka	4	F	16525	,,	,,	N	N	Simple UTI
41	Aswin	4	M	46681	Proteus	Ciproflox	N	N	,,
42	Razak prathosh	11	M	5827	Staphylo	Ampicillin	Enlarged kidneys	n	Glomerulonephritis
43	Mohan raj	4	M	58386	E.coli	Amikacin	N	N	Simple UTI
44	Anantha raj	10	M	1701	,,	,,	Absent (L)kidney	N	,,
45	Sabeena	2	F	62643	,,	,,	N	N	,,
46	Ashwin	4	M	46631	,,	,,	Cystitis	N	Cystitis
47	Dinesh	2	M	3101	,,	,,	PUV B/Lreflux	PUV B/Lreflux	PUV B/Lreflux
48	Raju	3	M	91467	,,	,,	N	N	Simple UTI
49	Sanjai	2	M	3802	,,	,,	N	N	,,
50	Dharani	4	F	4421	E.coli	Amikacin	N	N	Simple UTI

Sl. No	Name	Age	Sex	Ip /Op. No	Organism	Sensitivity	USG	VCUG	Diagnosis
51	Priyan	1	M	4491	Proteus	Cipro	N	N	Simple UTI
52	Linith	3	M	670	,,	,,	N	N	,,
53	Jeevanantham	2	M	3818	E.coli	Amikacin	N	N	,,
54	Nantha kumar	3	M	2186	,,	,,	Mild HN	®VUR	®VUR
55	Aalish	11	F	1555	,,	,,	N	N	Simple UTI
56	Gowrishankar	10m	M	360638	,,	,,	B/L HUN	Puv,ureterocele	Puv,u,cele reflux
57	Noufer	7	F	374165	,,	,,	N	N	Simple UTI
58	Narendiran	12	M	511355	,,	,,	N	N	,,
59	Surya	4	M	476237	Klebsiella	,,	N	N	,,
60	Balasingam	3	M	4405	E.coli	Gentamicin	Cystitis	N	Cystitis
61	Bharath	11	M	50388	,,	Amikacin	,,	N	,,
62	Rashidh	3	M	514551	Klebsiella	Ciproflox	N	N	,,
63	Fousiya	9	F	268901	Pseudomo	Cefatoxime	Large capacity	N	,,
64	Aravindh	7	M	59102	,,	,,	N	N	Simple UTI
65	Thangaraj	7	M	5116	Proteus	Cefatoxime	N	N	,,
66	Suresh	3	M	26220	,,	Amikaci	B/L HUN	B/L g IVreflux	B/L g IV VUR
67	Sameema banu	9	F	548356	proteus	Septran	N	N	Simple UTI
68	Arul pandi	2	M	31282	E.coli	Amikacin	(L) HUN	N	L)Vuj pyonephrosis
79	Pushparaj	9	M	578285	,,	,,	N	N	Simple UTI
70	Raj thilak	9	M	524941	,,	,,	N	N	,,
71	Pon raj	6	M	429549	,,	,,	(L)Hydronephrosis	N	L)Hydronephrosis
72	Muthu mari	8	F	26308	,,	,,	(L)PUJ calculous	N	(L) PUJcalculous
73	Vasuki	9	F	55608	,,	,,	N	N	Simple UTI
74	Manikandan	9	M	3391	Proteus	,,	N	N	,,
75	Sreedharan	3	M	23023	Proteus	Cefatoxime	Vesical calculous		Vesical calculous

Sl. No	Name	Age	Sex	Ip /Op. No	Organism	Sensitivity	USG	VCUG	Diagnosis
76	prakash	5	M	82208	Staphloco	Amikacin	Cystitis	N	Cystitis
77	Nithish kumar	9m	M	6474	E.coli	Amikacin	N	N	,,
78	Sathish kumar	1	M	41944	,,	,,	Cystitis	N	Cystitis
79	Vimala devi	10	F	894	,,	,,	®PUJcalculous	N	®PUJcalculous
80	Ashok	4	M	3730	Proteus	Cefatoxime	N	N	Simple UTI
81	Akitha	6	F	2761	E.coli	Gentamicin	(L)cont.kidney	N	L)VUR.non fun kid
82	Santhosh kumar	1	M	3994	Proteus	Ciproflox	N	N	Simple UTI
83	Rithik	2	M	57582	E.coli	Amikacin	N	N	,,
84	Karuppasamy	1	M	13721	,,	,,	N	N	,,
85	Jamsheer	11	F	55918	klebsiella	Cefatoxime	N	N	,,
86	Prabhu	11	M	53230	proteus	Amikacin	N	N	,,
87	Vignesh	11m	M	11787	Proteus	,,	(L) HN PUJ	N	(L) Hydronephrosis
88	Prashanth	6	M	31896	E.coli	Amikacin	N	N	,,
89	B/Opriya	15d	M	20274	E.coli	Amikacin	Patent urachus	N	Patent urachus
90	Balaji	3	M	321725	,,	,,	Cystitis	N	Cystitis
91	Priya	1	M	129479	klebsiella	Cefatoxime	N	N	Simple UTI
92	Sruthi	2	F	99964	E.coli	Amikacin	N	N	,,
93	Mercy monika	10	F	268901	E.coli	Amikacin	N	N	,,