

Urinary tract infection in children

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Definition

- ▶ Presence of actively proliferating organisms within the urinary tract

Epidemiology

- Generally commoner in girls (< 1 yr in males)
- Incidence is higher in uncircumcised boys
- Could be ascending infection from perineal flora
- Can occur as haematogenous spread (in neonates)
- Breast fed babies have a lower incidence

Significance

- ▶ Troublesome symptoms
- ▶ It damages growing kidney
- ▶ UTI tends to recur
- ▶ May indicate underlying obstructions and structural abnormalities
- ▶ Reveals vesicoureteral reflux and renal damage

Types of UTI

- ▶ Pyelonephritis (upper tract)
 - ▶ Cystitis (Lower tract)
 - ▶ Asymptomatic bacteriuria
 - ▶ Focal pyelonephritis (nephronia)
 - ▶ Renal abscess less common
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- ▶ Fever without a focus ?UTI

Definitions

Significant bacteriuria

Colony count $>10^5$ /ml of a single species in a midstream / clean catch sample

Asymptomatic bacteriuria

Presence of significant bacteriuria in two or more specimens in a child with no symptoms

Complicated UTI

Toxicity, persistent vomiting, dehydration, renal angle tenderness, renal impairment, clinically no response to treatment after 48 hours

Simple UTI

UTI with low grade fever, dysuria, frequency, urgency but none of the symptoms of complicated UTI

Associated abnormalities in the urinary tract

- ▶ 50% Normal urinary tract
- ▶ 33% VUR
- ▶ 12% Renal scarring
- ▶ 4% Obstruction
- ▶ 5% Others with no VUR or obstruction
 - solitary kidney
 - horse shoe kidney

Aetiology

- *E.coli* 70–90%
- *Klebsiella*
- *Proteus mirabilis*
- *Staphylococcus saprophyticus*
- *Enterococcus*
- *Strep. faecalis*
- *Pseudomonas*
- *Viral – adenovirus acute cystitis*
- *Mycobacteria*

Predisposing Factors

- Female gender
- Vesicoureteral reflux
- Improper toilet training
- Voiding dysfunction
- Obstructive uropathy
- Urethral instrumentation
- Wiping from back to front in girls
- Uncircumcised male

Predisposing Factors

- Tight clothing (underwear)
- Pinworm infection
- Constipation
- Bacteria with P fimbriae
- Anatomic abnormality (**labial adhesions**)
- Sexual activity
- Pregnancy
- Neuropathic bladder

Host factors

- ▶ Inflammation of bladder mucosa
- ▶ Local trauma
- ▶ Impaired immunity

Think of UTI

- ▶ Children with clinical features suggestive of UTI
- ▶ Unexplained fever of $\geq 38^{\circ}\text{C}$ – test urine sample within 24 hrs (after 24 hours at the latest)
- ▶ Those with alternative site of infection who remain unwell – test urine after 24 hours at the latest (after 24 hours)

Clinical features <3 months

- Fever
- Vomiting
- Lethargy
- Irritability
- Poor feeding
- Failure to thrive
- Jaundice
- Haematuria
- Odorous urine

Clinical features > 3 months

Preverbal

- Abdominal pain, Loin tenderness, Vomiting, Poor feeding, Lethargy, Irritability, Haematuria, Odorous urine, Failure to thrive

Verbal

- Frequency, Dysuria, Dysfunctional voiding, Incontinence, Abdominal pain, Loin tenderness, Fever, Malaise, Vomiting, Haematuria, Odorous urine, Turbid urine

Physical signs

- Fever
- Dehydration
- General ill health
- Renal angle tenderness
- Palpable bladder(after voiding)–Neurogenic bladder or Posterior urethral valve
- Ballotable kidneys
- Spinal defects
- Abnormalities in external genitalia (Labial adhesions,Phimosis)

Features to suggest upper urinary tract involvement

- ▶ Young age eg. infancy
- ▶ High fever
- ▶ Ill and toxic child
- ▶ Loin pain & tenderness
- ▶ high CRP
- ▶ Renal involvement in imaging (DMSA, abnormal Doppler, USS)

Asymptomatic bacteriuria

Presence of significant bacteriuria in two or more specimens in an asymptomatic child

- ▶ Seen almost exclusively in girls
- ▶ Benign condition – no treatment required except in pregnant women
- ▶ Routine urine cultures are not necessary

Diagnosis

Urine full report

- Pyuria – >10 WBC/ μ l in an uncentrifuged specimen or >5 WBC/hpf in a centrifuged specimen
- Presence of red cells > 5 /hpf in a centrifuged specimen
- Granular casts – in pyelonephritis
- Epithelial cells >10 /hpf
Indicate possible contamination
- Gram stain can be done

Sterile pyuria

- ▶ Balanoposthitis
- ▶ Vulvovaginitis
- ▶ Renal TB
- ▶ Neoplasm
- ▶ Fever
- ▶ Kawasaki disease

Urine for dipstick

- **Nitrite test**

Conversion of dietary nitrate to nitrite which is not usually found in urine



- **Leucocyte esterase test**

derived from neutrophils and indicates pyuria

Urine culture

- Gold standard to confirm UTI
- Can identify ABST pattern
- Positivity depends on the collection method of urine
- Heavy mixed growth indicates improper collection and contamination

Methods of urine collection

- ▶ **Mid stream urine sample** – in toilet trained children
- ▶ **Clean catch sample** – in small children who can not void on request
- ▶ **“In and out” catheter sample** – when there is repeated contamination , in phimosis , need urgent antibiotics but failed to collect the culture in an ill child

Methods of urine collection

- ▶ **Suprapubic aspiration** – for sick infants and for those who have repeated cultures with mixed growth
- ▶ **Bag specimen** – not recommended, high chance of contamination. If culture becomes negative it rules out UTI.

Urine culture positivity

- ▶ Mid stream/ clean catch sample – $>10^5/\text{ml}$
- ▶ In and out catheter sample – $>10^5/\text{ml}$
- ▶ If symptoms or UFR positive, then culture of a pure growth $10^4/\text{ml}$ or more is diagnostic
- ▶ Supra pubic aspirate –
 - Gram negative – any number
 - Gram positive – $>10^3/\text{ml}$

Collection of urine

Urine culture bottle should be a sterile bottle with a wide mouth and a screw cap



Storage and transport

- Immediate transport (within 2 hrs) and mount on culture media
- Otherwise keep at 4⁰C (maximum time 24hrs)
- Can preserve with Boric acid if there is a delay

Blood investigations

- ▶ **Blood** – FBC / CRP / Blood culture
in an ill febrile child

Management

- ▶ Acute management
- ▶ Imaging
- ▶ Treatment of obstruction
- ▶ Prevention of recurrence
- ▶ Follow-up

Acute management

Treatment of acute infection

- After history, examination and urine taken for culture:

start treatment without a delay if febrile, on a sick child or very young (<3 months)

Antibiotics on empirical basis until ABST available

- Can step up or step down with antibiotics once the ABST is available

NICE guidelines – Treatment of UTI

- ▶ Upper UTI or Pyelonephritis
 - If < 3 months – IV antibiotics initially at least 72 hours followed by oral to complete 7–10 days
 - If > 3 months
 - If sick/not tolerating oral – IV antibiotics for at least first 48–72 hours, then oral drugs for 7–10 days
 - If less severely ill – oral antibiotics for 7–10 days
- ▶ Lower UTI or Cystitis in > 3 months
 - Oral antibiotics for 3–5 days

Antibiotics of choice

- IV-Co amoxiclav ,3rd generation cephalosporins, aminoglycoside (preferred as a single daily dose)
- Add ampicillin in neonates
- Oral- Co amoxiclav , cephalosporins
- Cystitis – trimethoprim, cephalosporins, nitrofurantoin, nalidixic acid, amoxycillin

Oral drug dosage used in treatment

Drug	mg/kg/d	
Cefixime	8	daily/bd
Cephalexin	30–60	tds
Co–amoxiclav	20–40	tds
Co–trimoxazole	6–10	bd
Nitrofurantoin	5	qds
N.acid	25–50	qds

IV Antibiotics

Cefotaxime	100-150 mg/kg/d	tds
Ceftriaxone	50-100 mg/kg/d	Bd/daily
Cefuroxime	50-100 mg/kg/d	tds
Co-amoxiclav	50-100 mg/kg/d	tds
Gentamicin	7.5 mg/kg/d	Daily dose preferred to tds dosing

Supportive management

- ▶ Management of fever
- ▶ Adequate hydration
- ▶ Nutrition
- ▶ Pain relief if necessary

Definition of recurrent UTI

- ▶ 2 or more episodes of acute pyelonephritis
- ▶ One episode of pyelonephritis and one or more episodes of cystitis
- ▶ 3 or more cystitis

Management of recurrent UTI

- Treat promptly and start prophylaxis
- Identify correctable risk factors (e.g. constipation, poor hygiene, inappropriate voiding practices)
- Treat phimosis or labial adhesions appropriately
- Imaging studies are indicated
- Check compliance

Long term management

Imaging

Aim is to

- assess the anatomy and function of kidney & UT
- find out underlying cause of infection
- exclude UT obstruction
- predict the prognosis

Imaging after UTI –USS

NICE Guidelines

- ▶ If < 6 months
 - USS during acute illness– in atypical or recurrent UTI
 - USS within 6 weeks – all others
- ▶ If > 6 months
 - USS during acute illness – in atypical UTI
 - USS within 6 weeks – in recurrent UTI
- **The current practice in Sri Lanka** – All children should have US following confirmed diagnosis of first upper UTI

Atypical UTI (NICE guidelines)

- ▶ seriously ill
- ▶ poor urine flow
- ▶ abdominal or bladder mass
- ▶ raised creatinine
- ▶ septicaemia
- ▶ failure to respond to treatment with suitable antibiotics within 48 hours
- ▶ infection with non-E. coli organisms

Findings on USS

- ▶ Acute parenchymal changes
- ▶ cortico medullary demarcation
- ▶ Presence, site, size & shape of kidneys
- ▶ Anatomy of spine
- ▶ Dilated ureters
- ▶ Thickened bladder wall & distended bladder
- ▶ Post-voidal volume of urine in the bladder

Imaging – DMSA scan

Indications–

(Tc99 dimercaptosuccinic acid scan)

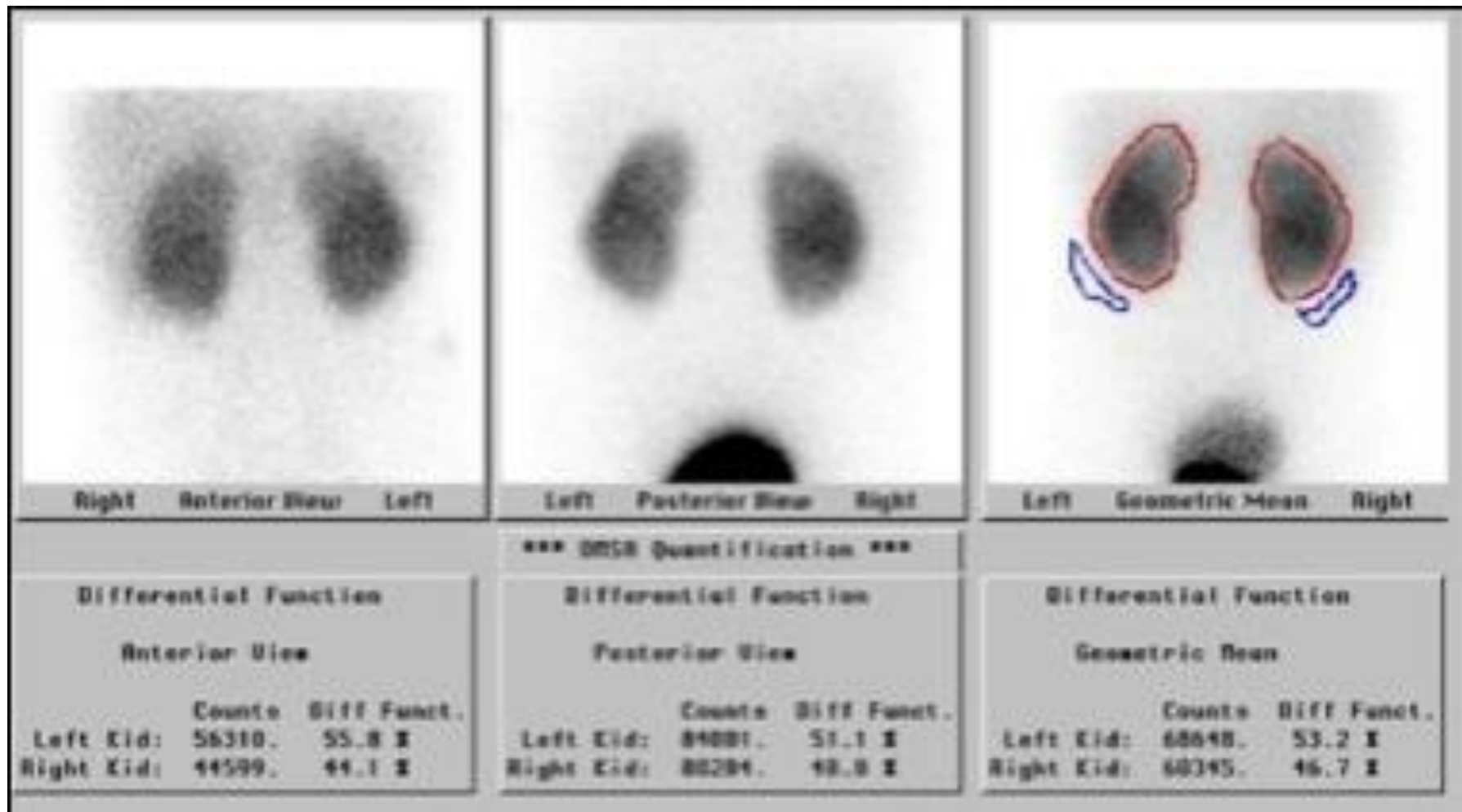
- a better substitute for IVU to detect scarring
- done after 6 months from the UTI

Only performed in Atypical UTI or in Recurrent UTI or abnormal US

DMSA

is the gold standard to identify and localize parenchymal changes in acute stage – but not done routinely for this purpose

DMSA



Imaging _ MCUG

Indications –

(Micturating cysto-urethrogram)

< 6 months – in atypical or recurrent UTI

>6 months < 3 years – only if ;

- Abnormal USS

- Poor urine flow

- Non E coli UTI

- Family history of VUR

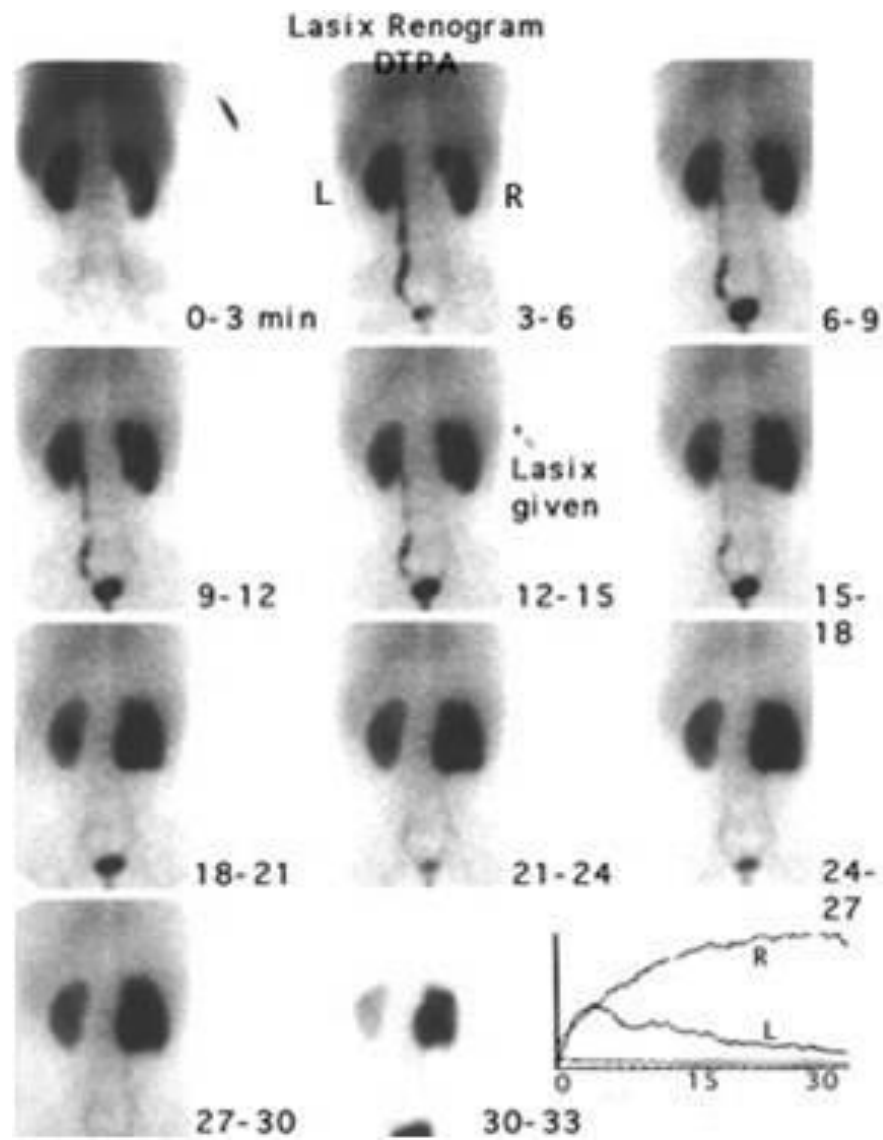
Imaging –DTPA

- ▶ DTPA

(Tc99 diethylene triamine penta–acetic acid scan)

for suspected outflow obstruction eg. PUJ obstruction

DTPA



Relief of obstruction

- ▶ Posterior urethral valves, calculi

Prevention of further infection

- ▶ Continuous AB prophylaxis
- ▶ Improve bladder emptying

Low dose un-interrupted AB therapy

- ▶ to prevent re-infection, an effective drug which has increased urinary concentration, given daily
- ▶ Do not give higher doses than recommended

Antibiotic prophylaxis

- ▶ Should continue till investigations are performed and should be withdrawn if the renal tract anatomy is normal in first episode of UTI in infants
- ▶ Underlying urinary tract problem
Eg. VUR, PU valve, neurogenic bladder (eg. following meningomyelocele repair)
Continue at least until 5 years

Antibiotics for prophylaxis

Cephalexin	10 mg/kg/dose	First 3 months
Cotrimoxazole	Trimethoprim 2 mg/kg/dose	Avoid in < 1 month
Nalidixic acid	12.5 mg/kg/dose	Avoid < 6 month
Nitrofurantoin	1-2 mg/kg/dose	Avoid < 3 month

Measures to improve regular bladder emptying

- ▶ Regular drinking
- ▶ Regular complete voiding
- ▶ Double micturation
- ▶ Avoid constipation

Follow up

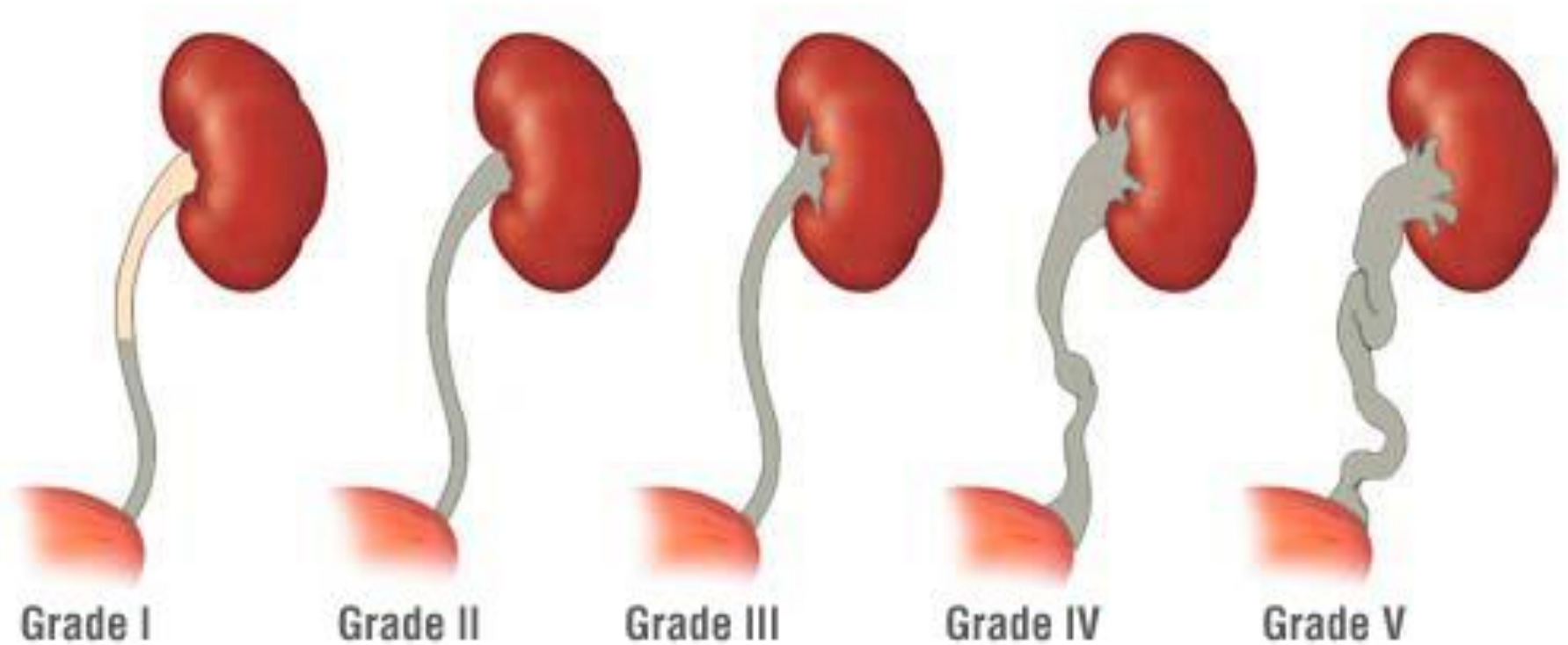
- ▶ **Clinical assessment** re: bowel & voiding habits, growth assessment
- ▶ Continuation of prophylaxis
- ▶ **Urine cultures** – no place for routine urine cultures
Need if symptomatic

Vesico-ureteric reflux

Vesico-ureteric reflux

- ▶ 1% of all children
- ▶ 35% have siblings with VUR independent of the grade
- ▶ Family screening is indicated
- ▶ 80% are females
- ▶ B/L grade IV less likely to resolve
- ▶ Grade V rarely resolves

Vesico-ureteric reflux





Management of VUR

- ▶ Prophylaxis indicated till 5 years of age
Longer regimens are indicated for recurrent UTIs
- ▶ Double micturition at bed time
- ▶ Treat recurrent attacks of UTIs promptly
- ▶ Repeat DMSA may be done after recurrent febrile UTI to detect new scarring
- ▶ Repeat MCUG to assess the improvement of reflux is **not recommended** unless there is a plan for surgery

Indications for surgical interventions in VUR

- ▶ Definite indication
 - Recurrent breakthrough infections

- ▶ Relative indications
 - Poor compliance for prophylaxis
 - Recurrent infections despite prophylaxis
 - New scar formation
 - Impaired renal function
 - Persistent gross VUR (grade 1 V–V)
 - Persistent moderate VUR (grade 1 1 1) with recurrent infections after discontinuation of prophylaxis

Long term management of renal scarring

- ▶ Prophylaxis till 5 years
- ▶ Check BP, growth, renal functions, urinalysis every 3–6 months
- ▶ Continue follow up into adult life
- ▶ Girls – advice on possible pregnancy related complications

Posterior Urethral Valves



Management of PUV

- ▶ MCUG – gold standard imaging modality
- ▶ Prompt surgical relief of obstruction – endoscopic ablation of valves
- ▶ Preoperative management
 - Adequate bladder drainage
 - Treatment/prevention of UTI
 - Correction of fluid , electrolyte & acid base imbalance

Phimosis

- “Fore skin cannot retracted till it has **separated from the glans**” (5 – 6 years)
- True phimosis – an indication for circumcision
- Recurrent Balanoposthitis
 - Not a definite indication for circumcision
- Preputial dilatation should be discouraged
- L/A of 0.5% Hydrocortisone for 4 – 6 weeks

Neurogenic bladder (Neuropathic bladder)

Neurogenic bladder

Causes

- ▶ Birth defects of the spinal cord
- ▶ Brain or spinal cord tumours
- ▶ Cerebral palsy
- ▶ Following encephalitis
- ▶ Multiple sclerosis
- ▶ Learning disabilities

Neurogenic bladder

Other associations

- ▶ CNS tumours
- ▶ Sacrococcygeal tumours
- ▶ Spinal abnormalities associated with imperforated anus

Urological manifestations

- ▶ Urinary incontinence
- ▶ UTI
- ▶ Hydronephrosis from detrusor–sphincter dyssynergia – causes functional obstruction of the outflow tract

Treatment options

- **Oxybutynin**
(medicines that reduce the bladder pressure – anti cholinergic)
- CIC – clean intermittent catheterization
- Antibiotic prophylaxis for UTI
- Transurethral injection of botulinum toxin (Botox) to the sphincter

Thank you

