



Urinary tract infections in children :An overview

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History taking

Dysurea : symptom of burning or pain upon urination

Important points in history in a child with dysurea

1. Associated urinary symptoms: urgency, frequency, hematuria, abdominal or loin pain, fever
2. Family history of stones, dietary habits
3. History of vaginal discharge, itching

Differential diagnosis of dysurea

1. infections of genitourinary tract

:pyelonephritis,cystitis,urethritis

2. vulvovaginitis : infections

3. chemical irritation from soaps, poor hygiene,inproper wiping

4. stones.hypercalcuria,hyperoxlauria,
hyperuricosuria

5.others as labial adhesions, sexual abuse ,trauma

physical examination

1.temp, renal angle and suprapubic tenderness

2.genitalia exam : look for vulvitis,discharge,meatal stenosis

Labial adhesions

3.Back for sacral dimple

Indicate bladder dysfunction

4.Palpable bladder, stool



Urinary Tract Infections

8% girls, 2% boys had UTI by age of 11

5% of febrile infants had UTI

Highest incidence during first year, more in females

M > F as neonate, more in uncircumcised

Recurrence rate 12- 30% in first 6-12 m after UTI

Ascending infections from periurethral colonization, rarely hematogenous spread

TABLE 1 Frequently Used Terms for UTI

Category	Term	Definition
Signs and symptoms	Febrile UTI	UTI associated with temperature $\geq 38^{\circ}\text{C}$ (100.4°F)
	Symptomatic UTI	UTI associated with fever and/or urinary symptoms
	ABU	Significant bacteriuria in a child with no symptoms of UTI
	Sterile pyuria	Increased white cells in urine in the absence of bacteria on urine culture
	BBD	Spectrum of signs and symptoms, including incontinence, constipation and/or encopresis associated with functional and behavioral abnormalities of the bowel, lower urinary tract, and pelvic floor
Site of infection	Upper-tract UTI	UTI involving kidneys and ureters
	Lower-tract UTI	UTI involving bladder and urethra but not upper tract
	Pyelonephritis	Kidney infection (febrile UTI may or may not be due to pyelonephritis)
	Cystitis	Bladder infection
Severity of infection	Complicated UTI	UTI in newborns; abdominal and/or bladder mass; kidney and urinary tract anomalies; urosepsis; organism other than <i>E coli</i> ; atypical clinical course, including absence of clinical response to antibiotic within 72 h; and renal abscess
	Complicated cystitis	Children with comorbid medical conditions, underlying bladder pathology, indwelling bladder catheter, and atypical clinical course
Renal status	Reflux nephropathy	Renal cortical abnormalities associated with VUR (may be congenital dysplasia or acquired scarring)
	Renal scarring	Acquired renal damage due to APN
	Renal dysplasia	Congenital renal cortical abnormalities

symptoms

- In neonates: fever , sepsis,decrease feeding,hypoactivity ,Failure to thrive,prolonged jaundice
- In children :fever ,vomiting,abdominal,flank pain
- Urinary symptoms:dysuria,frequency,urgency ,new onset day or night time incontinence,hematuria ,smelly urine,diarrhea

History of UTI

Bladder diary of voided volume, as frequency, urge incontinence, voided volume, holding manoeuvres

Bowel habits; frequency and consistency

History of previous UTI

Relation of UTI to toilet training

Family history of UTI in siblings

Urine specimen

- Urethral cathertization or suprapubic aspiration
- Clean cath
- Midstream in toilet trained
- Bag not used has a high false positive result, high risk of contamination



CLINICAL PRACTICE GUIDELINE

Urinary Tract Infection: Clinical Practice Guideline for the Diagnosis and Management of the Initial UTI in Febrile Infants and Children 2 to 24 Months

Action Statement 3

To establish the diagnosis of UTI, clinicians should require *both* urinalysis results that suggest infection (pyuria and/or bacteriuria) *and* the presence of at least 50 000 colony-forming units (CFUs) per mL of a uropathogen cultured from a urine specimen obtained through catheterization or SPA (evidence quality: C; recommendation).

Diagnosis

Diagnosis: urine culture and microscopy,

Simple urine analysis:

Pyuria is more than 5 cells per HPF

Klebsiella UTI low rates of pyurea

Microscopic hematuria is common, macroscopic seen in 25%

Urine gram stain of bacteria is most sensitive and specific

Negative analysis with symptoms doesn't rule out UTI

Automated urine analysis

Pyuria is more than 10 cells/ul

Dipstick for LE:(not specific)

Dipstick for nitrite :(specific but not sensitive),if negative doesn't rule out UTI

High CRP, neutrophilic leukocytosis indicate pyelonephritis

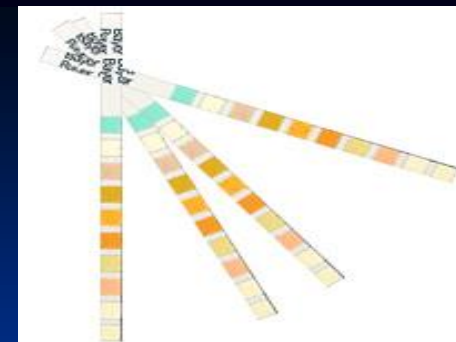


TABLE 1 Sensitivity and Specificity of Components of Urinalysis, Alone and in Combination

Test	Sensitivity (Range), %	Specificity (Range), %
Leukocyte esterase test	83 (67–94)	78 (64–92)
Nitrite test	53 (15–82)	98 (90–100)
Leukocyte esterase or nitrite test positive	93 (90–100)	72 (58–91)
Microscopy, WBCs	73 (32–100)	81 (45–98)
Microscopy, bacteria	81 (16–99)	83 (11–100)
Leukocyte esterase test, nitrite test, or microscopy positive	99.8 (99–100)	70 (60–92)

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Subcommittee on Urinary Tract Infection, Steering Committee on Quality Improvement and Management
Pediatrics 2011;128;595; originally published online August 28, 2011;

Which children will have urine tested ?

Risk factors for UTI

For females : White race, age <12 months, temperature ≥ 39.0 C, fever ≥ 2 days, and absence of another source of infection.

For males, White race, temperature ≥ 39.0 C, fever >24 hours, absence of another source of infection.

Which children will have urine tested ?

Risk factors for UTI

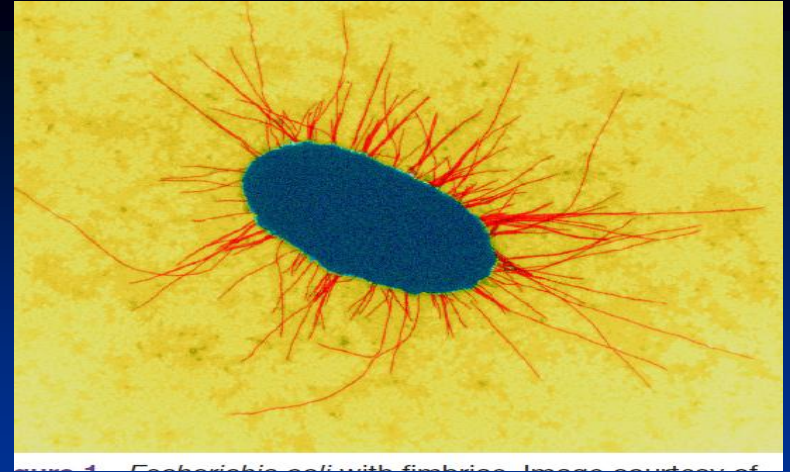
For females : White race, age <12 months, temperature $\geq 39^{\circ}\text{C}$, fever ≥ 2 days, and absence of another source of infection.

For males, White race, temperature $\geq 39^{\circ}\text{C}$, fever >24 hours, absence of another source of infection.

A calculator was developed to estimate probability of UTI based on risk factors

- Age less than 12 months
- Female sex or uncircumcised boy
- Temperature ≥ 39
- Fever ≥ 48 hour
- Absence of another source of fever

Types of Flora



80% caused by E.coli, other org
(Klebsiella, Enterobacter, enterococcus, Proteus, Pseudomonas)

Pathogenesis: P Ecoli has strong adhesive capacity
Bacteria usually comes from bowel, from under
foreskin in boys

Risk factors for UTI

Female sex, uncircumcised male

Younger age

High grade VUR

CAKUT as Obstructive uropathy

Bowel and bladder dysfunction

Common errors in diagnosis of UTI

- Contaminated urine specimen : if bag sample
- Sources of contamination are feces and skin
- Insignificant count and more than 2 pathogens (mixed growth) are suggestive of contamination
- Organisms as viridians strepy, coagulase negative staphylococcus are considered contaminants

- **Asymptomatic bacteriuria:** colonization of bladder in absence of inflammation
- Incidence 1-3 % and resolves spontaneously
- Antibiotic treatment isn't recommended
- Observed in children with neurogenic bladder on CIS, bladder augmentation

- **Sterile pyuria :** appendicitis ,viral infections, partially treated UTI, immunologic conditions (Glomerulonephritis , stones, Kawasaki, Interstitial nephritis, vaginitis, febrile children

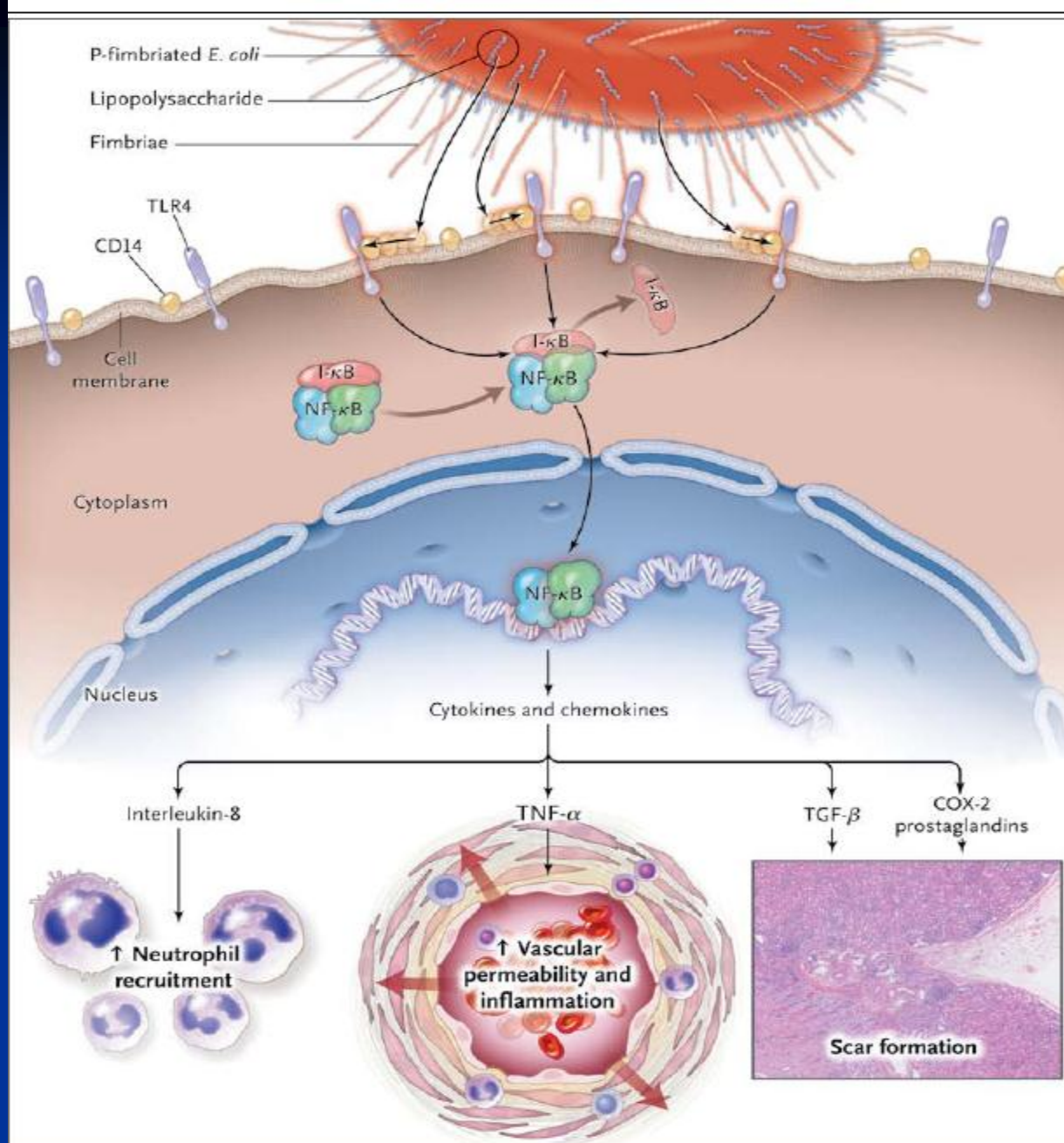
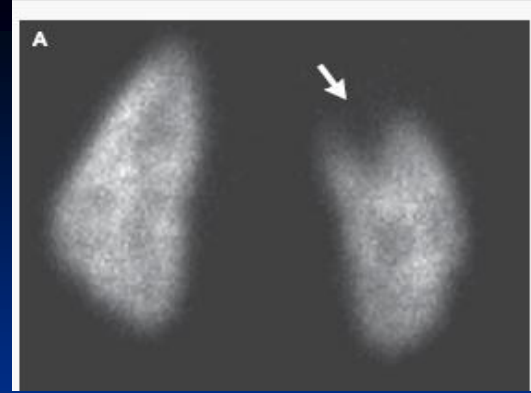


Figure 2. Pathophysiology of Acute Pyelonephritis.

Pathogenesis of scarring



10-40 % have scarring unrelated to age

DMSA scan acutely favors pyelonephritis

DMSA scan done 4-6 months after UTI

30% of prenatal VUR have abnormal DMSA, dysplasia

Scarring leads to proteinuria, hypertension, chronic kidney disease and PET

Risk factors for scarring

Young age, but some studies found older age

High grade VUR

Bowel and bladder dysfunction

Delayed treatment > 72 h

Recurrent UTI

Bacterial virulence: non E. coli organisms higher risk

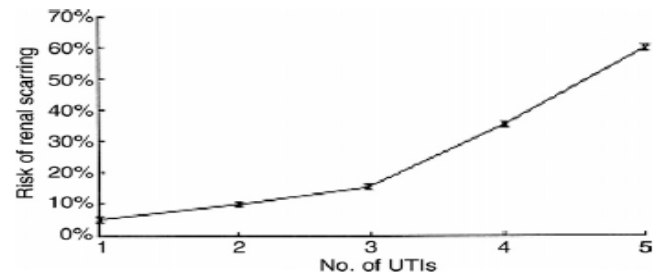


FIGURE 4

Relationship between renal scarring and number of bouts of pyelonephritis. Adapted from Jodal.⁵⁹

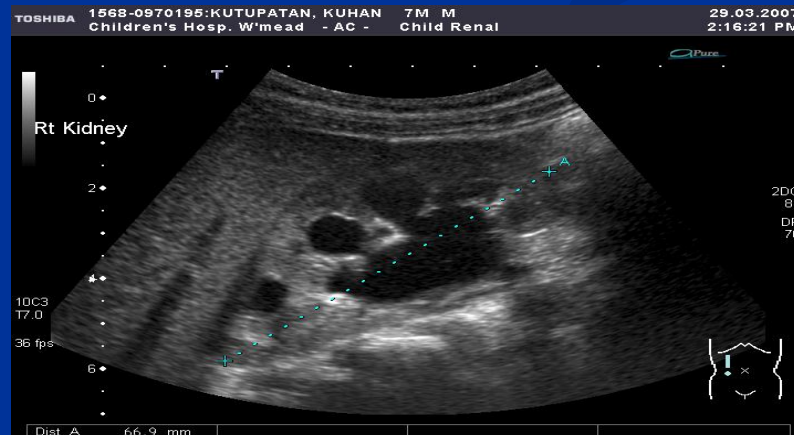
Complications

- Urosepsis
- Acute focal bacterial nephritis
- Renal or perirenal abscesses
- Pyonephrosis if underlying PUJ
- Acute kidney injury
- Tubulointerstitial disease :impaired acid excretion,impaired urine concentrating ability, secondary transient pseudohypoaldosteronism (hyponatremia,hyperkalemia)

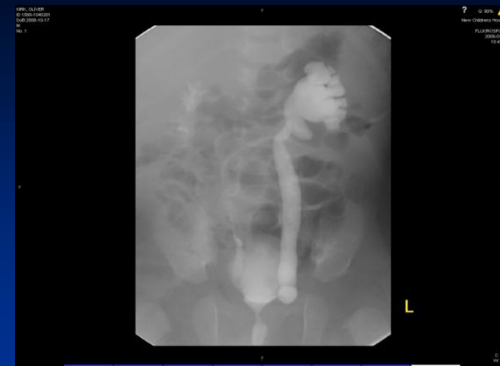
Imaging in UTI

Prevalence 34 % Of reflux in children with UTI

Febrile infants with UTIs should undergo renal and bladder ultrasonography (RBUS) (evidence quality: C; recommendation).



VCUG should not be performed routinely after the first febrile UTI; VCUG is indicated if RBUS reveals hydronephrosis, scarring, or other findings that would suggest either high-grade VUR or obstructive uropathy, as well as in other atypical or complex clinical circumstances (evidence quality B; recommendation).



Treatment

When initiating treatment, the clinician should base the choice of route of administration on practical considerations. Initiating treatment orally or parenterally is equally efficacious. The clinician should base the choice of agent on local antimicrobial sensitivity patterns (if available) and should adjust the choice according to sensitivity testing of the isolated uropathogen (evidence quality: A; strong recommendation).

Action Statement 4b

The clinician should choose 7 to 14 days as the duration of antimicrobial therapy (evidence quality: B; recommendation).

Antimicrobials

TABLE 2 Some Empiric Antimicrobial Agents for Parenteral Treatment of UTI

Antimicrobial Agent	Dosage
Ceftriaxone	75 mg/kg, every 24 h
Cefotaxime	150 mg/kg per d, divided every 6–8 h
Ceftazidime	100–150 mg/kg per d, divided every 8 h
Gentamicin	7.5 mg/kg per d, divided every 8 h
Tobramycin	5 mg/kg per d, divided every 8 h
Piperacillin	300 mg/kg per d, divided every 6–8 h

TABLE 3 Some Empiric Antimicrobial Agents for Oral Treatment of UTI

Antimicrobial Agent	Dosage
Amoxicillin-clavulanate	20–40 mg/kg per d in 3 doses
Sulfonamide	
Trimethoprim-sulfamethoxazole	6–12 mg/kg trimethoprim and 30–60 mg/kg sulfamethoxazole per d in 2 doses
Sulfisoxazole	120–150 mg/kg per d in 4 doses
Cephalosporin	
Cefixime	8 mg/kg per d in 1 dose
Cefpodoxime	10 mg/kg per d in 2 doses
Cefprozil	30 mg/kg per d in 2 doses
Cefuroxime axetil	20–30 mg/kg per d in 2 doses
Cephalexin	50–100 mg/kg per d in 4 doses

Antibiotics used

For Pyelonephritis: third generation cephalosporin as ceftriaxone, ampicillin and aminoglycoside in infants less than 3 months for At least a week

If previous cultures or ESBL bacteria used carbapenem or aminoglycosides

For non febrile cystitis: TMS, second or third generation cephalosporin as cefuroxime, cefixime or amoxicillin-clavulanic acid for 3-5 days

After empirical treatment, can change antibiotics according to sensitivities

Course of disease

Patients usually afebrile after 48 hour

If still febrile consider upgrading antibiotics due to resistant strains or complications

Routine follow up urine culture after resolution aren't necessary

Can continue oral antibiotics after intravenous

Surveillance

ACTION STATEMENT 7

After confirmation of UTI, the clinician should instruct parents or guardians to seek prompt medical evaluation (ideally within 48 hours) for future febrile illnesses to ensure that recurrent infections can be detected and treated promptly (evidence quality: C; recommendation).

Table 1. AAP Clinical Practice Guideline on UTI in Febrile Infants and Young Children: Key Updates

<i>Area of management</i>	<i>Updates from the 1999 guideline</i>
Diagnosis	Both an abnormal urinalysis result and a positive urine culture result are needed to confirm inflammation A positive culture result is defined as at least 50,000 colony-forming units per mL, rather than the previous criterion of at least 100,000 colony-forming units per mL Guidance is added for using clinical criteria to establish a threshold to decide whether to obtain a urine specimen
Treatment	Oral treatment is as effective as parenteral treatment
Imaging	Voiding cystourethrography is not recommended routinely after the first febrile UTI; ultrasonography should include the bladder and the kidneys
Follow-up	Emphasis is on urine testing with subsequent febrile illnesses, rather than on regularly repeated urine cultures after treatment

NOTE: The guideline applies to infants and children two to 24 months of age with unexplained fever.

AAP = American Academy of Pediatrics; UTI = urinary tract infection.

Information from reference 4.

Treatment

RCT showed no difference between IV antibiotic followed by oral with oral in treatment of pyelonephritis in:

- 1-Time to fever resolution
- 2-Recurrent UTI
- 3-Renal parenchymal defects

Role of prophylactic antibiotics



Table 11 Prophylactic antimicrobial agents

Antibiotic	Dose
Trimethoprim (TMP)–sulfamethoxazole	2 mg TMP/kg/day daily
Nitrofurantoin	1-2 mg/kg/dose daily
Cephalexin	10 mg/kg/dose daily
Amoxicillin	10 mg/kg/dose daily

Table 2 Properties of an ideal prophylactic agent

- Active against uropathogenic bacteria
 - Enteric uptake in the small intestine leading to minimal activity against bacteria in the colon and the periurethral area
 - Adequate urine concentration
 - Few short- or long-term adverse effects
 - Low selection of resistant bacteria
 - Available in formulas suitable for children
 - Good taste
 - Easily degradable to minimize negative environmental effect
-

Prevention

- Prophylactic antibiotics decrease UTI recurrence especially in children with VUR and BBD

No study has demonstrated any beneficial effect of antimicrobial prophylaxis on the prevention of renal scarring

- Antibiotic resistance is a major risk of long term

Prophylaxis

- Treatment of constipation and bladder dysfunction
- No evidence for use of cranberry for prevention of UTI in children

VUR

Causes: Primary or secondary to PUV, neurogenic bladder

Associated with renal agenesis, ectopia, lower pole of duplex kidney

33% of UTI cases have VUR

Incidence of reflux in siblings 27-45 %

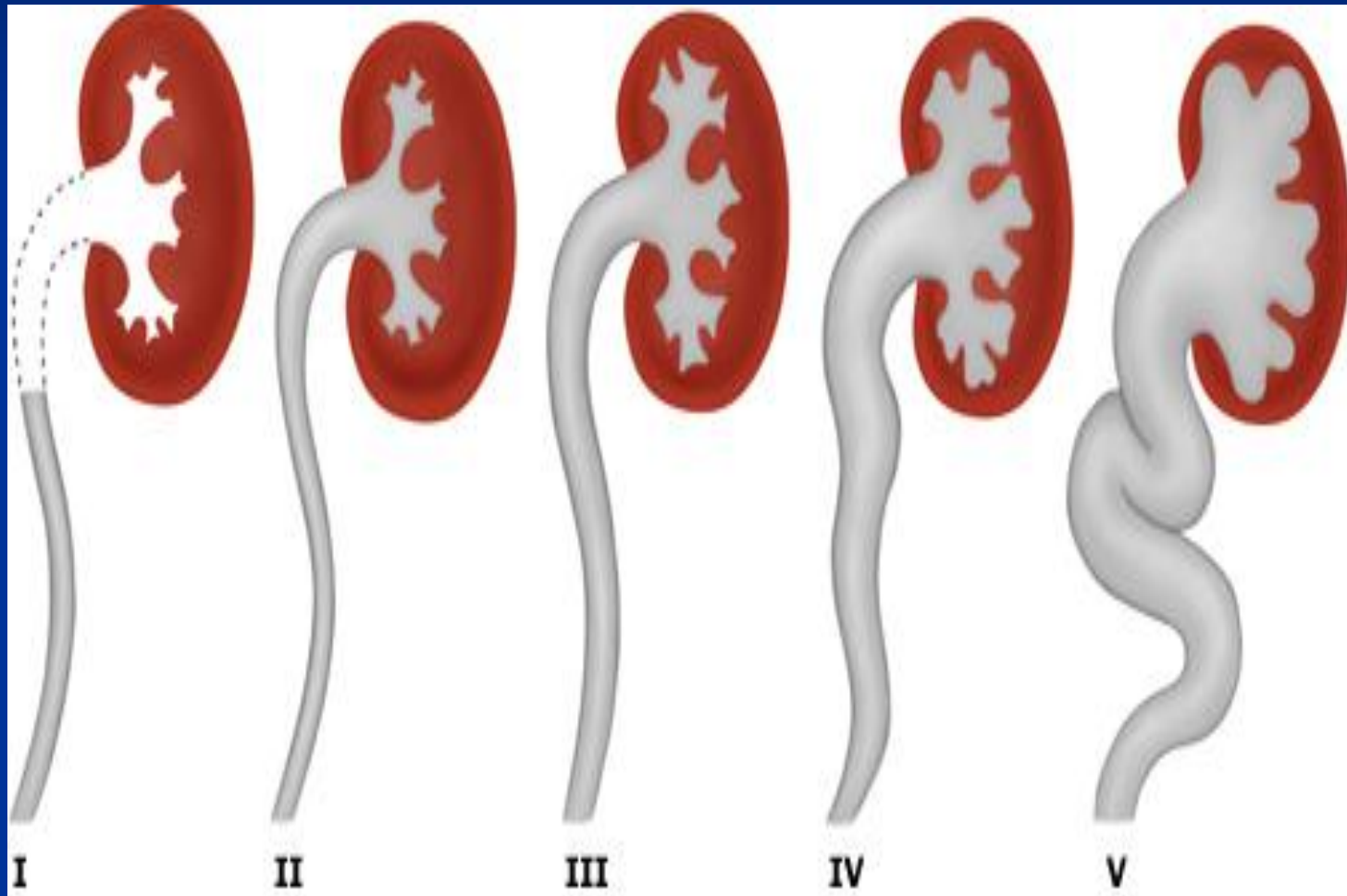
Management of VUR

Antimicrobial prophylaxis

Surgical correction ;high grade VUR, recurrent UTI despite prophylaxis,worsening of renal scars

Open ureteral reimplantation,endoscopic treatment

International classification of VUR





THANK YOU