

BACTERIURIA AND PYURIA

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BASICS

DESCRIPTION

- Urinary tract infection (UTI) is an inflammatory response of urothelium to bacterial invasion that is usually associated with bacteria and pyuria.
- Bacteriuria: Presence of bacteria in the urine, which is normally bacteria free
- Bacteriuria = valid indicator of bacterial infection or colonization
 - Can be either symptomatic or asymptomatic
 - Significant bacteriuria: Quantitative count $> 1 \times 10^5$ colony forming units (CFU/mL) in 2 consecutive specimens
 - Majority of individuals with significant bacteria have significant pyuria
 - Usually 1 organism
 - > 1 organism: Either contamination or polymicrobial infection
- Pyuria: Presence of WBC in the urine:
 - Generally implies an inflammatory response or infection
 - Significant pyuria: > 10 WBCs/HPF centrifuged
 - Close association between pyuria and bacteriuria; 96% of patients who are symptomatic and bacteriuric have > 10 WBCs/HPF
- Sterile pyuria: Presence of WBCs in the urine in the absence of bacteriuria:
 - Contamination: Vaginal or prepuce secretions
 - Infections: Treated UTI, mycobacterial, TB, chlamydial, gonococcal, fungal (GU or systemic), viral, haemophilus, bilharzia
 - Other infections: Appendicitis, diverticulitis, prostatitis
 - Noninfectious: Nephritis, stones, foreign bodies, transplant rejection, trauma, malignancy, chemotherapy, nephrotoxic substances, drug-induced interstitial nephritis
- Cystitis: Clinical syndrome of dysuria, frequency, urgency occasionally with suprapubic pain
 - Usually indicative of bacterial cystitis but can be associated with infections of the urethra or vagina or noninfections process such as interstitial cystitis, bladder carcinoma, or calculi

EPIDEMIOLOGY

Incidence (1)

- 0.3–0.5 episodes of bacteriuria per person per year among asymptomatic females aged 18–40
- Newborns:
 - Males: 1.5–3.6%; females: 0.4–1.0%
- 1–5 yr:
 - Males: 0.0–0.4%; females: 0.7–2.7%
- School-age:
 - Males: 0.04–0.2%; females 0.7–2.3%
- Adult (middle-age):
 - Males $< 1\%$; females 4–6%
- Older adults:
 - Males 11–13%; females 6–33%
- Almost 100% prevalence of bacteriuria in individuals with long-term, indwelling catheters

Prevalence

- Pregnancy: 2–7% of all pregnant females (2)
- Elderly: 20% of females, 10% of males
 - 24% of nursing home residents vs. 12% of healthy domiciliary elderly (3)

RISK FACTORS

Age, diabetes mellitus, sexual intercourse, use of diaphragm or spermicide, delayed postcoital micturition, history of recent infection, immunosuppression, long-term indwelling catheters, pregnancy, neurologic disorders, foreign bodies, stones, obstructive uropathy, vesicoureteral reflux.

Genetics

Certain populations may be more susceptible to bacteriuria and recurrent UTIs due to distinct molecular defects causing impaired host responses. Certain receptor sites on epithelial cells may predispose some women to UTIs.

PATHOPHYSIOLOGY

- Urinary tract is normally sterile.
- Bacteriuria usually ascends up the urinary tract from colonizing flora of the gut, vagina, or distal urethra.
- Bacteriuria can also invade the urinary tract hematogenously or through direct transfer after instrumentation.
- Bacteria colonize the urinary tract and then multiply, causing inflammation with pyuria.
- Bacterial factors:
 - Certain bacteria are more efficient at adhering to mucosal cells than others due to fimbria.
 - Virulence factors: Hemolysis, adhesions, colicin, metabolic properties, etc.
- Host factors:
 - Cystitis prone: Certain patients are more prone to bacteriuria (transitional cell bacterial receptor sites).
 - Menstrual cycle: Bacteriuria may be influenced by hormones.
 - Postmenopausal: Increasing incidence of bacteriuria
 - Vaginal pH: Normally acidic pH; colonization with uropathogens may occur as vaginal pH rises
 - Competitive organisms: Normal vaginal flora discourages uropathogenic colonization
 - Buccal and vaginal cells: More receptive to uropathogens' adherence in cystitis-prone patients
 - Local production of IgA, IgG may play defense role.
 - Production of mucous protective layer as a local bladder defense
 - Blood group antigen (secretors) saturate or block bacterial adherence.

ASSOCIATED CONDITIONS

Diabetes mellitus, pregnancy, immunosuppression, structural urinary tract abnormalities, indwelling catheters

GENERAL PREVENTION

- Screening and treatment of asymptomatic bacteriuria in at-risk populations such as pregnant patients or prior to urologic intervention can prevent subsequent morbidity of UTIs.
- Screening of asymptomatic spinal cord injury patients or those with indwelling Foley catheter is not recommended.
- Bacteriuria and pyuria from an incompletely treated UTI may be avoided with the appropriate use of antibiotic class with sufficient duration; patient compliance should be encouraged.

DIAGNOSIS

HISTORY

- Dysuria, frequency, urgency, malaise, rarely low-grade fever, malodorous urine
- Occasionally hematuria (gross): Especially in the female patient; uncommon in children and men
- Fever and flank pain with upper tract origin: Pyelonephritis
- Asymptomatic or atypical symptoms: Young and old patients
- Young patients: Abdominal discomfort, failure to thrive, fever, vomiting, jaundice
- Older patients: May be asymptomatic or have incontinence, fevers, frequency, and urgency
- Varied symptoms with sterile pyuria associated with differing conditions
- History of childhood fevers: May imply UTIs and associated congenital abnormalities
- Problems with toilet training, urgency, incontinence
- UTI family history: Mothers, daughters, sisters
- History of a risk factor for bacteriuria

PHYSICAL EXAM

- Suprapubic tenderness: Cystitis
- Flank tenderness: Pyelonephritis
- Fever: Usually with upper tract infection
- Children may have abdominal discomfort, tenderness, or distention.

DIAGNOSTIC TESTS & INTERPRETATION

Lab

- Indications for screening:
 - Symptomatic patients
 - Pregnant women
 - Prior to genitourinary procedures
- Urine dipstick: Best for screening:
 - Leukocyte esterase test:
 - Detects enzyme release by WBCs
 - Sensitivity 90%, specificity 95% for UTI
 - Conversion of nitrate to nitrite (Griess test): 70–80% sensitivity for UTI
 - Catalase test: Cannot differentiate infection from inflammation
- Microscopy:
 - Rapid in-office test: 80% accurate; usually fresh unspun
 - Centrifugation: Increases finding 10-fold
 - Difficult to see bacteria if $< 1 \times 10^5$ CFU/mL
 - Vaginal organisms may be misread as uropathogens: Lactobacilli and Corynebacterium
- Gram stain: Increases identification of bacteria with sensitivity and specificity of 96.2% and 93.0%, respectively

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- Urine culture:
 - Clean-catch midstream urine: Commonly used
 - Catheterized urine: May be necessary to assure diagnosis or in special situations (ie, children, patients unable to void, the debilitated, the obese)
 - Segmented urine specimen, initial 10 mL, midstream, post exam: For localization of bacteria or WBCs
 - Quantitative counts in UTI are usually $>1 \times 10^5$ CFU/mL with a uropathogen
 - Range 1×10^2 to 1×10^6
 - $<10^3$ per milliliter in 47% of patients
 - $<10^4$ per milliliter in 30% of patients
 - $>10^2$ per milliliter: Uropathogen; suspect UTI
- Conditions causing variation: Hydration, bacterial growth rate, urinary pH, pyelonephritis, catheterized specimen:
 - Multiple organisms usually indicate contamination or polymicrobial infection
- Uncomplicated infections: *Escherichia coli*, other Enterobacteriaceae, *Staphylococcus saprophyticus*, enterococci
- Complicated infections: *E. coli*, other Enterobacteriaceae, *Pseudomonas*, *S. aureus*, coagulase negative staph, enterococci
- Contaminants: Lactobacilli, streptococci, diphtheroids, *Gardnerella*, *Mycoplasma*, coagulation-negative staph

Imaging

- Bacteriuria:
 - Childhood: US, VCUG, radionuclide cystogram, IV pyelogram
 - Adult: Only indicated if suspicious of pathology or childhood history, obstruction, stone disease, hematuria, febrile infections, failure to respond to therapy, recurrent UTIs
 - Imaging in routine UTIs involving normal adult females: Very low yield of pathology
- Pyuria:
 - Associated with infection and bacteriuria: Same indications
 - Sterile pyuria evaluation for other causes
 - Isotopic function studies and cystogram
 - CT: Localization of nidus or abnormality responsible for bacteriuria/pyuria (ie, abscess)

Diagnostic Procedures/Surgery

Localization of bacteria: Segmented urine, ureteral catheterization, immunologic antibody studies

DIFFERENTIAL DIAGNOSIS

- Cystitis: Pyuria, positive culture, abrupt onset
- Urethritis: Pyuria, negative urine culture, gradual onset
- Vaginitis: No pyuria, vaginal discharge, pruritus
- Pyelonephritis
- Noninfectious causes
 - Interstitial cystitis
 - Nonuropathogenic cause, as in sterile pyuria
- Contamination with vaginal/skin flora



TREATMENT

GENERAL MEASURES

- Obtain urine culture:
 - Indwelling catheters should be used as infrequently as possible
 - In patients with indwelling catheter, urine specimen for culture should be obtained at the time catheter is changed under sterile conditions from newly placed catheter

MEDICATION

- Asymptomatic bacteriuria is treated as a UTI in childhood, prior to urologic surgery, and in pregnancy.
 - Persistent or recurrent bacteriuria may need treatment for more prolonged periods followed by chronic low-dose medication.
 - TMP-SMX (Trimethoprim-sulfamethoxazole) 40/200 mg daily
 - Nitrofurantoin 50–100 mg daily
 - Cephalexin 250 mg daily
 - Postmenopausal: Treated only if symptomatic or associated with complicating factors:
 - Diabetes, obstruction, immunosuppression (14–21 days of therapy)
 - Norfloxacin 400 mg PO BID
 - Ciprofloxacin 500 mg PO BID
 - Gentamicin 1–1.7 mg/kg IV Q8h
 - Ceftriaxone 1–2 mg IV/Q 24 h
 - Catheter-associated bacteriuria, if asymptomatic, should not be treated (may be due to colonization).
 - Bacteriuria in pregnancy should be treated, as untreated bacteriuria is linked with prematurity, IUGR, low birth weight, and neonatal death.

ADDITIONAL TREATMENT

Radiation Therapy

N/A

Additional Therapies

N/A

Complementary & Alternative Therapies

Cranberry juice may decrease frequency of bacteriuria and pyuria in selected populations.



ONGOING CARE

PROGNOSIS

Variable severity ranging from asymptomatic bacteriuria to severe UTI with urosepsis and secondary organ failure

COMPLICATIONS

20–40% of untreated bacteriuria in pregnancy leads to pyelonephritis

FOLLOW-UP

Patient Monitoring

- Repeat exam: 2 wk posttreatment, not necessary in young women who are asymptomatic after therapy
 - Microscopic urinalysis and culture
- Periodic office visits to verify sterile urine
- 2008 USPSTF guidelines:

– In pregnant women, high certainty exists that net benefit of screening for asymptomatic bacteriuria is substantial (1)[A].

- In men and nonpregnant women, there is moderate certainty that the harms of screening for asymptomatic bacteriuria outweigh the benefits. (1)[D]
- Adults with diabetes were included in this recommendation, for the general adult population, the USPSTF did not consider evidence for screening specific patient groups at high risk for severe UTIs, including transplant recipients, patients with sickle cell disease, and those with recurrent UTIs.

Patient Resources

<http://patienteducationcenter.org/articles/asymptomatic-bacteriuria/>

REFERENCES

1. Screening for asymptomatic bacteriuria in adults: US Preventive Services Task Force reaffirmation recommendation statement. *Ann Intern Med.* 2008;149:43–47.
2. Genao L, Buhr GT. Urinary tract infections in older adults residing in long-term care facilities. *Ann Longterm Care.* 2012;20(4):33–38.
3. Imade PE, et al. Asymptomatic bacteriuria among pregnant women. *N Am J Med Sci.* 2010;2(6):263–266.

ADDITIONAL READING

- D'Hondt F, Everaert K. Urinary tract infections in patients with spinal cord injuries. *Curr Infect Dis Rep.* 2011;13(6):544.
- Siddiq DM, Darouiche RO. New strategies to prevent catheter-associated urinary tract infections. *Nat Rev Urol.* 2012;9(6):305.

See Also (Topic, Algorithm, Media)

- Bacteriuria and Pyuria Image ☼
- Cystitis, General Considerations
- Pyuria Algorithm †
- Urinary Tract Infection (UTI), Adult Female
- Urinary Tract Infection (UTI), Adult Male
- Urinary Tract Infection (UTI), Catheter-related
- Urinary Tract Infection (UTI), Pediatric

ICD9 CODES

- 590.80 Pyelonephritis, unspecified
- 595.9 Cystitis, unspecified
- 599.0 Urinary tract infection, site not specified

ICD10

- N12 Tubulo-interstitial nephritis, not spcf as acute or chronic
- N30.90 Cystitis, unspecified without hematuria
- N39.0 Urinary tract infection, site not specified



CLINICAL/SURGICAL PEARLS

Screening of asymptomatic spinal cord injury patients or those with indwelling Foley catheter is not recommended.

BALANITIS AND BALANOPOSTHITIS

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BASICS

DESCRIPTION

- Balanitis: Inflammation of the glans penis.
- Balanoposthitis: Inflammation of the foreskin and glans penis (affects uncircumcised men).

EPIDEMIOLOGY

Incidence

- Can occur at any age.
- No incidence studies of balanoposthitis have been reported in US.
 - 1.5% of uncircumcised boys ages 0–15 were affected in a Japanese cohort.

Prevalence

- Common, the exact prevalence is unknown.
 - Balanitis affects 11% of adult men and 3% of boys seen in urology clinics.

RISK FACTORS (1)

- Presence of a foreskin (uncircumcised)
- Tight foreskin (phimosis)
- Poor genital hygiene
- Intertrigo (see below)
- Sexual contact (with or without infection)
- Poorly controlled diabetes mellitus
- Immunocompromised host
- Coexisting penile cancer

Genetics

N/A

PATHOPHYSIOLOGY (2)

- The pathophysiology is usually different in young boys compared to adult men:
 - Boys: From bacterial invasion of tissue
 - Men: Combination of poor genital hygiene, intertrigo, irritant dermatitis, maceration injury, and bacterial, or candidal overgrowth
 - Candida is the most common infectious cause
- Intertrigo refers to a condition in which damp, moist body areas are predisposed to inflammation:
 - Involves genitals, inner thighs, underbelly
 - Risk factors: Grossly overweight, diabetes, bed rest, diaper use, poor personal hygiene
 - Skin dampness predisposes to secondary opportunistic bacterial or fungal overgrowth

- Balanitis xerotica obliterans (BXO) is a specific form of balanitis:
 - Chronic, progressive, fibrotic disease (a form of lichen sclerosis isolated to the penis)
 - Elastin is replaced by collagen
 - The skin around the meatus becomes white, featureless, contracted, causing meatal stricture
 - BXO may spread to the foreskin and coronal sulcus. In extreme cases, the entire end of the penis is replaced by fibrotic tissue, becomes thickened and nonretractile, causing sexual and voiding issues (eg, weak stream, obstruction)

ASSOCIATED CONDITIONS

Diabetes mellitus

GENERAL PREVENTION

- Maintain good genital hygiene
- Retraction of foreskin to clean the glans
- Keep the glans and foreskin dry
- Circumcision
- Safe sexual contact
- Manage risk factors (eg, glycemic control)

DIAGNOSIS

HISTORY

- Symptoms may include: Pain, discharge, irritation, voiding symptom (dysuria, weak stream)
- Prior episodes and treatment
- Uncircumcised
- Foreskin retractability
- Genital hygiene habits
- Sexual contacts, sexually transmitted diseases
- Other systemic risk factors (eg, diabetes)

PHYSICAL EXAM

- Inspection (ulcers, mass, genital pus, edema)
- Palpation (tenderness, induration, mass)
- Inguinal lymph nodes should be nonpalpable

DIAGNOSTIC TESTS & INTERPRETATION

Lab

Swab of glans/foreskin for viral, bacterial, and fungal culture

Imaging

N/A

Diagnostic Procedures/Surgery

- Potassium hydroxide and Tzanck preparation for men
 - Potassium hydroxide smear evaluates for fungus
 - Tzanck preparation for herpes virus

Pathologic Findings

- Biopsy is indicated for:
 - Balanitis that persists and in which the cause remains unclear warrants biopsy to rule out coexisting neoplasm or premalignant lesions
 - For definitive diagnosis of BXO

DIFFERENTIAL DIAGNOSIS

- Fixed drug eruption (allergy)
- Contact dermatitis
- Squamous cell carcinoma of the penis
- Carcinoma in situ of the penis
- Zoon (plasma cell) balanitis
- Psoriasis
- Reiter syndrome (Reactive arthritis/reactive arthritis triad) (with circinate balanitis)
- Human papilloma virus

TREATMENT

GENERAL MEASURES

- Meticulous genital hygiene
- Keep the glans and foreskin clean and dry
- Expose the glans to air as often as possible
- Avoid excessive dampness in the genitals
- Avoid soaps while inflammation is present
- Cleaning with soap and water routinely
- Manage risk factors (eg, glycemic control)

MEDICATION

Treatment depends on the underlying cause (infectious vs. inflammatory) and organisms

BALANITIS AND BALANOPOSTHITIS

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First Line

- Candidal infection: The most common cause of infectious balanitis
 - Clotrimazole cream 1%
 - Miconazole cream 2%
 - Apply BID until symptoms resolve
 - Oral fluconazole if symptoms are severe
 - Nystatin cream if allergic to imidazole
 - Imidazole with hydrocortisone if inflammation
- Anaerobic infection:
 - Metronidazole 400 BID for 1 wk
 - Optimal dosage schedule is unknown
 - Alternatively, amoxicillin/clavulanic acid PO or clindamycin topically
- Aerobic infection:
 - Group A streptococci, *Staphylococcus aureus*, *Gardnerella vaginalis* are all reported cases of balanitis.
 - Treatment based on sensitivity of the culture (topical antibiotics, occasionally oral antibiotics)
- BXO:
 - Topical steroids (clobetasol propionate or betamethasone valerate) offers limited efficacy
- Zoon (plasma cell) balanitis:
 - Topical steroids with or without antibacterial cream
- Circinate balanitis (Reiter syndrome):
 - Hydrocortisone cream 1% apply BID
 - Treatment of associated infection
- Irritant, allergic balanitis:
 - Avoid exposure to irritants especially soaps
 - Emollients aqueous cream: Apply PRN and used as a soap substitute while inflammation is present
 - Hydrocortisone 1% apply QD or BID until symptoms resolve

Second Line

N/A

SURGERY/OTHER PROCEDURES

- Circumcision is reserved for recurrent balanitis, balanoposthitis, or phimosis that have failed conservative treatments.
- Occasionally dorsal slit may be performed.
- For BXO that does not respond to steroid:
 - Periodical self-dilation with tapered dilators
 - Dilation by urologists
 - Formal surgical reconstructive repair

ADDITIONAL TREATMENT

Radiation Therapy

N/A

Additional Therapies

N/A

Complementary & Alternative Therapies

N/A

ONGOING CARE

PROGNOSIS

- Can be recurrent or persistent
- 10% recurrence rate
- Some patients may require circumcision to prevent recurrence and ensure resolution.

COMPLICATIONS

- Abscess formation
- Penile cellulitis
- Progression to Fournier gangrene
- Scarring and subsequent phimosis

FOLLOW-UP

Patient Monitoring

- After an acute episode and treatment is implemented, patients should be seen again to ensure resolution of symptoms and infection.
 - Progression to cellulitis or gangrene may occur in diabetic patients with genital infection.
- Follow closely with genital dysplasia among those men with condyloma with a history of balanoposthitis than those with no such history.

Patient Resources

N/A

REFERENCES

1. Vohra S, Badlani G. Balanitis and balanoposthitis. *Urol Clin North Am.* 1992;19(1):143–147.
2. Edwards S. Balanitis and balanoposthitis: A review. *Genitourin Med.* 1996;72(3):155–159.

ADDITIONAL READING

Wikström A, Hedblad MA, Syrjänen S. Human papillomavirus-associated balanoposthitis—a marker for penile intraepithelial neoplasia? *Int J STD AIDS.* 2013;24(12):938–943.

See Also (Topic, Algorithm, Media)

- Balanitis and balanoposthitis Image ✨
- Balanitis Xerotica Obliterans
- Balanitis, Zoon (Plasma Cell Balanitis)
- Lichen Sclerosis Et Atrophicus
- Penis, Lesion

CODES

ICD9

- 605 Redundant prepuce and phimosis
- 607.1 Balanoposthitis
- 607.81 Balanitis xerotica obliterans

ICD10

- N47.1 Phimosis
- N47.6 Balanoposthitis
- N48.1 Balanitis

CLINICAL/SURGICAL PEARLS

- Maintaining good genital hygiene is a key preventive strategy (keep the foreskin and glans clean and dry).
- Underlying risk factors should also be managed (eg, glycemic control in diabetes).
- Treatment depends on the underlying cause (infectious vs. inflammatory) and organisms.
- Circumcision is reserved for recurrent balanitis, balanoposthitis, or phimosis that have failed conservative treatments.
- Balanitis that persists and if the cause remains unclear warrants biopsy to rule out coexisting neoplasm or premalignant lesions.