VOLUME - XIII
ISSUE - LXXVIII
NOV/DEC 2016

The Crux

BIMONTHLY FORUM FOR THE LABORATORIANS

CONTENTS

1 Editorial
2 Disease Diagnosis
12 Interpretation
13 Bouquet
14 Trouble Shooting
16 Tulip News

Editorial

A **urinary tract infection** (**UTI**) is an infection that affects part of the urinary tract. When it affects the lower urinary tract it is known as a **bladder infection** (**cystitis**) and when it affects the upper urinary tract it is known as **kidney infection** (pyelonephritis). Symptoms from a lower urinary tract include pain with urination, frequent urination, and feeling the need to urinate despite having an empty bladder. Symptoms of a kidney infection include fever and flank pain usually in addition to the symptoms of a lower UTI. Rarely the urine may appear bloody. In the very old and the very young, symptoms may be vague or non-specific.

The most common cause of infection is *Escherichia coli*, though other bacteria or fungi may rarely be the cause. Risk factors include female anatomy, sexual intercourse, diabetes, obesity, and family history. Although sexual intercourse is a risk factor, UTIs are not classified as sexually transmitted infections (STIs). Kidney infection, if it occurs, usually follows a bladder infection but may also result from a blood-borne infection. Diagnosis in young healthy women can be based on symptoms alone. In those with vague symptoms, diagnosis can be difficult because bacteria may be present without there being an infection. In complicated cases or if treatment fails, a urine culture may be useful.

In uncomplicated cases, UTIs are treated with a short course of antibiotics such as nitrofurantoin or trimethoprim/sulfamethoxazole. Resistance to many of the antibiotics used to treat this condition is increasing. In complicated cases, a longer course or intravenous antibiotics may be needed. If symptoms do not improved in two or three days, further diagnostic testing may be needed. Phenazopyridine may help with symptoms. In those who have bacteria or white blood cells in their urine but have no symptoms, antibiotics are generally not needed, although during pregnancy is an exception. In those with frequent infections, a short course of antibiotics may be taken as soon as symptoms begin or long term antibiotics may be used as a preventative measure. To know more about MALE UTI please refer to **"DISEASE DIAGNOSIS"** within. To further assist in this cause, both **"INTERPRETATION"** and **"TROUBLE SHOOTING"** also discuss related matters. Peep in please!

ISO 9001

Tulip Group

PUBLISHED FOR THE TULIP GROUP CUSTOMERS

FOR PRIVATE CIRCULATION ONLY

DISEASE DIAGNOSIS

URINARY TRACT INFECTION (MALES)

Background

The incidence of true urinary tract infection (UTI) in adult males younger than 50 years is low (approximately 5-8 per year per 10,000), with adult women being 30 times more likely than men to develop a UTI. The incidence of UTI in men approaches that of women only in men older than 60 years. The causes of male UTI addressed in this article include prostatitis, epididymitis, orchitis, and—as they apply to adult males—pyelonephritis, cystitis, and urethritis. Nosocomial urinary tract infections (UTIs) and their main risk factor, indwelling urethral catheters, are also discussed, with attention directed to unique aspects of the male urinary system.

Anatomy

The normal male urinary tract has many natural defenses to infection. Transitional epithelium conducts urine from the kidneys to an elastic bladder, which can store large volumes at low pressures. The male urethra is separated from the rectum by several centimeters of keratinized squamous epithelium; the long urethra provides an additional barrier between the bladder and the perineum. Because of these many defenses, many experts consider UTIs in males, by definition, to be complicated. Complicated infections are those that are more likely to be associated with anatomic abnormalities, requiring surgical intervention to prevent sequelae. The diagnosis and treatment of UTIs in males should proceed with this concept in mind. UTIs can be divided anatomically into upper- and lower-tract infections. In the male, lower-tract disease includes prostatitis, epididymitis, cystitis, and urethritis. Upper-tract disease (pyelonephritis) is similar in males and females. The phrase "significant bacteriuria" is sometimes used to emphasize that the number exceeds that which might be caused by contamination during the collection of the specimen. Bacteriuria can be symptomatic or asymptomatic.

Pathophysiology

As with females, the usual route of inoculation in males is with gram-negative aerobic bacilli from the gut, with *Escherichia coli* being the most common offending organism. Recent hospitalization, urinary catheter, and fluoroquinolone use in the past 6 months are independent risk factors for fluoroquinolone resistance in community-onset febrile *E coli* UTI. Fluoroquinolone resistance may be a marker of broader resistance, including extended-spectrum beta-lactamase (ESBL) positivity. In the normal host, UTI may occur due to infection of other portions of the genitourinary tract, typically the prostate. Older males with prostatic hypertrophy have incomplete bladder emptying, predisposing them to UTI on the basis of urinary stasis. However, in males aged 3 months to 50 years, the incidence of UTI is low; therefore, the possibility of an anatomic abnormality must be entertained in this age group. Entry of microorganisms into the prostate gland almost always occurs via the urethra; with intraprostatic reflux of urine, bacteria migrate from the urethra or bladder through the prostatic ducts. Other possibilities include entry via the hematogenous route, via the lymphatics from the rectum, and during prostate surgery. However, many patients have no known precipitating event. Prostatic fluid contains various antibacterial substances, including zinc and antibodies, which are lacking in some patients with chronic bacterial prostatitis. Interestingly, acute prostatitis usually does not result in chronic prostatitis, and chronic bacterial prostatitis is usually not antedated by acute prostatitis. Of men referred for prostatitis, less than 10% have either acute or chronic bacterial prostatitis.

Acute and chronic prostatitis

In the 1800s, prostatitis was thought to be secondary to excessive alcohol consumption or physical or sexual activity. It was often associated with gonorrhea and could be fatal or lead to abscess formation. By the 1920s, most cases were attributed to microorganisms, and antibiotics combined with prostate massage were standard therapy after World War II. Although the role of bacteria was questioned in the 1950s, it was reemphasized in 1968 when Meares and Stamey described their "4-glass test." Acute prostatitis is caused by an acute infection of the entire prostate gland, resulting in fever and localized pain. Microscopically, neutrophilic infiltrates, diffuse edema, and microabscesses may be seen, which may coalesce into larger collections. Chronic prostatitis may be caused by inflammatory or noninflammatory diseases. This condition may arise via dysfunctional voiding, intraprostatic reflux, chronic exposure to microorganisms, autoimmune mechanisms, irritative urinary metabolites, and as a variant of neuropathic pain. Chronic bacterial prostatitis often produces few or no symptoms related to the prostate, but it is probably the most common cause of relapsing UTI in men.

Chronic prostatitis has been subdivided by the National Institutes of Health (NIH) into the following categories:

Category II: Chronic bacterial prostatitis.

Category III: Chronic abacterial prostatitis. Category IIIA is chronic, inflammatory abacterial prostatitis, and category IIIB is chronic, noninflammatory abacterial prostatitis, also known as chronic pelvic pain or prostatodynia.

Category IV: Asymptomatic, inflammatory prostatitis.

Chronic bacterial prostatitis is the most common cause of relapsing UTI in men, with *E coli* as the main causative organism (80%), but other gram-negative bacteria and enterococci may also be observed. Rare cases may be caused by yeasts (eg, *Candida*, *Blastomyces*, *Histoplasma*, *Cryptococcus*) and mycobacteria. Whether *Staphylococcus epidermidis*, *S aureus*, and diphtheroids are pathogenically significant is doubtful, and the evidence supporting a causative role for *Chlamydia* and *Ureaplasma* is not convincing.

Epididymitis

Epididymitis is a clinical syndrome caused by infection or inflammation of the epididymis. This condition is the most common cause of acute scrotum in adult male populations. Long-term complications include abscesses, infarction, recurrence, chronic pain, and infertility. The pathophysiology of epididymitis is divided; *Chlamydia trachomatis* and *Neisseria gonorrhoeae* are the most common pathogens in patients younger than 35 years, whereas Enterobacteriaceae and gram-positive cocci are frequent pathogens in older patients. In either case, infection results from retrograde ascent of infected urine from the prostatic urethra into the vas deferens and, finally, into the epididymis.

Orchitis

Because of the widespread use of mumps vaccination, orchitis is no longer a common infection in the United States. Orchitis is one of the few genitourinary infections to result from a viral pathogen. Mumps orchitis occurs in 18% of postpubertal boys infected with the mumps virus. Other viruses that can cause the disease include coxsackie B, mononucleosis, and varicella. Unlike the majority of genitourinary infections, viral particles are spread to the testicle by the hematogenous route. Granulomatous orchitis is rare and results from hematogenous dissemination of tuberculosis, fungi, and actinomycosis.

Pyelonephritis

Pyelonephritis is an infection of the renal parenchyma. Infection usually occurs in a retrograde, ascending fashion from the bladder, but it may occur hematogenously. The ureteral orifice becomes edematous and loses its one-way valve function during infection. Retrograde flow of bacteria into the upper urinary tracts and into the renal parenchyma results in clinical symptoms. Bacteremia, particularly with virulent organisms such as *S aureus,* can result in pyelonephritis with focal renal abscesses. Bacterial adherence allows for mucosal colonization and subsequent infection by an ascending route. Whereas type 1 pili are produced by most uropathogenic strains of *E coli,* P-pili, which bind to the uroepithelial glycosaminoglycan layer, are found in most strains of *E coli* that cause pyelonephritis. Genotypic factors may affect uroepithelial susceptibility to these adherence molecules. Endotoxin from gram-negative organisms can retard ureteral peristalsis. *E coli* is responsible for approximately 25% of cases in males, with *Proteus* and *Providencia* causing many remaining infections; *Klebsiella*, *Pseudomonas*, *Serratia*, and enterococci are less frequent.

Bacterial cystitis

Bacterial cystitis without concomitant infection in other portions of the genitourinary tract is believed to be a rare event in males. The abrupt onset of irritative voiding symptoms (eg, frequency, urgency, nocturia, dysuria) and suprapubic pain are clinically diagnostic. Most cases of bacterial cystitis occur by an ascending mechanism. Bacterial cystitis in the male is uncommon in the absence of anatomic abnormality, defect in bladder emptying mechanism, or urethral catheterization (eg, poor bladder emptying from prostatic obstruction or dysfunctional voiding). Elevated postvoid residuals allow bacteria to multiply to critical levels. High voiding pressures and poor bladder compliance diminish the natural uroepithelial resistance to infection.

Urethritis

Urethritis has been described for thousands of years. The term gonorrhea (*gonus* meaning seed, *rhoia* meaning flow) was coined by Galen. The urethral nonsquamous epithelium can be penetrated by *N gonorrhoeae,* resulting in periurethral microabscesses. Necrotic debris is sloughed into the urethra lumen, producing a milky penile discharge. Gonococcal urethritis remains the most commonly reported communicable bacterial disease worldwide.

Urinary catheter–associated UTIs

Up to 25% of hospitalized patients have urinary catheters inserted; of these individuals, 10-27% develop UTIs. In fact, UTI accounts for approximately 40% of all nosocomial infections; 15% of these infections occur in clusters and often involve highly resistant organisms. The single most important risk factor for nosocomial bacteriuria and UTI is the presence of an indwelling urethral catheter; 80% of nosocomial UTIs are associated with the use of urethral catheters. Once the urethral catheter is in place, the daily incidence of bacteriuria is 3-10%. Because most patients who become bacteriuric do so by 30 days, that is a convenient dividing line between short- and long-term catheterization.

Etiology

Risk factors for UTI and bacterial causes of prostatitis, epididymitis, orchitis, pyelonephritis, cystitis, and urethritis are discussed in this section.

Risk factors

Obstruction from any cause is a major risk factor for the development of UTI, as are instrumentation of the urinary tract, catheterization, and urologic surgery. In males older than 50 years, prostatic hypertrophy with partial obstruction is the main contributor to the increase in UTI. Risk factors observed more commonly in elderly or institutionalized males include cognitive impairment, fecal or urinary incontinence, and the use of catheters. Catheter-associated bacteriuria risk factors include female sex, significant comorbid conditions (especially diabetes mellitus), age older than 50 years, lack of systemic antibiotic(s), and a serum creatinine level greater than 2mg/dL. Risk factors for bacteremia secondary to catheter-associated UTI (CAUTI) are male sex, UTI caused by *Serratia marcescens,* older age, underlying urologic disease, and an indwelling catheter. In young men, risk factors for acute cystitis include homosexual behavior with anal intercourse, intercourse with a female infected or colonized with a uropathogen, lack of circumcision, and human immunodeficiency virus (HIV) infection with CD4 counts of 200/µL or less.

Prostatitis

Gram-negative uropathogens (eg, Enterobacteriaceae, such as *E coli, Klebsiella,* and *Pseudomonas*) are acknowledged pathogens of the prostate. Probable pathogens include *Enterococcus* and *S aureus*, and possible pathogens include coagulase-negative *Staphylococcus*, *Chlamydia*, *Ureaplasma*, anaerobes, *Candida*, and *Trichomonas*. Acknowledged nonpathogens of the prostate include diphtheroids, lactobacilli, and *Corynebacterium*. Bacterial pathogens cannot be demonstrated in cases of nonbacterial prostatitis. Viruses and cell wall–deficient bacteria have a controversial association with prostatitis. Rare cases have been reported from *Clostridia* and *Burkholderia* (formerly *Pseudomonas*) *pseudomallei* (the causative agent of melioidosis). Unusual pathogens reported in patients with acquired immunodeficiency syndrome (AIDS) include cytomegalovirus (CMV) and some fungi (*Aspergillus*, *Histoplasma*, and *Cryptococcus*). The prostate is a known reservoir for *Cryptococcus neoformans*.

Epididymitis

Chlamydia trachomatis and *N gonorrhoeae* are the most common pathogens in patients younger than 35 years with UTI, whereas Enterobacteriaceae and gram-positive cocci are frequent pathogens in older patients.

Orchitis

Orchitis is one of the few genitourinary infections resulting from viral pathogens, such as the mumps, coxsackie B, Epstein-Barr (EBV), and varicella (VZV) viruses. Granulomatous orchitis is rare and results from hematogenous dissemination of tuberculosis, fungi, and actinomycosis. *Brucella* also been associated with orchitis; clinically, these patients resemble patients with tuberculosis. Colorado tick fever has also been associated with epididymo-orchitis. Secondary orchitis is a more common condition; it is a late complication of untreated epididymitis.

Pyelonephritis and cystitis

Bacteria responsible for pyelonephritis and cystitis in males include *E coli*, *Klebsiella*, *Enterobacter*, *Proteus*, *Pseudomonas*, *Serratia*, *Enterococcus*, and *Staphylococcus* species.

Urethritis

N gonorrhoeae is the most common cause of urethritis in males; nongonococcal causes of urethritis include *C trachomatis* (in up to 50% of cases), *Ureaplasma urealyticum, Trichomonas vaginalis*, and herpes simplex virus (HSV). The role of Mycoplasma in urethritis is controversial.

Catheter-associated bacteriuria

Short-term catheters are placed for a mean duration of 2-4 days. The usual indications are for acute illnesses, output measurement, perioperative routine, and acute retention. Approximately 15% of patients develop bacteriuria, usually with a single organism (*E coli*). Catheter-associated bacteriuria usually resolves after the catheter is

removed; however, one third of patients may have symptoms, and bacteremia is the most serious complication. Approximately 10-30% of patients develop a fever, and the risk of postoperative wound infection associated with bacteriuria is increased. Long-term catheters are placed for chronic medical or neurologic problems, including chronic urinary retention and incontinence. Essentially all patients develop bacteriuria, which is polymicrobial in up to 95% of cases. New pathogens often emerge, whereas many persist because of adherence properties (fimbrial adhesion in *Providencia* and *E coli*) or their effect on the local environment (*Proteus* and *Morganella*). Catheter obstruction in long-term catheterization may occur, via an interaction between bacteria, the glycocalyx, protein, and crystals; *Proteus mirabilis* is a potent producer of urease, which alkalinizes the urine, precipitating struvite and apatite.

Epidemiology

Although this article exclusively addresses UTI in males, the clinician should appreciate that the incidence of UTI is much higher in females during adolescence and childbearing years (adult women are 30 times more likely than men to develop a UTI). The incidence of UTI in men approaches that of women only in males older than 60 years; in men aged 65 years or older, 10% have been found to have bacteriuria, as compared with 20% of women in this age group. Internationally, there is a similar incidence in developed countries; however, in developing countries where men have shorter life spans, the incidence of UTI due to prostatic hypertrophy is lower. Young men rarely develop UTIs, and the prevalence of bacteruria is 0.1% or less. There is an early peak incidence during the first 3 months of life; in neonates, UTIs occur more frequently in boys than in girls (with a male-to-female ratio of 1.5:1), and they are often part of the syndrome of gram-negative sepsis. The cumulative incidence of symptomatic UTI (including pyelonephritis) in boys during the first 10 years of life has been reported at 1.1-1.6%. The incidence of true UTI in adult males younger than 50 years is low (approximately 5-8 per year per 10,000). In this population, the symptoms of dysuria or urinary frequency are usually due to sexually transmitted disease (STD)–related infections of the urethra (eg, gonococcal and nongonococcal urethritis) and prostate. In men older than 50 years, the incidence of UTI rises dramatically (range, 20-50% prevalence), because of enlargement of the prostate, prostatism, debilitation, and subsequent instrumentation of the urinary tract. The spectrum of causative agents is also somewhat broader in these older men.

Prostatitis, epididymitis, urethritis, and orchitis

In contrast to UTI, prostatitis affects men of all ages and, from 1990-1994, accounted for almost 2 million office visits per year in the United States. Prostatitis syndromes account for 25% of male office visits for genitourinary complaints, 8% of visits to urologists, and 1% of visits to primary care physicians. Of these men, 5% have bacterial prostatitis, 64% have nonbacterial prostatitis, and 31% have prostatodynia. Epididymitis has a bimodal distribution, corresponding to different age groups and pathogens. Most cases in men younger than 35 years are due to sexually transmitted pathogens. Older patients are more likely to have obstructive prostatism or a history of instrumentation or catheterization. Gonococcal urethritis is more common in ethnic minorities, lower socioeconomic groups, and persons living in urban centers. The risk to a male having intercourse with an infected female is 17%. Some of these associations may be limited by confounding. The peak age for urethritis is 20-24 years. Mumps orchitis occurs in 18% of postpubertal boys infected with the mumps virus.

History

In men, the most frequent chief complaint related to urinary tract infection (UTI) is dysuria. In fact, complaints of dysuria, urinary frequency, and urgency are approximately 75% predictive for UTI, whereas the acute onset of hesitancy, urinary dribbling, and slow stream are only approximately 33% predictive for it. Other aspects to inquire about include the following:

- Previous UTI(s).
- Nocturia, gross hematuria, any changes in the color and/or consistency of the urine. Prostatic enlargement.
- Urinary tract abnormalities - Personally and within their families.
- Comorbid conditions - Eg, diabetes.
- Human immunodeficiency virus (HIV) status.
- Immunosuppressive treatments for other conditions - Eg, prednisone.
- Any previous surgeries or instrumentation involving the urinary tract.

In a younger man, the presence of UTI is often associated with anatomic abnormality. In the absence of this history, a detailed sexual history may implicate activities such as sex with a new partner, sex with multiple partners, or other risk-taking behavior associated with sexually transmitted disease (STD)-related urethritis, prostatitis, or epididymitis that may lead to UTI. Certain patients are at increased risk of urosepsis and complications, such as the very sick and the immunosuppressed, as well as those with a history of genitourinary surgery, a neurogenic bladder, papillary necrosis (sickle cell disease, diabetes, or analgesic abuse), and a history of ureteral stricture or tumor with obstruction.

Physical Examination

Males who present with genitourinary complaints warrant a thorough general physical examination, with particular attention to the vital signs, kidneys, bladder, prostate, and external genitalia. Auscultation over the upper abdominal quadrants and the costovertebral angles may reveal the bruits of renal artery stenosis, an aneurysm, or an arteriovenous malformation. The costovertebral angles should also be percussed for tenderness. Palpation of the suprapubic area should be performed; a bladder that contains 500mL or more of fluid is often palpable as a suprapubic mass. The external genitalia should be examined carefully. The penis should be examined for the presence of ulcers or lesions, and special attention should be paid to the urethral meatus for the presence of erythema or discharge. The testes and epididymis must be examined and palpated for tenderness and swelling. A rectal examination with a 360° sweep of the interior of the rectum followed by careful palpation of the prostate can be performed. However, in patients with suspected acute bacterial prostatitis, palpation can be painful and may lead to bacteremia. Some authorities note that it is of little benefit in diagnosing acute prostatitis and state that prostatic massage should not be conducted in the setting of UTI or urethritis. Physical findings of UTI may include the following: Fever, Tachycardia, Flank pain/costovertebral angle tenderness, Abdominal tenderness in the suprapubic area, Scrotal hematoma, hydrocele, masses, or tenderness, Meatal discharge, Prostatic tenderness, Inguinal adenopathy.

Prostatitis Syndromes

These syndromes tend to occur in young and middle-aged men. Symptoms may include pain (in the perineum, lower abdomen, testicles, or penis or with ejaculation), bladder irritation, and, sometimes, blood in the semen.

Acute prostatitis

Acute prostatitis typically presents with spiking fever, chills, malaise, myalgia, dysuria, pelvic or perineal pain, and cloudy urine. Obstructive symptoms can result from swelling of the acutely inflamed prostate, and these range from dribbling and hesitancy to anuria. A less common

presentation is with a vague, flu like illness. Careful examination of the prostate is not contraindicated in acute bacterial prostatitis, but prostatic massage is contraindicated. Upon examination, the prostate is warm, swollen, soft ("boggy"), and extremely tender. The patient may have a fever and appear acutely uncomfortable; hypotension may be noted. A rectal examination with a 360° sweep of the interior of the rectum followed by careful palpation of the prostate can be performed. However, in patients with suspected acute bacterial prostatitis, palpation can be painful and may lead to bacteremia. Some authorities note that it is of little benefit in diagnosing acute prostatitis and state that prostatic massage should not be conducted in the setting of UTI or urethritis.

Chronic prostatitis

Patients with chronic prostatitis, by definition, have had symptoms for at least 3 months. Although this condition is not life threatening, the patient's quality of life has been compared with someone with unstable angina or active Crohn disease. Interestingly, many men with chronic bacterial prostatitis are asymptomatic. Chronic bacterial prostatitis and nonbacterial prostatitis have similar presentations, including dysuria, frequency, urgency, perineal discomfort, and a low-grade temperature. The only way to differentiate between these 2 entities is through culture of prostatic secretions. Prostatodynia, a noninflammatory disorder, also has a symptom complex similar to that of chronic prostatitis, except that the patient does not give a history of recurrent UTIs. In chronic bacterial prostatitis, the physical findings are variable. A low-grade fever may be present, and the rectal examination may be unremarkable or may reveal severe anal sphincter spasm. The prostate may be mildly or extremely tender. Examination of urine voided after prostate massage is more helpful diagnostically than quantitating the amount of pain experienced during the digital examination. The Meares-Stamey 4-glass test with prostatic massage is a classic diagnostic test for chronic prostatitis. Prostatic massage should not be conducted in the setting of UTI or urethritis.

Epididymitis and Cystitis

In early epididymitis, the epididymis is tender and indurated, but the testis itself is nontender and soft. In hours to days, inflammation progresses to the adjacent testicle and patients may complain of scrotal pain and swelling, as well as urinary frequency, urgency, or dysuria. Identifying the lateral sulcus between the testicle and epididymis then becomes increasingly difficult, and discerning testis from epididymis may be impossible. Dysuria, frequency, urgency, and suprapubic pain usually are present in patients with cystitis. Fever and flank pain may be present, but not usually. Note that symptoms cannot reproducibly differentiate cystitis (lower UTI) from pyelonephritis (upper UTI).

Orchitis

The most common presentation of orchitis is in a patient in the later stages of epididymitis. In this situation, inflammation has spread to the adjacent testicle and results in a tender, warm, and swollen hemi-scrotal mass. Patients have the characteristic history and urinary findings of epididymitis. Of patients with orchitis resulting from tuberculosis, 70% have other genitourinary or pulmonary symptoms of this disease. Viral orchitis is notable for the symptoms of the viral syndrome. Orchitis occurs in approximately 18% of postpubertal boys infected with the mumps virus; symptoms usually begin within 1 week of parotitis. Up to 30% of cases are bilateral, and sterility develops in up to 10% of cases.

Pyelonephritis

Patients with pyelonephritis appear ill; have fever, chills, and flank pain; and may have hypotension. Although fever is very suggestive of pyelonephritis, it has also been demonstrated in some males with simple cystitis. Note that 30-50% of pyelonephritis cases may be silent, without clinical symptoms. In the older male, prostate enlargement along with delayed presentation are the primary causes of pyelonephritis. Other historical risk factors include nephrolithiasis, neurogenic bladder, prostatitis, or symptom duration greater than 5 days. Classic findings with pyelonephritis include fever, chills, and flank pain/costovertebral angle tenderness that follow the symptoms of UTI; these findings are combined with pyuria and bacteriuria. Occasionally, the urinalysis and urine culture findings are negative, such as when an obstruction of the upper urinary tract is present due to stone disease. The differential diagnoses include appendicitis, diverticulitis, pancreatitis, and lower-lobe pneumonia.

Urethritis

The incubation period of gonococcal urethritis is 2-6 days. Occasionally, 2 weeks may elapse before symptoms such as dysuria; thick, milky discharge; and pruritus occur. The incubation period of nongonococcal urethritis (NGU) is 2-6 weeks. The symptoms are less severe and the discharge may be clearer than with gonococcal urethritis. Patients are likely to have a higher level of education (ie, 90% of urethritis cases in college health services is NGU) and fewer sexual contacts. Because patients with urethritis have a thick, milky discharge, the underpants may be impressively stained. Typically, patients with gonorrhea have a thicker, more copious discharge, but significant overlap with chlamydial urethritis is not uncommon. Gram stain is the key to an immediate diagnosis, although patients frequently have co-infections.

Catheterized and Hospitalized Patients

Clinical and microbiologic criteria for the diagnosis of UTI are not well established in catheterized hospitalized patients. Symptoms in these individuals may be atypical or may be attributed to other disease processes, and no reliable colony count cutoff defines significant bacteriuria. Low-level (100-1000 colony-forming units [CFU] per mL) colonization can progress to high-level (>100,000 CFU/mL) bacteriuria within 3 days in 96% of catheterized patients who are cultured on subsequent days (and not treated with antimicrobials). Thus, most experts agree that growth of more than 100 CFU/mL of a predominant pathogen represents catheter-associated UTI (CAUTI).

Diagnostic Considerations

PyuriaProstatitisEpididymitisCystitisEmphysematous and xanthogranulomatous pyelonephritisTuberculosis

One of the difficulties in diagnosing urinary tract infections (UTIs) in males lies in the fact that dysuria, with or without discharge, is the typical chief complaint with urethritis, which is a much more common disease. Determining the history of urinary and genital tract symptoms and sexual encounters, combined with laboratory testing of urine and urethral swabs, should allow differentiation of the 2 conditions. Absence of bacteruria despite symptoms of frequency, urgency, or dysuria suggests urethritis. However, bacteruria may be symptomatic or asymptomatic. In males aged 15-50 years, UTI is more common in males with anatomic abnormalities; in the sexually active male with no urinary tract abnormalities, sexually transmitted disease (STD) – related urethritis predominates, although UTI may occasionally be diagnosed. In elderly patients, the typical manifestations of UTI may be absent or replaced by vague findings of failure to thrive or worsening mental status. In addition, failure to consider an obstructing urinary calculus in this patient population results in delay of inpatient consultation with a urologist in the septic elderly patient. Patients with diabetes and those with recent urinary tract instrumentation, recent hospitalization, or taking broad-spectrum antibiotics have an increased incidence of resistant organisms. The differential diagnoses for infectious causes of sterile

pyuria include perinephric abscess, urethral syndrome, chronic prostatitis, renal tuberculosis, and fungal infections of the urinary tract, including *C neoformans* and *Coccidioides immitis.* Noninfectious causes of pyuria include uric acid and hypercalcemic nephropathy, lithium and heavy metal toxicity, sarcoidosis, interstitial cystitis, polycystic kidney disease, genitourinary malignancy, and renal transplant rejection. Prostatitis can coexist with benign prostatic hyperplasia (BPH) and prostate cancer. The symptom complex of BPH and chronic prostatitis overlap; older men are sometimes misdiagnosed with one or the other. In addition, prostatitis can increase prostate-specific antigen levels, raising the concern for prostate cancer. Young men have a very low incidence of UTI; if UTI is diagnosed frequently in this population, the physician is probably overlooking the far more likely sexually transmitted disease (STD)–related urethritis/prostatitis. Among patients with acute scrotum, 90% of cases are caused by epididymitis, torsion of the spermatic cord, and torsion of a testicular appendage. Bacteria and leukocytes observed on a urethral Gram stain support a diagnosis of epididymitis, although some overlap may be observed between epididymitis, torsion of the spermatic cord, and torsion of a testicular appendage. Consultation with a urologist is mandatory in all but the most clear-cut cases for operative salvage of the torsed testicle. Torsion of the spermatic cord must be assumed until proven otherwise, because unresolved torsion of the cord is likely to result in irreversible necrosis in less than 12 hours. In men older than 50 years, the presentation of cystitis is difficult to differentiate from that of obstructive prostatism due to prostatic hyperplasia, transitional cell carcinoma of the bladder, or acute or chronic bacterial prostatitis. In young men, urolithiasis, bladder cancer, and strictures are included in the differential diagnoses. Microscopic hematuria is found in approximately half of cystitis cases; when found without symptoms or pyuria, it should prompt a search for malignancy. Other factors to be considered in the differential diagnoses include calculi, vasculitis, renal tuberculosis, and glomerulonephritis. In a developing country, hematuria is suggestive of schistosomiasis, which can be associated with salmonellosis and squamous cell malignancies of the bladder. Emphysematous pyelonephritis is an infection caused by gas-forming organisms. It results in a necrotizing infection of the renal and perirenal tissue. This process occurs mostly in patients with diabetes. Glucosuria enhances organism fermentation and carbon dioxide production. Obstruction of the upper urinary tract by calculi or necrotic renal papillae is common in this condition. The mortality rate for this complication is reported to be 43%. *E coli* is the most common pathogen, followed by *Klebsiella* and *Proteus.* Intraparenchymal gas can be seen on imaging studies. This is distinctly different from gas occurring in the collecting system per se, which is not infrequent in pyelonephritis and is associated with a much better prognosis. Of emphysematous pyelonephritis cases, 10% are bilateral. Prompt treatment with antibiotics and nephrectomy or surgical drainage is required. Xanthogranulomatous pyelonephritis is a rare, but severe, renal infection that is clinically difficult to differentiate from renal tumors. It can progress to nonfunction and swelling of the involved kidney, and it is often associated with obstructing calculi. *Proteus* is the most common pathogen, followed by *E coli.* A granulomatous reaction with suppuration results in destruction and swelling of the renal parenchyma. Although no distinguishing characteristics can be observed upon imaging, the diagnosis can be made by examining cytologic specimens; the lipid material collects in macrophages (xanthoma cells). Pus and debris may fill the collecting system, creating the condition known as pyonephrosis. Tuberculosis may involve the prostate, but epididymitis is the most common presentation of male genital tuberculosis. The testis and seminal vesicles may also be involved. A palpable mass is present in most cases. Ironically, although patients may present with infertility, tuberculosis may be spread by semen.

Differential Diagnosis

- Acute Pancreatitis
- Acute Pyelonephritis
- Appendicitis
- Bacterial Pneumonia
- Bacterial Sepsis
- Benign Prostatic Hypertrophy
- Chlamydial Genitourinary Infections
- Chronic Pelvic Pain in Men
- Chronic Pyelonephritis
- Prostatitis, Bacterial
- Tuberculosis of the Genitourinary System
- Urinary Diversions and Neobladders
- Urinary Tract Obstruction
- Vesicoureteral Reflux Imaging
- Xanthogranulomatous Pyelonephritis Imaging

Approach Considerations

The workup of urinary tract infections (UTIs) is dependent on the suspected diagnosis; however, routine studies include urine studies, such as urinalysis, Gram staining, and urine culture. The threshold for establishing true UTI includes finding 2-5 or more white blood cells (WBCs) or 15 bacteria per high-power field (HPF) in a centrifuged urine sediment. As with females, a positive nitrite test is poorly sensitive but highly specific for UTI, and false-positives are uncommon. Proteinuria is commonly observed in UTIs, but the proteinuria is usually low-grade. More than 2g of protein per 24 hours suggests glomerular disease. The older patient who appears toxic, has diabetes, or is immunocompromised may be at risk for emphysematous pyelonephritis; radiographic studies (eg, kidney, ureters, bladder [KUB]) may be necessary to exclude this possibility.

Urine Studies

Urine specimens may be obtained by suprapubic aspiration, catheterization, or midstream clean catch. Most males can perform a midstream clean catch reasonably well, with a reliability approaching that of suprapubic aspiration. Uncircumcised men must retract the prepuce and cleanse the glans before obtaining a specimen. If the patient is unable to cooperate, a catheterized specimen or suprapubic aspiration is necessary. Bacteriuria without pyuria suggests contamination or colonization. Pyuria without bacteriuria suggests nongonococcal urethritis (NGU), genitourinary tuberculosis, stone disease, or malignancy. If a Gram stain of an uncentrifuged clean-catch midstream urine sample reveals the presence of 1 bacterium per oil-immersion field, this represents 10,000 bacteria/mL of urine. A specimen (5mL) that has been centrifuged for 5 minutes at 2000 revolutions per minute (rpm) and examined under high power after Gram staining allows for the identification of bacteria in lower numbers. In general, Gram staining has a sensitivity of 90% and a specificity of 88%. Urine culture remains the criterion standard for the diagnosis of UTI. Collected urine should be immediately sent for culture; if not, it should be refrigerated at 4°C. Two culture techniques (dip slide, agar) are used widely and are accurate. The exact number of bacteria in a urine culture that is needed to define UTI in a man is a bit controversial; generally, positive results are seen if there are more than 1000 colony-forming units (CFU)/mL of urine, much lower than the threshold for women. However, most authors would accept a value of more than 10,000 CFU/mL. Some advocate the

treatment of any pathogens growing in a patient with symptoms of UTI.

Imaging Studies

Imaging and urologic intervention should be considered in the following patients:

- Patients with a history of kidney stones, especially struvite stones, are candidates for urosepsis.
- Patients with diabetes are susceptible to emphysematous pyelonephritis, and they may require immediate nephrectomy; persons with diabetes may also develop obstruction from necrotic renal papillae that are sloughed into the collecting system and obstruct the ureter.
- Patients with polycystic kidneys are prone to abscess formation.
- Patients with tuberculosis are prone to developing ureteral strictures, fungus balls, and stones.

Imaging in the emergency department is typically not necessary unless concomitant obstructive uropathy is suspected, as this is an emergent condition that requires prompt intervention. Modalities for this include ultrasonography, contrasted computed tomography (CT) scanning, or helical CT scanning of the urinary system (currently preferred by most experts).

Plain film imaging

Plain films may localize stone densities, but identification within the urinary tract cannot be confirmed. Uric acid and some struvite stones are radiolucent. Plain films provide no information about the renal parenchyma or function.

Ultrasonography

Measurement of the postvoid residual by bladder scan or ultrasonography should be performed on every patient admitted to the hospital for UTI. Its use may minimize the need for Foley catheter insertion. Renal ultrasonography is a noninvasive study that requires no contrast and provides useful information about the renal parenchyma. This imaging modality can be performed at the bedside in a hemodynamically unstable patient, and it can help to detect hydronephrosis, pyonephrosis, and perirenal abscess. However, the quality of the study depends on the skill of the examiner; the study may be of little benefit in patients who are obese. Ureteral dilatation secondary to UTIs may mimic obstruction. Transrectal ultrasonography is the study of choice to demonstrate a prostate abscess; a CT or magnetic resonance imaging (MRI) scan may also be useful. Virtually all men older than 60 years have some prostatic calculi; however, no correlation exists between chronic prostatitis and the presence or absence of prostatic calculi. Scrotal ultrasonography with Doppler interrogation and radionuclide scans can be helpful in equivocal cases to differentiate the causes of acute scrotum, including epididymitis, torsion of the spermatic chord, and torsion of a testicular appendage. Torsion of the spermatic cord must be assumed until proven otherwise, because necrosis can develop in less than 3 hours. Consultation with a urologist is mandatory in all but the most clear-cut cases of torsion, because the standard is to try to intervene in less than 3 hours.

CT scanning

Noncontrast helical CT scanning is the preferred diagnostic test for obstructive nephrolithiasis. CT scanning with contrast is the imaging study of choice, offering excellent information about the renal parenchyma and the collecting system. It is also a functional study when the excretory phase is included, which demonstrates the site and degree of obstruction very well.

Histologic Findings

In acute bacterial prostatitis, inflammation is observed in part or all of the gland. This is characterized by marked infiltration with neutrophils and diffuse edema. Microabscesses may be present, and these may coalesce into larger collections. The histology of chronic bacterial prostatitis is that of focal, nonacute inflammation; however, this finding is not diagnostic, because it may be observed in men without bacterial infection. Because chronic bacterial prostatitis may be a focal disease, needle biopsies may be unreliable. Occasionally, biopsies reveal a granulomatous prostatitis of unknown cause.

Pyuria Workup

The most accurate method to measure pyuria is counting leukocytes in unspun fresh urine using a hemocytometer chamber; more than 10 WBCs/mL is considered abnormal. Examination for pyuria is a sensitive (80-95%), but nonspecific (50-76%), method of diagnosing UTI. WBC counts determined from a wet mount of centrifuged urine are not reliable measures of pyuria. An uncontaminated specimen is suggested by a lack of squamous epithelial cells. White cell casts in urine specimens may be observed in conditions other than infection, and they may not be observed in all cases of pyelonephritis. If the patient has evidence of acute infection and white cell casts are present, the infection likely represents pyelonephritis. A spun sample (5mL at 2000rpm for 5min) is best used for evaluation of cellular casts. The presence of leukocyte esterase on a dipstick test is a rapid screening for pyuria; it is 57-96% sensitive and 94-98% specific for identifying pyuria. The nitrite test is a rapid screening test for bacteriuria; false-negative test results are seen in low-grade bacteriuria, but false-positive results are rare. A positive nitrite test has 27% sensitivity and 94% specificity for UTI when the cutoff is 100,000 CFU/mL.

Prostatitis Workup

In acute bacterial prostatitis, most patients have pyuria and bacteruria, allowing the infecting organism to be isolated by midstream urine collection. Blood cultures, a complete blood count (CBC), and a basic metabolic panel should be obtained. In chronic bacterial prostatitis, bacteria and leukocytes may or may not be observed in prostate-specific secretions (ie, expressed prostatic secretions [EPS] or a third midstream bladder specimen [VB_3] postprostatic massage). More than 15 leukocytes/HPF is abnormal.

4-Glass test

Although the 4-glass test is the standard for the diagnosis of chronic prostatitis, it is used infrequently. The 4-glass test was described by Meares and Stamey in 1968 to accurately localize bacteria (ie, urethra vs prostate). One should obtain simultaneous cultures of: (1) urethral urine, (ie, first voided bladder specimen VB_1); (2) midstream urine (ie, second midstream bladder specimen VB_2); (3) EPS; and (4) VB_3. The tests should be performed when the patient does not have significant bacteruria, and the specimens must be quantitatively cultured immediately after collection. If bacteruria is present, ampicillin, cephalexin, or nitrofurantoin should be given for 2-3 days to sterilize the urine; these agents are not effective against chronic bacterial prostatitis. If the number of bacteria in EPS ejaculate or VB_3 exceeds that in VB_1 or VB_2 by at least 10-fold, the infection is prostatic in origin.

Premassage/postmassage test

A simpler procedure for the diagnosis of chronic prostatitis was suggested by Nickel. In the premassage and postmassage test, urine is obtained before and after prostate massage. These specimens are sent for culture and sediment microscopy. If bacteria and leukocytosis in the postmassage specimen exceed those in the premassage specimen, category II prostatitis is suggested. Leukocytosis alone indicates category IIIA, whereas no bacteria or leukocytosis indicates category IIIB.

Postvoid residual urine volume measurement

Measurement of the postvoid residual urine volume may be helpful in the older patient for whom prostatism is suspected. Although this measurement is traditionally performed via catheterization, some institutions are now using ultrasonography for this measurement. If the postvoid residual urine volume is elevated, then a urinary catheter must be placed and urologic consultation obtained.

Urodynamic studies

Chronic prostatitis may result in an element of bladder neck obstruction, which may be demonstrated by urodynamic studies and may be corrected with transurethral surgery.

Epididymitis and Orchitis Workup

In epididymitis, a microscopic examination of the urethral secretions is helpful only in cases with very mild symptoms, when torsion is not a consideration. Leukocytes and bacteria on a Gram stain would suggest epididymitis (unless the patient previously had a vasectomy). Torsion of the spermatic cord and torsion of a testicular appendage would be the main differential diagnosis considerations. Spermatic cord torsion is normally diagnosed using ultrasonography, which is very sensitive and specific, or with surgical exploration. The latter does not alter the outcome of epididymitis if the testicle is inadvertently explored to pursue torsion. Of patients with orchitis resulting from tuberculosis, 70% have other genitourinary or pulmonary symptoms of this disease. Testing urine for acid-fast bacilli (AFB), testing using purified-protein derivative (PPD), and performing chest radiography are helpful. Testicular cancer is the most common malignancy in males aged 15-35 years. Although it usually presents as a painless intraparenchymal mass, 10% of cases present after minor trauma. For this reason, any patient felt to have a lesion within the parenchyma of the testicle should be referred for immediate urologic evaluation.

Cystitis Workup

Microscopic hematuria is found in approximately 50% of cystitis cases; when microscopic hematuria is found without symptoms or pyuria, it should prompt a search for malignancy. Other conditions that should be considered include calculi, vasculitis, renal tuberculosis, and glomerulonephritis. In a developing country, hematuria is suggestive of schistosomiasis, which can be associated with salmonellosis and squamous cell malignancies of the bladder.

Urethritis Workup

In younger men, differentiation of UTI from urethritis may necessitate a urethral smear and culture or urinary antigen testing for chlamydia and *N gonorrhoeae.* For urethritis, a urethral swab obtained 1 hour after the last micturition is 95% sensitive and 99% specific for gonorrhea. Inflammatory cells without intracellular gram-negative diplococci suggest nongonococcal urethritis (NGU). A small swab should be carefully inserted approximately 1 inch into the male urethra and rotated about its axis 5 times. The swab then should be withdrawn and immediately streaked onto either chocolate agar or Thayer-Martin/New York City media. The same swab then should be rolled onto a slide, which should then be heat-fixed and stained (ie, Gram stain). Importantly, roll the specimen on only a very limited part of the slide; this will make the microscopic search easier. The same swab then may be sent for chlamydia testing, although many public health facilities do not have the funds to test males for this disease. Chocolate agar is heated blood agar; the heating causes the red blood cells (RBCs) to lyse, releasing their intracellular contents, thereby enhancing the recovery of fastidious organisms such as *N gonorrhea.* This media is perfectly suited for culturing the male urethra, which is normally sterile. Thayer-Martin and New York City agars have antibiotics (including vancomycin) incorporated into them, thereby limiting the growth of competing bacteria that may overgrow the gonococcus. These media are perfect for culturing the female cervix, the pharynx, or the anus. They also can be used for the male urethra, although the vancomycin may actually inhibit the growth of the gonococcus, creating a false-negative culture result. All neisserial growths must be confirmed as gonorrhea with a QUADFERM test (a 2h carbohydrate degradation method for detecting *Neisseria* species); gonorrhea will only change the color in the glucose well.

TREATMENT

Approach Considerations

As a general rule, all urinary tract infections (UTIs) in men are considered complicated. Therefore, the possibility that infection has ascended to the kidneys must be considered, and treatment regimens must assume that infection of the upper urinary tract has occurred. Urine culture results allow adjustment of the treatment plan if antibiotic sensitivity testing demonstrates a resistant organism. In elderly patients, pyelonephritis carries a 3% mortality rate. Take a conservative management approach with these patients. The decision to treat young men who are sexually active for UTI versus sexually transmitted disease (STD) – related urethritis rests primarily on epidemiologic grounds (eg, recent new sexual partner, multiple sexual partners).

Outpatient Versus Inpatient UTI Management

Patients who are well appearing, have stable vital signs, are able to maintain oral hydration and comply with oral therapy, and have no significant comorbid conditions can be treated as outpatients with adequate follow-up arranged in 48-72 hours. If the patient appears toxic, has obstructive uropathy, has stones, is unable to tolerate fluids by mouth, has significant comorbid disease, or otherwise is unable to care for himself at home, inpatient admission is recommended. For example, consider admission for UTI for elderly patients and patients who have diabetes, who are immunocompromised, or who show signs of dehydration, hyperpyrexia, or rigors. Initial inpatient treatment includes intravenous (IV) antimicrobial therapy with a third-generation cephalosporin, such as ceftriaxone; a fluoroquinolone, such as ciprofloxacin; or an aminoglycoside. Antipyretics, analgesics, and adequate IV fluids to restore appropriate circulatory volume and promote adequate urinary flow are also important.

Pharmacotherapy

Administer antimicrobial therapy, initially given intravenously, such as a third-generation cephalosporin, a fluoroquinolone, or an aminoglycoside. In patients with risk factors associated with an unfavorable prognosis, such as old age, debility, renal calculi, recent hospitalization or instrumentation, diabetes, sickle cell anemia, underlying carcinoma, or intercurrent cancer chemotherapy, the antimicrobial coverage should be broadened and an antipseudomonal agent should be added. Adult males with UTI should receive a 10-14 day course of antibiotics. Outpatient regimens include a fluoroquinolone, trimethoprim-sulfamethoxazole (TMP-SMZ), minocycline, or nitrofurantoin (should not be given if glomerular filtration rate < 50). Treat the symptom of dysuria with phenazopyridine. Unfortunately, the prevalence of uropathogens resistant to TMP-SMZ, nitrofurantoin, and first-generation cephalosporins has continued to rise. There are data that suggest overall resistance to TMP-SMZ is approximately 25% (range, 10-45%), based on the area of the country, and resistance to nitrofurantoin is slightly higher. Although studies have indicated that resistance to fluoroquinolones has been acceptably low, more recent microbiologic data suggest that fluoroquinolone resistance, particularly on the West Coast, may be an increasing problem. Despite these

concerns, fluoroquinolones remain the preferred initial drug therapy.

Dietary considerations

Keeping the patient well hydrated is important, especially if an obstruction was recently relieved. Drinking cranberry juice offers little benefit. Although it appears to inhibit *E coli* from adhering to human uroepithelium, the amounts of bacteriostatic hippuric acid that are present are unlikely to be clinically effective. For complicated UTIs associated with struvite calculi, foods and vitamin supplements rich in phosphorus and magnesium are advised. Remember that divalent cations (eg, magnesium) can chelate oral fluoroquinolones, preventing their absorption from the gut.

Activity considerations

Bedrest and avoiding certain activities (eg, bike riding) may be beneficial in patients with prostatitis. For patients with category IIIB (chronic, noninflammatory, abacterial) prostatitis, bedrest for 2 weeks has been advocated. Sitting on ring cushions can be a simple way to minimize symptoms. In urethritis, sexual activity may be resumed when both partners have completed treatment; barrier methods are encouraged. No one knows for certain when sexual activity may be resumed for the other topics discussed in this article.

Overview of Prostatitis Treatment

To eradicate prostatitis, therapeutic drug levels must be achieved within the prostatic acini. Other challenges include prostatic calculi (a nidus for infection), inspissated secretions and microabscesses, and biofilms produced by offending organisms. Bladder outlet obstruction promotes stasis (and thus infection).

Antimicrobial agents

Nitrofurantoin, sulfonamides, vancomycin, penicillins, and cephalosporins do not penetrate well into the prostate. Antibiotics that penetrate well into the acid milieu of the prostate are nonpolar and lipid-soluble and have a high measure of acid strength, a small molecular radius, and low serum protein binding. Drugs that best fit these criteria are the fluoroquinolones, doxycycline, minocycline (particularly effective against methicillin-resistant *Staphylococcus aureus* [MRSA]), trimethoprim (available in the United States only as trimethoprim-sulfamethoxazole [TMP-SMZ]), rifampin, and erythromycin. Of this group, the fluoroquinolones appear to achieve the best tissue levels. Erythromycin is used as a second-line agent when culture results are available.

Nonantimicrobial agents

Many nonantimicrobial agents are available for prostatitis. Narcotics, nonsteroidal anti-inflammatory drugs (NSAIDs), and tricyclic antidepressants (TCAs; eg, amitriptyline) may be needed for pain relief. Hormonal manipulation with a 5-alpha-reductase inhibitor (finasteride) may decrease glandular inflammation; lycopene, prominent in tomato sauces, may also diminish glandular swelling. Diazepam and baclofen may decrease sphincter or perineal muscle spasm. Alpha blockers may minimize ductal reflux and dysfunctional voiding. Because of tadalafil's possible effect in BPH, it may be useful in preventing recurrent UTIs.

Nonpharmaceutical therapy

Nonpharmaceutical approaches may also be used for prostatitis. An example of "what's old is new" is prostate massage. For decades prior to the antibiotic era, prostate massage was the primary therapy for prostatitis. In difficult cases, repetitive prostate massage may be of benefit because of its potential for improving antibiotic penetration and improving drainage of clogged ducts.

Acute and Chronic Prostatitis Therapy

The primary management of prostatitis is medical therapy. In certain circumstances, however, surgical intervention may be required.

Acute bacterial prostatitis

The intensely inflamed prostate allows antimicrobials to easily pass from the plasma. Hospitalized patients with acute bacterial prostatitis can receive various antimicrobials; parenteral ampicillin and gentamicin are often used. In most cases, the fever resolves in 2 days. Once improved, appropriate oral agents include TMP-SMZ or a fluoroquinolone (preferred). Therapy should be continued for a minimum of 4 weeks to prevent chronic bacterial prostatitis from developing. Analgesics and stool softeners may be helpful. If the patient with acute prostatitis has significant urinary obstruction, a Foley catheter can be gently inserted. If this is too uncomfortable, a suprapubic cystotomy may be required. The catheter can usually be removed 1-2 days later.

Chronic bacterial prostatitis

Although chronic bacterial prostatitis is very difficult to cure medically, an attempt should be made to cure this condition with antimicrobial therapy. Long-term results with TMP-SMZ (15-60% cure rate) probably reflect the inability of sulfa drugs to penetrate the noninflamed prostate; the usual regimen is 1 double-strength TMP-SMZ dose twice a day for 3 months. The combination of TMP with rifampin may be useful but needs further study in chronic bacterial prostatitis. Some evidence suggests that 30 days of a fluoroquinolone may be superior to TMP-SMZ. Coverage for *Chlamydia* and *Ureaplasma* should be considered for patients with category IIIA prostatitis (ie, leukocytosis without demonstrable bacteria). If therapy fails, appropriate management of chronic bacterial prostatitis is to either treat acute exacerbations or to try chronic suppressive therapy (using half-normal doses). Antimicrobials are not needed for asymptomatic patients who have evidence of inflammation on biopsy specimens or in secretions (category IV prostatitis); however, antimicrobials should be considered for men who are infertile who have bacteria or inflammation in their semen.

Surgery: Surgery is indicated only for a few specific conditions, including bladder neck obstruction, prostatic calculi (seen in the image below), and recurrent infection with the same bacteria. Transurethral incision of the bladder neck benefits some patients with bladder neck obstruction; however, transurethral balloon dilatation of the prostate is not helpful. A partial transurethral prostatectomy (TURP) removes only part of the infected gland and, therefore, benefits only one third of patients. Radical or total prostatectomy is usually not required or beneficial; complications include incontinence and impotence. Patients for whom a radical TURP or total prostatectomy should be considered are those with either prostatic calculi or those in whom the same bacteria have been consistently isolated from prostatic specimens. A prostate biopsy may confirm that the bacteria are actually originating from the prostate. These are rarely cured by antimicrobials alone; drainage is best achieved by an ultrasonographically guided needle. Other surgical interventions may be needed to remove or address other complications, such as bladder calculi.

Epididymitis Therapy

For epididymitis, antibiotic treatment for patients younger than 35 years should target *Chlamydia* and gonococci. Ceftriaxone (intramuscular [IM] 250 mg) followed by doxycycline (oral [PO] 100 mg twice daily [bid] for 7-10 days) is usually effective. Epididymitis therapy for older men should address enteric gram-negative rods. TMP-SMZ (double-strength, 1 dose PO bid) or a fluoroquinolone can be used; a 30-day course covers concomitant prostatic infection. When risk factors for urosepsis are present, such as fever or urinary retention, the patient should be hospitalized and IV antibiotics should be started. Of cases of acute scrotum, 90% are caused by epididymitis, torsion of the spermatic chord, and torsion of a testicular appendage. Torsion of the spermatic cord must

be assumed until proven otherwise, because unresolved torsion of the cord is likely to result in irreversible necrosis in less than 12 hours. Consultation with a urologist is mandatory in all but the most clear-cut cases for operative salvage of the torsed testicle. The surgical intervention is detorsion and orchidopexy, with orchidopexy of the contralateral side (because this side is predisposed to torsion at a later date).

Pyelonephritis Therapy

Most patients with pyelonephritis should undergo imaging studies to rule out other lesions, and IV antibiotic treatment should be initiated empirically with an aminoglycoside and ampicillin. Third- and fourth-generation cephalosporins, a carbapenem, or aztreonam also provides broad gram-negative rod coverage. Fluid resuscitation is important if the blood pressure is unstable or if the patient is very old. IV antibiotics are usually continued until the patient is afebrile for 24 hours, and then oral therapy is prescribed to complete at least 14 days of treatment; 30 days of treatment are typically necessary, because most cases are due to chronic prostatitis. Urologic consultation should be considered for patients whose condition does not respond rapidly to antibiotics. In one study, fever persisted for 3 days in 13% of hospitalized patients with pyelonephritis, but none had complications; prolonged fever was associated with high baseline creatinine levels, younger age, and a high peripheral white blood cell (WBC) count.

Emphysematous pyelonephritis

Patients with diabetes are prone to develop emphysematous pyelonephritis, which is characterized by gas formation in the urinary tract. It often requires immediate nephrectomy for survival.

Orchitis, Cystitis and Urethritis Therapy

Orchitis

For viral orchitis, supportive therapy with scrotal support, cold compresses, and bedrest is all that is needed. The use of estrogens, gammaglobulin, and steroids has been advocated by some, but these have not been shown to decrease the risk of sterility or shorten the duration of symptoms. Symptoms usually resolve spontaneously in 7-10 days. In cases of mumps orchitis, the patient and his family should be advised that sterility develops in up to 10% of affected individuals. Because no treatment is available for this entity, it is important that the measles-mumps-rubella (MMR) vaccine be administered in childhood and repeated in late adolescence.

Cystitis

For the few men with uncomplicated cystitis, TMP-SMZ can be used in areas where resistant *E coli* number less than 20%; alternatively, a fluoroquinolone can be used. The length of treatment should be 7-10 days.

Urethritis

For urethritis, ceftriaxone (125 mg IM as a single dose) treats penicillinase-producing *N gonorrhoeae.* Treatment for nongonococcal urethritis (NGU) should also be given (doxycycline 100 mg PO bid for 7 days). Sexual partners should also be treated, and patient counseling regarding safe sex is paramount; cases need to be reported to public health departments.

UTI Prevention

Preprocedure prophylaxis, condom use, and appropriate use of urinary catheters can reduce the risk of infections and complications. Unfortunately, instillation of antimicrobial agents into the bladder (unidirectional flow from the bladder to the bag is best), placing antimicrobials in the urine-drainage bag (which breaks the closed-drainage system), use of methenamine, and rigorous meatal cleansing are of little benefit. A guideline from the Infectious Diseases Society of America (IDSA) advises against the routine addition of antimicrobials or antiseptics to the drainage bag of patients who are catheterized in an effort to reduce the risk of catheter-associated bacteriuria or catheter-associated UTI (CAUTI).

Preoperative prophylaxis

Preoperative antibiotics can reduce complications. Procedures of concern include open, transurethral, or laser prostatectomy; transrectal prostate biopsy; cystoscopy in patients with preoperative bacteruria or a preoperative indwelling catheter; and renal transplantation. Before antibiotic coverage, the rate of septicemia from a transrectal biopsy was 5-10%; currently, the rate is less than 0.1%. Fluoroquinolones are the prophylactic drugs of choice for urologic procedures. Post-transurethral prostatectomy (TURP) bacteriuria rates are approximately 10% in patients who receive systemic antibiotics, compared with approximately 35% in those who do not. Single-dose therapy is as effective as longer treatment courses. Unfortunately, neither cefuroxime nor ciprofloxacin has been shown to reduce the rate of bacteriuria (approximately 20%) after lithotripsy. The American Heart Association recommends antimicrobial prophylaxis to prevent bacterial endocarditis in patients with moderate- to high-risk cardiac conditions. High-risk conditions include the presence of prosthetic valves, the previous occurrence of bacterial endocarditis, complex cyanotic congenital heart diseases, and the presence of surgically constructed systemic pulmonic shunts. Moderate-risk conditions include most other congenital heart diseases, hypertrophic cardiac myopathy, and mitral prolapse with regurgitation. For patients with moderate- or high-risk cardiac conditions, urologic procedures that warrant prophylaxis include prostate surgery, cystoscopy, and urethral dilatation; prophylaxis is not recommended for inserting a Foley catheter in a patient with uninfected urine.

Antibiotic regimens

Regimens for high-risk patients include ampicillin (or vancomycin) plus gentamicin. Ampicillin is given as 2000 mg IM or IV within 30 minutes of starting the procedure; 6 hours later, 1000 mg of ampicillin (or amoxicillin PO) is given once. Gentamicin is dosed at 1.5 mg/kg IV or IM (not to exceed 120 mg) and is given only once, with the first dose of ampicillin. For patients allergic to ampicillin, 1000 mg of vancomycin is given IV over 1-2 hours only once; it should be completed within 30 minutes of starting the procedure. For kidney transplant recipients, TMP/SMZ (1 dose PO daily) beginning 2-4 days after surgery and continuing for 4-8 months was found to reduce the incidence rate of UTIs from 38% to 8% (especially after the catheter was removed), cut febrile hospital days and bacterial infections (during and after hospitalization) in half, and reduce graft rejection. Regimens for moderate-risk patients include amoxicillin or vancomycin. Amoxicillin is given only once, in a 2000 mg dose administered orally 1 hour before the procedure. For patients allergic to amoxicillin, 1000 mg of vancomycin is given intravenously over 1-2 hours only once; it should be completed within 30 minutes of starting the procedure.

Prevention of STD-related infections

Condoms are useful in preventing sexually transmitted diseases (STD) such as urethritis; latex condoms help to prevent the transmission of the human immunodeficiency virus (HIV). Remember that these patients are at risk for more than 1 infection (gonorrhea, chlamydia, syphilis, hepatitis B, herpes, *Trichomonas,* HIV). The risk of acquiring HIV from an infected sexual partner is approximately 0.3% on average; the risk is 30-50% for herpes and gonorrhea. If abstaining is not an option, condoms are the best protection.

Prevention of CAUTIs

According to accepted recommendations the guideline for the diagnosis, prevention, and treatment of CAUTI in adults, if an indwelling catheter has been in place for more than 2 weeks at the onset of CAUTI and remains indicated, the catheter should be replaced to promote continued resolution of symptoms and to reduce the risk of subsequent catheter-associated infection. The guideline also states that an indwelling catheter may be considered at the patient's request in exceptional cases and when other approaches to management of incontinence have proven ineffective.

The CDC guideline recommends the following preventive measures:

- Catheters should be used only for appropriate indications.
- Catheters should be kept in place only for as long as needed.
- Indwelling catheters in operative patients should be removed as soon as possible postoperatively.
- Use of urinary catheters for treatment of incontinence should be avoided in patients and nursing home residents.

Appropriate indications for indwelling urethral catheters include the relief of bladder outlet obstruction, treatment of urinary incontinence in a patient with an open sacral wound, and monitoring of urine output; they are also indicated for use during prolonged surgical procedures. The CDC guideline recommends that clinicians avoid the routine use of systemic antimicrobials to prevent CAUTI in patients requiring either short- or long-term catheterization. Polymicrobial bladder infections are not uncommon in catheterized patients, and nonpathogenic organisms can be significant in catheterized patients. According to the CDC guideline, in acute care hospital settings, aseptic technique and sterile equipment for catheter insertion must be used to minimize the risk of CAUTI.

Long-Term Monitoring

If a patient fails to respond to antibiotics, an abscess should be considered. Upper- and lower-tract studies (eg, helical CT scanning, ultrasonography, cystoscopy) are important to consider in older patients at risk for anatomic abnormalities. Follow-up urine cultures are warranted in males with UTIs; however, follow-up urethral cultures are not routinely warranted unless the man is symptomatic, in which case the symptoms are likely to be the result of exogenous reinfection. Consider admission for UTI for elderly patients and patients who have diabetes, who are immunocompromised, or who show signs of toxicity such as dehydration, hyperpyrexia, rigors, or inability to tolerate oral fluids or medications. Also admit if the patient is unable to care for himself.

Antibiotics

Empiric antimicrobial therapy must be comprehensive and should cover all likely pathogens in the context of the clinical setting. Available and most often used antibiotics are: **Ciprofloxacin, Ofloxacin, Norfloxacin, Trimethoprim, Trimethoprim-sulfamethoxazole, Rifampin. Sister compounds/molecules and cephalosporins are also used widely.**

Analgesics, Urinary

Urinary analgesics, such as phenazopyridine, can help to treat the symptoms of dysuria.

THE IDEAL CIRCUMSTANCE IS TO START EMPERICALLY INITIALLY AND LATER AFTER OBTAINING CULTURE AND SENSITIVITY RESULTS TO SHIFT TO SPECIFIC ANTIMICROBIAL AGENT.

INTERPRETATION

URINE CULTURE

Reference Range

Urine specimen - No growth in 24-48 hours

A positive urine culture is based on the growth of bacteria at a high number of colony forming units (CFUs).

Urine culture results should be interpreted in conjunction with clinical symptoms of urinary tract infection (UTI), such as dysuria, urinary frequency, suprapubic pain, flank pain, and fever. For clean-catch urine samples, a positive urine culture as indicated by the growth of bacteria greater than 100,000 CFUs/mL is suggestive of UTI; growth of 1,000-100,000 CFUs/mL may still indicate UTI, especially for a specimen taken at cystoscopy or other invasive procedures.

Reliability of results is determined by the quality of the specimen and specimen collection, transport, and handling to the laboratory.

Growth of 2 or more different bacteria or polymicrobial growth is likely to the result of contamination.

A positive urine culture is further tested to identify the organism and to test its susceptibility to antibiotics, in order to guide with antimicrobial therapy, if

Collection and Panels

Specimen type:

- Random urine specimen – More commonly used
- First-void morning specimen – Used in certain situations (eg, diagnosing urethritis due to *Neisseria gonorrhea* or *Chlamydia trachomatis*)

Specimen container: Sterile plastic containers

Specimen volume: 1 mL

Collection methods:

- Midstream clean catch - Patient voids first portion of urine, then collects urine specimen midstream and discards the latter portion
- Catheterization - Urine collected directly from an indwelling urethral catheter or from intermittent catheterization
- Suprapubic aspiration - Urine collected from needle aspiration through suprapubic abdominal wall into the bladder
- Cystoscopy or other invasive procedures - Sample can also be obtained during this type of procedure

Specimen handling: Urine should be processed within 2 hours of collection. If it cannot be processed in a timely manner, then either (1) refrigerate the specimen at 2-8°C (specimen will be stable for 24 hours) or (2) place the sample in preservative fluid and store at room temperature for up to 24-72 hours; boric acid is the most common preservative fluid used for culture.

Background

Urine in the urinary bladder is normally sterile or can be transiently colonized with small numbers of organisms. The urethra is usually colonized with larger number of organisms. Urinary tract infections (UTIs) occur most commonly thru the ascending route; they can also occur via hematogenous and lymphatic routes. Females are much more commonly predisposed to UTIs than males, mainly because of anatomical differences: females have shorter urethras and their urethras have closer proximity to the vagina and perianal areas. The most common urinary tract pathogens grow rapidly. *Escherichia coli* is the most common UTI pathogen. Most infections are caused by a single bacterial species.

Indications/Applications

Urine culture is used for the diagnosis of UTI, namely cystitis, urethritis and pyelonephritis to identify the pathogen and guide in the antimicrobial therapy.

Considerations

As mentioned, a positive urine culture and the need for treatment should be interpreted in the context of clinical symptoms and signs of UTI. All symptomatic UTIs should be treated. Because of the higher risk of developing a symptomatic UTI, especially pyelonephritis, asymptomatic bacteriuria should be treated in pregnant women and those undergoing invasive urological instrumentation most authorities also treat renal transplant recipients who have asymptomatic bacteriuria. Treatment decisions for asymptomatic bacteriuria in children are based on imaging studies. Recent or concurrent antibiotic therapy can lead to false-negative urine culture results.Urine specimens that have not been processed immediately (eg, left at room temperature for >2 hours) are susceptible to the growth of bacteria, including contaminants, leading to false-positive results. These specimens should be discarded. Urine specimens obtained from catheter bags are also unacceptable.

BOUQUET

In Lighter Vein

Two boys were arguing when the teacher entered the room.
The teacher says, "Why are you arguing?"
One boy answers, "We found a ten dollor bill and decided to give it to whoever tells the biggest lie."
"You should be ashamed of yourselves," said the teacher, "When I was your age I didn't even know what a lie was."
The boys gave the ten dollars to the teacher.

A: I have the perfect son.
B: Does he smoke?
A: No, he doesn't.
B: Does he drink whiskey?
A: No, he doesn't.
B: Does he ever come home late?
A: No, he doesn't.
B: I guess you really do have the perfect son. How old is he?
A: He will be six months old next Wednesday.

Woman: Is there a problem, Officer?
Officer: Ma'am, you were speeding.
Woman: Oh, I see.
Officer: Can I see your license please?
Woman: I'd give it to you but I don't have one.
Officer: Don't have one?
Woman: Lost it 4 times for drunk driving.
Officer: I see…Can I see your vehicle registration papers please.
Woman: I can't do that.
Officer: Why not?
Woman: I stole this car.
Officer: Stole it?
Woman: Yes, and I killed and hacked up the owner.
Officer: You what?
Woman: His body parts are in plastic bags in the trunk if you want to see.
The Officer looks at the woman, slowly backs away to his car, and calls for back up. Within minutes 5 police cars circle the car. A senior officer slowly approaches the car, clasping his half drawn gun.
Officer 2: Ma'am, could you step out of your vehicle please!
The woman steps out of her vehicle.
Woman: Is there a problem sir?
Officer 2: One of my officers told me that you have stolen this car and murdered the owner.
Woman: Murdered the owner?
Officer 2: Yes, could you please open the trunk of your car. The woman opens the trunk, revealing nothing but an empty trunk.
Officer 2: Is this your car, ma'am?
Woman: Yes, here are the registration papers.
The first officer is stunned.
Officer 2: One of my officers claims that you do not have a driving license.
The woman digs into her handbag and pulls out a clutch purse and hands it to the officer. The officer snaps open the clutch purse and examines the license. He looks quite puzzled.
Officer 2: Thank you ma'am, one of my officers told me you didn't have a license, that you stole this car, and that you murdered and hacked up the owner.
Woman: Betcha the lying IDIOT!! told you I was speeding too.

Wisdom Whispers

Brain Teasers

1) **Incorrect sampling time is a type of error.**
   A. Preanalytical B. Analytical
   C. Postanalytical D. None of the above.
2) **Wrong matrix (wrong type of sample), hemolysis, hyperbilirubinemia, lipemia are errors.**
   A. Preanalytical B. Analytical
   C. Postanalytical D. None of the above.
3) **The effect of the extremely complex and variable mixture of proteins, carbohydrates, lipids, and small molecules and salts constituting the sample is known as:**
   A. Hook effect B. Matrix effect
   C. Both of the above D. None of the above.
4) **Complement binds to portion of the antibody.**
   A. Fc B. Fab
   C. Both of the above D. None of the above.
5) **Rheumatoid factors are usually antibodies of the class.**
   A. IgG B. IgA
   C. IgM D. IgE.
6) **Rheumatoid factors are usually directed against the Fc portion of the class antibodies.**
   A. IgG B. IgA
   C. IgM D. IgE.

ANSWERS: 1.A 2.A 3.B. 4.A 5.C 6.A

TROUBLESHOOTING

URINE CULTURE

Test Overview

A urine culture is a test to detects mico-organisms - bacteria in the urine that can cause an infection. Urine in the bladder is normally sterile. This means it does not contain any bacteria or other organisms (such as fungi). But bacteria can enter the urethra and cause a urinary tract infection (UTI). A sample of urine is added to a substance that promotes the growth of germs. If no germs grow, the culture is negative. If germs grow, the culture is positive. The type of germ may be identified using a microscope or chemical tests. Sometimes other tests are done to find the right medicine for treating the infection. This is called sensitivity testing. UTIs are more common in women and girls than in men. This may be partly because the female urethra is shorter and closer to the anus. This allows bacteria from the intestines to come into contact more easily with the urethra. Men also have an antibacterial substance in their prostate gland that lowers their risk.

Why It Is Done

A urine culture may be done to:

- Find the cause of a urinary tract infection (UTI).
- Make decisions about the best treatment for a UTI. This is called sensitivity testing.
- Find out if treatment for a UTI worked.

How To Prepare

You do not need to do anything before you have this test. If you are taking or have recently taken antibiotics, tell your doctor.

You will need to collect a urine sample. Avoid urinating just before having this test. Talk to your doctor if you have any concerns about the need for the test, its risks, how it will be done, or what the results will mean.

How It Is Done

You will be asked to collect a clean-catch midstream urine sample for testing. The first urine of the day is best because bacterial levels will be higher.

Clean-catch midstream urine collection

This method helps protect the urine sample from germs that are normally found on the penis or vagina.

- Wash your hands before you collect the urine.
- If the collection container has a lid, remove it carefully. Set it down with the inner surface up. Do not touch the inside of the cup with your fingers.
- Clean the area around your genitals.
  - For men: Pull back the foreskin, if you have one. Clean the head of the penis thoroughly. Use medicated towelettes or swabs.
  - For women: Spread open the folds of skin around the vagina with one hand. Then use the other hand to clean the area around the vagina and urethra thoroughly. Use medicated towelettes or swabs. Wipe the area from front to back to avoid spreading bacteria from the anus to the urethra.
- Start to urinate into the toilet or urinal. Women should keep holding apart the folds of skin around the vagina while they urinate.
- After the urine has flowed for several seconds, place the collection cup into the stream. Collect about 60 mL (2 fl oz) of this "midstream" urine without stopping the flow.
- Do not touch the rim of the container to your genital area. And don't get toilet paper, pubic hair, stool (feces), menstrual blood, or other foreign matter in the urine sample.
- Finish urinating into the toilet or urinal.
- Carefully replace the lid on the cup. Wash your hands. Return the cup to the lab. If you are collecting the urine at home and can't get it to the lab in an hour, refrigerate it.

How It Feels

Collecting a urine sample is not painful.

Risks

Collecting a urine sample does not cause problems.

Results

A urine culture is a test to find germs (such as bacteria) in the urine that can cause an infection. Urine culture results are usually ready in 1 to 3 days. But some germs take longer to grow in the culture. So results may not be available for several days.

Urine culture

Normal:

No bacteria or other germs (such as fungi) grow in the culture. The culture result is **negative**.

Abnormal:

Organisms (usually bacteria) grow in the culture. The culture result is **positive**. A count of 100,000 or more bacteria per milliliter (mL) of urine may be caused by an infection. A count ranging from 100 to 100,000 could be caused either by infection or by contamination of the sample. You may need to repeat the urine culture. If the count is 100 or less, infection is unlikely. But you may have a count of 100 or less if you are already taking antibiotics. If test results are positive, sensitivity testing may be done to help make decisions about treatment.

What Affects The Test

You may not be able to have the test, or the results may not be helpful, if:

- You take antibiotics or have just finished taking them.
- You take water pills (diuretics) or drink a large amount of liquid. This may dilute your urine and reduce the number of bacteria in the sample.
- You take a lot of vitamin C.

What To Think About

- A urine culture done in the early stage of a urinary tract infection (UTI) may be less accurate than one that is done after the infection becomes established.

- A urine culture may be done when an abnormal result from a urinalysis (such as an increased number of white blood cells) shows signs of an infection. To learn more, see the topic Urine Test.
- A urine culture may be repeated after the UTI has been treated. This is to make sure the infection is cured.
- A health professional may collect a urine sample by placing a urinary catheter into the bladder. This method is sometimes used to collect urine from a person in the hospital who is very ill or who can't provide a clean-catch sample. Using a catheter to collect a urine sample reduces the chance of getting bacteria from the skin or genital area in the urine sample. But catheter use sometimes causes a UTI.
- People who have a urinary catheter in place for a long time are at high risk for getting a UTI.
- Collecting a urine sample from a small child or baby may be done by using a special plastic bag with tape around its opening (a U bag). The bag is attached around the child's genitals until he or she urinates (usually within an hour). Then the bag is carefully removed. To collect a urine sample from a very sick baby, a doctor may insert a needle through the baby's belly directly into the bladder. (This is called a suprapubic tap.)
- To diagnose tuberculosis that has spread to the urinary tract, a special test will be done using all of the first morning urine on 3 separate days.
- Sensitivity testing helps your doctor choose the best medicine to treat specific types of bacteria or fungus that may be causing a UTI.
- Some types of bacteria or fungi may take several weeks to grow in the culture.

MICROPRO™

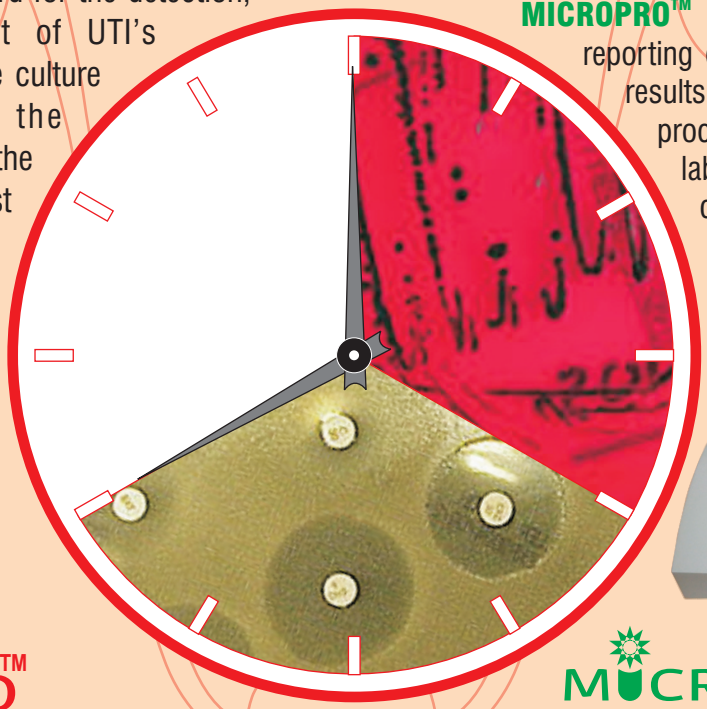
Broth Culture & Antibiotic Sensitivity System

For Urinary Tract Infections

Most of the urinary tract infections in humans are attributed to eight common urinary pathogens, that are responsible for over 97% of the infections and the resultant morbidity. The current globally acknowledged gold standard for the detection, diagnosis and treatment of UTI's remains the standard plate culture method followed by the antibiogram. This delays the aforesaid process by atleast 48 hours.

MICROPRO™ Broth Culture System is a novel system developed by ***Microxpress®*** that detects, enumerates and identifies most urinary pathogens within **4 hours** thereby expediting diagnosis for accurate and effective treatment.

MICROPRO™ - AST system allows reporting of Antibiotic Susceptibility results in **4 hours**. The simple procedure is adaptable by most laboratories and promises to change the way urinary tract infections are detected, diagnosed and treated, forever!



MICROPRO™

Broth Culture System

MICROPRO™-AST

Antibiotic Susceptibility Test

DETECTS, ENUMERATES, IDENTIFIES & ANTIBIOGRAM UTI IN 8 HOURS!

Printed and published by D.G. Tripathi, Edited by Dr. Ramnik Sood, M.D. (Path.) for and on behalf of Tulip Diagnostics Private Ltd., Gitanjali, Tulip Block, Dr. Antonio Do Rego Bagh, Alto Santacruz, Bambolim Complex Post Office, Goa - 403 202, INDIA.
Fax: (0832) 2458544. E-mail: sales@tulipgroup.com Website: www.tulipgroup.com