Urinary tract infections (UTI)

There are three clinical syndromes associated with urinary tract infection (UTI). Lower UTI (frequency dysuria syndrome), Upper UTI (acute bacterial pyelonephritis), Asymptomatic bacteriuria.

Bacteriuria: Bacterial colonization of the urine within this tract
Pyelonephritis: Infection of the upper urinary tract, consisting of the kidney and its pelvis. Infection of the lower tract may involve the bladder **(cystitis),** urethra **(urethritis),** or prostate **(prostatitis).**

EPIDEMIOLOGY

UTI is among the most common of diseases particularly **among women**. Prevalence is age and sex dependent. It is estimated that 20% or more of the female population suffers some form of UTI in their lifetime.
Approximately 1% of children, many of whom demonstrate functional or anatomic abnormalities of the urinary tract, develop infection during the neonatal period.

UTIs are much more common in women than in men for a number of reasons. The urethra is shorter in women than in men, and straight rather than curved as in men, making it easier for microbes to ascend to the bladder. Prostatic secretions have antibacterial properties, which further protects the male.

PATHOGENESIS

The urine produced in the kidney and delivered through the renal pelvis and ureters to the urinary bladder is sterile in health. Infection results when bacteria gain access to this environment and are able to persist.

Access primarily follows an ascending route for bacteria that are resident or transient members of the perineal flora. These organisms are derived from the large intestinal flora, which is uncomfortably nearby.

Conditions that create access are varied, but the most important is sexual intercourse, catheterization. Bacteria may also reach the urinary tract from the bloodstream. This is obviously much less common, because it requires an uncontrolled infection at another site.

For bacteria that reach the urinary tract, the major competing forces are the rich nutrient content of the urine itself and the flushing action of bladder voiding.

Persistence is favored by host factors that interrupt or retard the urinary flow such as instrumentation, obstruction, or structural abnormalities. In youth, factors are congenital malformations, and with age these include changes that alter the mechanics of outflow, such as prostatic hypertrophy.

Bacterial factors include the ability to adhere to the perineal and uroepithelial mucosa and to produce other classical virulence factors like exotoxins. ***Escherichia coli*** is by far the most common and potent UTI pathogen. Urease-producing members of the genus ***Proteus*** are associated with urinary stones, which themselves are predisposing factors for infection.

Bacterial virulence factors include:
. Fimbriae: certain serotypes of E. coli have specific fimbriae (pili) that facilitate colonization and adherence to the periurethral areas, urethra and bladder wall;
. Capsules: some strains of E. coli produce a polysaccharide capsule that inhibits phagocytosis and these are associated with the development of pyelonephritis.

Host factors
Defence mechanisms, which protect against UTI, include:
. hydrodynamic forces: the flow of urine removes microorganisms from the bladder and urethra;
. phagocytosis of microorganisms by polymorphs on the bladder surface;
. the presence of IgA antibody on the bladder wall;
. a mucin layer on the bladder wall prevents bacterial adherence;
. urinary pH.

The following are important host risk factors for UTI:
. Short urethra in females: sexual intercourse facilitates the passage of microorganisms up the urethra.
. Structural and functional abnormalities: causing outflow obstruction (e.g. prostatic enlargement, pregnancy, tumors, neurogenic bladder).

These result in residual urine in the bladder, which can act as a focus for infection.
Reflux of urine from the bladder up the ureter (vesicoureteric reflux) into the kidney can also result from anatomical abnormalities and cause pyelonephritis and renal scarring. Renal stones can also be associated with pyelonephritis;
. Increasing age: post-menopausal increase in vaginal pH and shift of normal vaginal flora to coliforms, bladder prolapse and prostatic disease.

Other host risk factors for UTI include:
. diabetes mellitus;
. immunosuppression (e.g. steroids, cytotoxic drugs);
. instrumentation (e.g. surgery or the use of urinary catheters); bacteria may be introduced into the bladder on catheter insertion, or may migrate up the catheter into the bladder at a later stage.
UTI associated with urinary catheterisation is an important cause of healthcare associated infection.

ETIOLOGIC AGENTS
Over 95% of UTIs are caused by a single bacterial species, and 90% of these are *E. coli*.
Other Enterobacteriaceae, ***Pseudomonas***, and Gram-positive bacteria become increasingly frequent with chronic, complicated, and hospitalized patients. Of the Gram-positive bacteria ***enterococci*** are the most important. ***Staphylococcus saprophyticus***, a coagulase negative staphylococcus, is now recognized as the etiology in a significant minority of symptomatic infections in young, sexually active women.

Sample collection
For non-catheterised patients, a well taken midstream specimen of urine (**MSSU**) should be collected, avoiding perineal contamination, into a sterile universal container.

Samples taken from catheterised patients should be collected directly from the catheter tubing, not from the drainage bag.

Ideally samples should be processed as soon after collection as possible, to prevent bacterial overgrowth. If a delay in processing is unavoidable, samples should be refrigerated at 4ºC.

Laboratory diagnosis
The use of commercial dipstick tests is popular as a point of care test (POCT) for screening for UTI. Infection can be confidently excluded in samples that test negative for both leucocyte-esterase and nitrites on dipstick testing, but positive results should be confirmed by microscopy and culture if clinically indicated.

The mainstay of laboratory diagnosis of UTI is assessment for the presence of:
. white and red blood cells, epithelial cells and casts by microscopy or flow cytometry; and

. bacteriuria by semi-quantitative culture of a freshly collected urine sample.

However, results should always be interpreted in the context of the clinical picture.
Significant bacteriuria is commonly defined as the presence of $\geq 10^5$ bacteria/mL of an MSSU sample.
Bacteriuria between 10^4 and 10^5 microorganisms/ mL should be correlated with clinical symptoms, antibiotic use, and fluid intake to determine whether infection is likely. When bacteriuria of$<10^4$ microorganisms/mL is detected, inpatients who are not receiving antibiotics, infection is unlikely.

White blood cells at a concentration of 10/mL or greater indicates significant pyuria; however, neutropaenic patients may not produce high numbers of cells in urine.

The presence of epithelial cells indicates perineal/ peri-urethral contamination, which may give a false positive culture result.

Sample contamination should also be suspected when culture yields more than two bacterial species. Blood cultures should also be taken, if pyelonephritis or bloodstream infection is suspected.

Antibiotic sensitivity tests are undertaken on bacterial isolates, which are considered to be of potential clinical significance. The results of these tests should be used as a guide to appropriate therapy.

Sexually transmitted diseases

STD caused by:

1. *C.trachomatis*
2. *N. gonorrhoeae*
3. *T. pallidum*
4. *bacterial vaginosis caused by Gardnerella vaginalis (gram variable rod*) and other anaerobes like Bacteroides.

Depending on the pathogen, the disease produced may be local or systemic. For the localized STDs, due to *chlamydia* for example, the most common manifestations are inflammation which may or may not be noticed by the patient. In some cases, deeper structures become involved when the

infection spreads beyond the local site by direct extension. As with other infectious diseases, some of these can gain access to the bloodstream and produce systemic symptoms and spread to other organs. The systemic STDs produce infection beyond the genital site as part of their basic pathogenesis (eg, HIV, hepatitis B, and syphilis); syphilis does and HIV and hepatitis B do not produce a local genital lesion.

GENITAL ULCERS

Single or multiple ulcerative lesions on the genitalia are one of the most common manifestations of STDs. Infection may begin as a papule or pustule and evolve into an ulcer.

AGENT	DISEASE OR SYNDROME
Bacteria	
Neisseria gonorrhoeae	Urethritis, cervicitis, proctitis, pharyngitis, conjunctivitis, endometritis, pelvic inflammatory disease, perihepatitis, bartholinitis, disseminated gonococcal infection
Chlamydia trachomatis	Nongonococcal urethritis, epididymitis, cervicitis, salpingitis, inclusion conjunctivitis, infant pneumonia, trachoma, lymphogranuloma venereum
Ureaplasma urealyticum	Nongonococcal urethritis
Treponema pallidum	Syphilis
Haemophilus ducreyi	Chancroid
Calymmatobacterium granulomatis	Granuloma inguinale