Urinary Tract Infection

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The concern of renal specialists for urinary tract infections (UTIs) had declined with the passage of time. This trend is now being reversed, owing to new imaging techniques and to substantial progress in the understanding of host-parasite relationships, of mechanisms of bacterial uropathogenicity, and of the inflammatory reaction that contributes to renal lesions and scarring.

UTIs account for more than 7 million visits to physicians’ offices and well over 1 million hospital admissions in the United States annually [1]. French epidemiologic studies evaluated its annual incidence at 53,000 diagnoses per million persons per year, which represents 1.05% to 2.10% of the activity of general practitioners. In the United States, the annual number of diagnoses of pyelonephritis in females was estimated to be 250,000 [2].

The incidence of UTI is higher among females, in whom it commonly occurs in an anatomically normal urinary tract. Conversely, in males and children, UTI generally reveals a urinary tract lesion that must be identified by imaging and must be treated to suppress the cause of infection and prevent recurrence. UTI can be restricted to the bladder (essentially in females) with only superficial mucosal involvement, or it can involve a solid organ (the kidneys in both genders, the prostate in males). Clinical signs and symptoms, hazards, imaging, and treatment of various types of UTIs differ. In addition, the patient’s background helps to further categorize UTIs according to age, type of urinary tract lesion(s), and occurrence in immunocompromised patients, especially with diabetes or pregnancy. Such various forms of UTI explain the wide spectrum of treatment modalities, which range from ambulatory, single-dose antibiotic treatment of simple cystitis in young females, to rescue nephrectomy for pyonephrosis in a diabetic with septic shock. This chapter categorizes the various forms of UTI, describes progress in diagnostic imaging and treatment, and discusses recent data on bacteriology and immunology.
Diagnosis

7.2 Tubulointerstitial Disease

FIGURE 7-1
Urine test strips. Normal urine is sterile, but suprapubic aspiration of the bladder, which is by no means a routine procedure, would be the only way of proving it. Urinary tract infection (UTI) cannot be identified simply by the presence of bacteria in a voided specimen, as micturition flushes saprophytic urethral organisms along with the urine. Thus a certain number of colony-forming units of uropathogens are to be expected in the urine sample. Midstream collection is the most common method of urine sampling used in adults. When urine cannot be studied without delay, it must be stored at 4°C until it is sent to the bacteriology laboratory. The urine test strip is the easiest means of diagnosing UTI qualitatively. This test detects leukocytes and nitrites. Simultaneous detection of the two is highly suggestive of UTI. This test is 95% sensitive and 75% specific, and its negative predictive value is close to 96% [3]. The test does not, however, detect such bacteria as Staphylococcus saprophyticus, a strain responsible for some 3% to 7% of UTIs. Thus, treating UTI solely on the basis of test strip risks failure in about 15% of simple community-acquired infections and a much larger proportion of UTIs acquired in a hospital.

FIGURE 7-2
Culture interpretation. Urinalysis must examine bacterial and leukocyte counts (per milliliter). An approximate way of estimating bacterial counts in the urine uses a dip-slide method: a plastic paddle covered on both sides with culture medium is immersed in the urine, shaken, and incubated overnight. The most specific results, however, are provided by laboratory analysis, which allows precise counting of bacteria and leukocytes. Normal values for a midstream specimen are less than or equal to $10^5$ Escherichia coli organisms and $10^4$ leukocytes per milliliter. These classical “Kass criteria,” however, are not always reliable. In some cases of incipient cystitis the number of $E. coli$ per milliliter can be lower, on the order of $10^2$ to $10^4$ [4]. When fecal contamination has been ruled out, growth of bacteria that are not normally urethral saprophytes indicates infection. This is the case for Pseudomonas, Klebsiella, Enterobacter, Serratia, and Moraxella, among others, especially in a hospital setting or after urologic procedures.
### Causes of Aseptic Leukocyturia

- Self-medication before urine culture
- Sample contamination by cleansing solution
- Vaginal discharge
- Urinary stone
- Urinary tract tumor
- Chronic interstitial nephritis (especially due to analgesics)
- Fastidious microorganisms requiring special culture medium (Ureaplasma urealyticum, Chlamydia, Candida)

### Bacteriology

#### A. Main Microbial Strains Responsible for Urinary Tract Infection

<table>
<thead>
<tr>
<th>Microbial Strain</th>
<th>First Episode or Delayed Relapse</th>
<th>Relapse Due to Early Reinfection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Escherichia coli</td>
<td>71%–79%</td>
<td>60%</td>
</tr>
<tr>
<td>Proteus mirabilis</td>
<td>11%-9.7%</td>
<td>15%</td>
</tr>
<tr>
<td>Klebsiella</td>
<td>—</td>
<td>20%</td>
</tr>
<tr>
<td>Enterobacter</td>
<td>1.0%-9.2%</td>
<td>—</td>
</tr>
<tr>
<td>Enterococcus</td>
<td>1.0%-3.2%</td>
<td>—</td>
</tr>
<tr>
<td>Staphylococcus saprophyticus</td>
<td>3%-7%</td>
<td>—</td>
</tr>
<tr>
<td>Other species</td>
<td>2%-6%</td>
<td>5%</td>
</tr>
</tbody>
</table>

#### FIGURE 7-4

- **A** and **B**, Most pathogens responsible for UTI are enterobacteriaceae with a high predominance of Escherichia coli. This is especially true of spontaneous UTI in females (cystitis and pyelonephritis). Other strains are less common, including Proteus mirabilis and more rarely gram-positive microbes. Among the latter, Staphylococcus saprophyticus deserves special mention, as this gram-positive pathogen is responsible for 5% to 15% of such primary infections, is not detected by the leukocyte esterase dipstick, and is resistant to antimicrobial agents that are active on gram-negative rods.

- **C**, Acute simple pyelonephritis is a common form of upper UTI in females and results from the encounter of a parasite and a host. In the absence of urologic abnormality, this renal infection is mostly due to uropathogenic strains of bacteria [5,6], a majority of cases to community-acquired E. coli. The clinical picture consists of fever, chills, renal pain, and a general discomfort. Tissue invasion is associated with a high erythrocyte sedimentation rate and C-reactive protein level well above 2 mg/dL.