Urinary System and Water, Electrolyte, and Acid-Base Balance Newsletter

Roosevelt High School Anatomy & Physiology

Infection Prevention for Recurrent UTIs

Urinary tract infections (UTIs) are the most common bacterial infections and the second most common illness (after colds) among women. About 10-15% of women develop UTIs several times a month. Men get UTIs also, but much less frequently. The female’s shorter urethra allows bacteria to enter the urinary bladder more easily. In addition, the urethral and anal openings are closer in females. Most first-time UTIs are caused by Escherichia coli (E. coli) bacteria that have migrated to the urethra from the anal area. E. coli bacteria are necessary for proper digestion and are welcome in the intestinal tract, but they cause much pain and suffering if they infect the urinary system.

Personal hygiene is the first line of prevention. Care must be taken to avoid transporting bacteria from the anal area to the urethra. Female toddlers should be taught to wipe from front to back and to wash hands thoroughly after using the toilet. When bathing, wash from front to back as well.

Menstrual blood provides an excellent growth medium for bacteria. Sanitary products that are used should be changed often to reduce the frequency of UTIs.

People who are prone to UTIs should drink at least 2 to 2.5 liters of fluid daily. Drinking cranberry and blueberry juice may help to decrease bacterial growth in the urinary bladder. Voiding frequently, every 2 to 3 hours, helps prevent recurrent UTIs because it expels bacteria and eliminates the urine needed for their growth.

Sexual intercourse is frequently associated with the onset of UTIs in women. Women who find that sex bring on UTIs learn to develop and teach their husband stringent personal hygiene. Women should drink plenty of water before and after sex and urinate as soon afterward as possible. This flushes out bacteria that may have entered the urethra.

At times a woman’s husband may be the source of bacterial transmission. When UTIs continue to recur, he should be tested for asymptomatic urethritis, which is the term for any bacterial infection of the urethra other than gonorrhea. Sometimes treating one person with antibiotics cures both persons.

Kidney Stones

A kidney stone is a hard mass, usually composed of calcium oxalate, uric acid, or calcium phosphate crystals. The medical term for a kidney stone is renal calculus. Researchers do not yet know why some people are predisposed to developing kidney stones. About 90% of stones will pass on their own within three to six weeks, so patients are usually advised to try lifestyle changes before going on to medical treatment. Increased fluid intake (3 to 4 quarts of fluid, preferably water, per day), and changes in diet and medications are often sufficient treatments.
Renal Failure

Renal failure is a decrease or cessation of glomerular filtration. In acute renal failure (ARF) the kidneys abruptly stop working entirely (or almost entirely). The main feature of ARF is the suppression of urine flow, leading to oliguria or anuria. Causes include low blood volume (for example, due to hemorrhage), decreased cardiac output, damaged renal tubules, kidney stones, or reactions to the dyes used to visualize blood vessels in angiograms, nonsteroidal anti-inflammatory drugs, and some antibiotic drugs.

Chronic renal failure (CRF) refers to a progressive and usually irreversible decline in glomerular filtration rate (GFR). CRF may result from chronic glomerulonephritis, pyelonephritis, polycystic kidney disease, or traumatic loss of kidney tissue. The final stage of CRF is called end-stage renal failure and occurs when about 90% of the nephrons have been lost. At this stage, GFR diminishes to 10-15% of normal, oliguria is present, and blood levels of nitrogen-containing wastes and creatinine are high. People with end-stage renal failure require dialysis therapy and are possible candidates for a kidney transplant operation.

Oliguria and Anuria

Conditions that greatly reduce blood pressure may cause glomerular blood pressure to fall so low that net filtration pressure drops despite constriction of efferent arterioles. Then, glomerular filtration slows, or even stops entirely. The result is oliguria (scanty urine production), a daily urine output between 50 and 250 mL, or anuria, a daily output of less than 50 mL.

Glucosuria, Polyuria, and Diuretics

When the blood concentration of glucose rises above normal, transporters in the proximal convoluted tubules may not be able to work fast enough to reabsorb all of the filtered glucose. As a result, some glucose remains in the urine, a condition called glucosuria. The most common cause of glucosuria is diabetes mellitus, in which the blood glucose level may rise far above normal because insulin activity is deficient. Because “water follows solutes” as tubular reabsorption takes place, any condition that reduces reabsorption of filtered solutes also increases the amount of water lost in urine. Polyuria, excessive excretion of urine, usually accompanies glucosuria and is a common sign of diabetes.

Diuretics are substances that slow reabsorption of water by the kidneys and thereby cause diuresis, an elevated urine flow rate. Naturally occurring diuretics include caffeine in coffee, tea, and sodas, which inhibits Na⁺ reabsorption, and alcohol in beer, wine, and mixed drinks, which inhibits secretion of antidiuretic hormone (ADH). In a condition known as diabetes insipidus, ADH secretion is inadequate or the ADH receptors are faulty, and a person may excrete up to 20 liters of very dilute urine daily.

Urinary Incontinence

A lack of voluntary control over micturition is termed urinary incontinence. Under about 2 to 3 years of age, urinary incontinence is normal because neurons to the external urethral sphincter muscle are not completely developed. Infants void whenever the urinary bladder is sufficiently distended to trigger the reflex. In stress incontinence, the most common type of urinary incontinence, physical stresses that increase abdominal pressure, such as coughing, sneezing, laughing, exercising, straining, lifting heavy objects, pregnancy, or simply walking, cause leakage of urine from the urinary bladder. Smokers have twice the risk of developing urinary incontinence as nonsmokers.
Polycystic Kidney Disease

Polycystic kidney disease (PKD) is one of the most common inherited disorders. In PKD, the kidney tubules become riddled with hundreds or thousands of cysts (fluid-filled cavities). In addition, inappropriate apoptosis (programmed cell death) of cells in noncystic tubules leads to progressive impairment of renal function and eventually to end-stage renal failure.

People with PKD also may have cysts and apoptosis in the liver, pancreas, spleen, and gonads, increased risk of cerebral aneurysms, heart valve defects, and diverticuli in the colon. Typically, symptoms are not noticed until adulthood, when patients may have back pain, urinary tract infections, blood in the urine, hypertension, and large abdominal masses. Using drugs to restore normal blood pressure, restricting protein and salt in the diet, and controlling urinary tract infections may slow progression to renal failure.

The Aging Kidney

As with other body organs, the kidneys undergo both age-related structural changes and decreasing functional capacity. Adults over 35 years of age gradually lose functional nephron units and kidney weight actually decreases. By approximately 80 to 85 years of age, most individuals will have experienced a 30% reduction in total kidney mass. In spite of a numerical reduction in actual nephron units and a decrease in the metabolic activity of remaining tubular cells, most of these individuals continue to exhibit normal kidney function. This is possible because older persons generally have a lower overall lean body mass and therefore a reduced production of waste products that must be excreted from the body. However, the "margin of safety" is reduced and any stress on the remaining functional nephrons, such as a systemic infection or a reduction in kidney blood flow, can produce almost immediate symptoms of kidney failure. Marginal kidney function in old age may make it difficult to excrete drugs that are easily cleared from the blood of younger persons and dosages of many medications have to be adjusted accordingly for older patients.

Fluid and Electrolyte Imbalances

People who are at risk for fluid and electrolyte imbalances include those who depend on others for fluid and food, such as infants, the elderly, and the hospitalized. Also at risk are individuals undergoing medical treatment that involves intravenous infusions, drainages or suction, and urinary catheters. People who receive diuretics experience excessive fluid losses and require increased fluid intake. Those who experience fluid retention and have fluid restrictions are also at risk. Finally at risk are postoperative individuals, severe burn or trauma cases, individuals with chronic diseases (congestive heart failure, diabetes, chronic obstructive lung disease, and cancer), people in confinement, and individuals with altered levels of consciousness who may be unable to communicate needs or respond to thirst.
Dehydration is a loss of body fluid that amounts to 1% or more of total body weight. It is most common during physical activity at a high temperature but can also occur during strenuous exercise at lower temperature. Fluid deficits of 5% are common in athletic events such as football, soccer, tennis, and long-distance running. Symptoms include irritability, fatigue, and loss of appetite.

With dehydration, water is lost from all body fluid compartments. The decrease in blood volume impairs physical performance because it decreases the amount of blood the heart can pump per beat. Muscles need oxygen to work. As cardiac output is reduced, muscle performance declines. The body tries to maintain blood volume to the muscles by constricting blood vessels in the skin, so less heat is lost and body temperature rises. Intracellular electrolyte changes may also occur.

Thirst is the body’s signal that its water level is getting too low. Unfortunately, thirst is not a reliable indicator of fluid needs. People tend to drink just enough to relieve their parched throats. The thirst mechanism is especially unreliable in children and older adults. Aging decreases the kidneys’ ability to retain water when the body needs fluids, which increases the susceptibility to dehydration.