McCance: Pathophysiology, 6th Edition

Chapter 37: Alterations of Renal and Urinary Tract Function in Children

Key Points – Print

SUMMARY REVIEW

Structure and Function of the Urinary System in Children

1. The Wilms tumor 1 gene and WNT signaling are important for kidney development, growth, and differentiation.
2. The kidney develops from three sets of structures: the pronephros (nonfunctional by the end of the embryonic period), mesonephros (nonfunctional), and metanephros (the functional kidney).
3. All nephrons are present at birth. The number does not increase with maturation, but they do increase in weight and function.
4. Urine formation begins by the third gestational month and contributes to the amniotic fluid.
5. Infants have a narrow chemical safety margin because of high hydrogen ion concentration, limited ability to regulate the internal environment, and lowered osmotic pressure.
6. Any disturbance, such as diarrhea, infection, fasting, or feeding alterations, can lead rapidly to severe acidosis and fluid imbalance in infants.
7. The composition of body fluids differs with age, thus making children more vulnerable to pathophysiologic changes.
8. Because the kidney develops from the medulla to the cortex, blood flow to the medullary nephrons is limited in infancy, and infants thus have limited urine-concentrating capacity.

Alterations in Renal Function in Children

1. Congenital renal disorders affect about 1 out of 500 newborns. These disorders range in severity from minor, easily correctable anomalies to those incompatible with life.
2. Horseshoe kidney is a single U-shaped kidney that develops from fusion of the kidneys as they descend from the midline. The kidney may be asymptomatic or associated with hydronephrosis, stone formation, or infection.
3. Hypospadias is a congenital condition in which the urethral meatus is located on the undersurface of the penis; epispadias is a congenital condition and a mild form of epispadias in which the urethral opening is located on the dorsal surface of the penis.
4. Exstrophy of the bladder is a congenital malformation in which the pubic bones are separated, the lower portion of the abdominal wall and anterior wall of the bladder are missing, and the back wall of the bladder is everted through the opening.

5. Ureteropelvic junction obstruction is blockage where the renal pelvis joins the ureter and is often caused by smooth muscle or urothelial malformation or scarring that leads to hydronephrosis.
6. Bladder outlet obstruction is usually caused by urethral valves or polyps.
7. A dysplastic kidney is the result of abnormal differentiation of renal tissues. The hypoplastic kidney is a very small but otherwise normal kidney.
8. Renal agenesis is the failure of a kidney to grow or develop. The condition may be unilateral or bilateral and may occur as an isolated entity or in association with other disorders.
9. Polycystic kidney disease is an autosomal dominant disorder in which the renal tubule or epithelium proliferates; excessive fluid transport causes cyst formation and obstruction.
10. Glomerulonephritis is an inflammation of the glomeruli secondary to immune mechanisms characterized by hematuria, edema, and hypertension. The cause is unknown but poststreptococcal glomerulonephritis may occur after infection, especially of the upper respiratory tract.
11. IgA nephropathies result from deposition of IgA immunoglobulins and other immune products in the mesangium of the glomerular capillaries. It is the most common type of childhood glomerulonephritis.
12. Henoch-Schönlein nephritis is an IgA nephropathy that affects glomerular blood vessels.
13. Hemolytic uremic syndrome is an acute disorder characterized by hemolytic anemia, acute renal failure, and thrombocytopenia and can be associated with *E. coli* verotoxin.
14. Nephrotic syndrome is a term used to describe a symptom complex characterized by proteinuria, hypoproteinemia, hyperlipidemia, and edema. Metabolic, biochemical, or physiochemical disturbance in the glomerular basement membrane leads to increased permeability to protein. The most common form is minimal change nephropathy.
15. Acute or chronic renal injury is rare in children and the most common cause is prerenal acute renal failure related to dehydration, sepsis, or hemorrhage.
16. Urinary tract infections can result from general sepsis in the newborn but are caused by bacteria ascending the urethra in older children. The bladder alone is infected in cystitis. The infection ascends to the kidney or kidneys in pyelonephritis. Urinary tract anomalies must be surgically corrected to prevent frequent recurrent infections.
17. Vesicoureteral reflux, which refers to the retrograde flow of bladder urine into the ureters, provides mechanisms for bladder infection in children whose ureters are shorter than those of adults. It can be unilateral or bilateral.
19. Wilms tumor is an embryonal tumor of the kidney that usually presents between birth and 5 years of age as an inherited (5% to 10%) or sporadic form. The tumor can be successfully treated by surgery, with a combination of drugs, and, sometimes, radiation therapy.
20. Enuresis refers to the involuntary passage of urine. Enuresis may occur during the day (diurnally) or night (nocturnally). The disorder tends to occur during non-REM sleep and can have a variety of organic and psychologic causes.