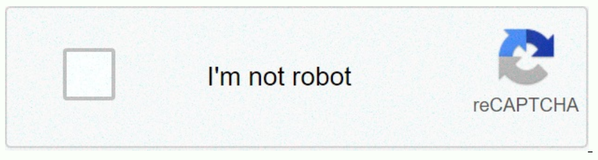

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Blank diagram of the urinary system

Upon completion of this chapter, you must be able to: • discuss the normal anatomical location, function and sonographic aspect of the organs of the urinary system • Discuss the normal physiology of the urinary system • Describe the sonographic scanning technique to image the urinary system • Define and discuss the pathologies discussed in this chapter • Identify and define the sonographic aspect of the pathologies included in this chapter • Discuss the role and limitations of sonography in patients with postrenal transplantation • Description of clinical signs and symptoms of tract problems and laboratory tests used to evaluate them The urinary system has two main functions: the excreating of waste and regulating the composition of blood. The composition of the blood should not be allowed to vary beyond the tolerable limits or the conditions in the tissue necessary for cell life will be lost. The regulation of the composition of the blood involves not only the disposal of harmful waste, but also the preservation of water and metabolites in the body. The urinary system is located posteriorly at the peritoneum lining the abdominal cavity in an area called retroperitoneum. The kidneys are located in the retroperitoneal cavity near the posterior wall of the body, just below the diaphragm (Figure 15-1). The lower ribs protect both kidneys. The right kidney is slightly lower than the left kidney, because the large right lobe of the liver pushes it lower. Kidneys move easily with breathing; On deep inspiration, both kidneys move down about 1 inch. FIGURA 15-1 Relationships of the kidneys, adrenal (adrenal) glands and vascular structures with each other. Kidneys are dark red, bean-shaped organs measuring 9 to 12 cm long, 5 cm wide and 2.5 cm thick. The outer cortex of the kidney is darker than the inner medulla due to increased blood infusion. The inner surface of the medulla is folded into projections called renal pyramids, which empty into the renal pelvis. The arches are located at the base of the pyramids and separate the medulla from the cortex. Numerous collection tubules bring urine from its training sites into the cortex to the pyramids. Kidney tubules, or nephrons, are the functional units of the kidney. On the medial surface of each kidney is a vertical indentation called renal hilum, where the renal vessels and ureter enter and exit. Inside the hilus of the kidney are other vascular structures, a ureter, and lymphatic. The renal artery is posterior and superior to the renal veins. The two branches of the renal vein are anterior to the renal artery (Figure 15-2). The ureter is located slightly below the renal artery. When present, the third branch of the renal artery may be seen to appear from hilus. Lymphatic vessels and sympathetic fibers are also found in the renal hilus. FIGURE 15-2 kidney kidneys to show the internal structure. Three layers of tissue surround and protect the kidneys. The inner layer surrounding the kidney is a fibrous capsule called the true capsule. Outside this fibrous capsule is a covering of perinefearous fat. The perinefearing fascia surrounds the perinefearing fat and encompasses the kidneys and adrenal glands. The perinefearous fascia is a condensation of the areolary tissue that is continuous laterally with the transverse fascia. Renal fascia, known as Gerota's fascia, surrounds the true capsule and the periverged fat. Previously to the right kidney are the right adrenal gland, liver, Morison bag, the second part of the duodenum, and the right colic flexure (Figure 15-3). Previously to the left kidney are the left adrenal gland, spleen, stomach, pancreas, left colic flexure, and jejun coils. FIGURA 15-3 Anatomical structures related to the anterior surfaces of the kidneys. Posterior to the right kidney are diaphragm, costodiaphragmatic niche of pleura, twelfth rib, muscle psoas, quadratus lumborum, and transversus abdominis muscles. Subcostal nerves (T12), iliohypogastric and ilioingguinal (L1) run down and sideways. Posterior to the left kidney are diaphragm, costodiaphragmatic niche of the pleura, eleventh and twelve ribs, muscle psoas, quadratus lumborum, and transversus abdominis muscles. The same nerves are seen near the left kidney as on the right. Inside the kidney, the upper extended end of the ureter, known as the renal pelvis of the ureter, is divided into two or three major chalices, each of which is further divided into two or three minor chalices (see Figure 15-2). The top of a medullary pyramid, called the renal papilla, indents every minor calix. The kidney consists of an internal medullary portion and an external cortical substance. The medullary substance consists of a series of striated conical masses, called renal pyramids. Pyramids range from 8 to 18 in number, and their bases are directed to the outer circumference of the kidney. Their apics converge towards the renal sinus, where their protruding papillae project in the light of minor calyces. Arranged spiral muscles surround the chalices and can exert a milking action on these tubes, helping to flow urine into the renal pelvis. As the pelvis leaves the renal sinus, it quickly becomes smaller and eventually merges with the ureter. Nephrons are located in the renal parenchyma and consist of two main structures — a renal corpuscle and a renal tube. Nephrons filter blood and produce urine. Blood is filtered into the renal corpuscle. The filtered liquid passes through the renal tube. As the filtrate passes through the tube, the substances needed by the body are returned to the blood. Waste, excess water and other substances are necessary to the body pass into the collection pipes in the form of urine. Renale Renale consists of a network of capillaries called glomerulus, which is surrounded by a cup-like structure known as Bowman's capsule. Blood flows into the glomerulus through a small related arterioles and leaves the glomerulus through an efferent arteriole. This arterioles leads the blood to a second set of capillaries, the peritubular capillaries, which surround the renal tube. The filter passes into the renal tube through an opening at the bottom of Bowman's capsule. The first part of the renal tube is the proximal coiled tube. After passing through the complicated proximal tube, the filtrate flows into the loop of Henle and then into the complicated distal tube. Urine from the distal tubules of several nephrons drains into a collection pipe. Part of the distal convoleted tube curves upwards and comes into contact with the related and efferent arterioles. Some cells of the distal tube and some cells of the related arteriola are modified to form the juxtcolomeral apparatus, a structure that helps regulate blood pressure in the kidneys. The renal corpuscle, the alaxiated proximal tube and the distal tube of each nephron are located in the renal cortex. Henle's curls sink into the medulla. The ureter is a 25 cm tubular structure whose proximal end is extended and continuously with the funnel shape of the renal pelvis. The renal pelvis is located in the hilus of the kidney and receives major chalices. The ureter comes out of the hilus of the kidney and runs vertically down behind the parietal peritoneum along the psoas muscle, which separates it from the tips of the transverse processes of the lumbar vertebrae. Enter the pelvis by crossing the bifurcation of the common iliac artery prior to the sacroiliac joint. Ureter courses along the lateral wall of the pelvis to the region of the ischial spine and turns forward to enter the lateral angle of the bladder. The ureter from the ureteropelvic junction to the bladder is not usually viewed on a sonogram. The ureters are located in the retroperitoneal cavity with the upper and distal ends of the ureters easier to visualize than midsection due to the intestinal gas above. Three constrictions occur along the course of the ureter: (1) if the ureter leaves the renal pelvis, (2) if it is bent as it crosses the pelvic edge, and (3) if it pierces the bladder wall. The bladder is a large muscle sac located above and behind the pubic bone. It has a posterior and lateral opening for ureters and an anterior opening for the urethra. The inside of the bladder is lined with very elastic transitional epithelium. When the bladder is full, the lining is smooth and taut; when it is empty, the lining is a series of folds. In the middle layer, a series of smooth muscle layers distend as urine collects and to expel urine through the urethra. Urine is produced almost continuously and accumulates in the bladder until increased pressure stimulates the nerve receptors of the organ to relax the sphincter of the urethra and urine is released from the bladder. The bladder is viewed sonographically when it is distanced with fluid. The urethra is a membrane tube that passes from the anterior part of the bladder to the outside of the body. It includes two sphincters: the internal sphincter and the external sphincter. The urethra is not regularly viewed sonographically. The main renal artery provides blood to the kidney. When a person is at rest, about 1.2 liters of blood per minute is pumped to the kidneys. Kidney arteries are lateral branches of the aorta, which are located only below the upper mesenteric artery (Figure 15-4). The branches of the renal artery can vary in size and number. In most cases, the renal artery is divided into two primary branches: a larger anterior and a smaller posterior. These arteries break down into smaller segmental arteries, then into interlobar arteries, and eventually into smaller arches. FIGURA 15-4 Vascular relations of large vessels and their tributaries to the kidneys. Five to six veins join together to form the main renal vein. This vein comes out of the renal hilus prior to the renal artery. The renal vein drains into the lateral walls of the lower cava vein (see Figure 15-4). The left renal vein heads transversely throughout the body going forward to the aorta and posterior upper mesenteric artery. Lymphatic vessels follow the renal artery to the lateral aortic lymph nodes close to the origin of the renal artery. Nerves originate from the sympathetic renal plexus and are distributed along the branches of the renal vessels. Blood supply to nephrons begins at the renal artery. The artery is subdivided into the kidneys. A small vessel (the related arterioles) enters Bowman's capsule, where it forms a smock of capillaries, glomerulus, which completely fills the concavity of the capsule. Blood leaves glomerulus through the efferent arterioles, which divide into a network of capillaries that surround the proximal and distal tubes and eventually join as veins, which become the renal vein. The renal vein returns the cleaned blood into the general circulation. The movements of substances between the nephron and the capillaries of the tubules alter the composition of the blood filtrate moving along in the tubules. From nephrons, the liquid moves to the collection of tubules and into the ureter, which leads to the bladder, where urine is stored. The arterial supply of the ureter is provided by the following three sources: renal artery, testicular or ovarian artery and upper bladder artery. The urinary system consists of two kidneys, which remove from the blood and produce urine, and two ureters, which act as tubal ducts that lead from the hilus of the kidneys and drain into the bladder. The bladder collects and stores urine, which is eventually discharged through the urethra. The urinary system is located posteriorly at the peritoneum lining the abdominal cavity in an area called retroperitoneum. The function of the kidneys is to excrete urine. More than any other organ, the kidneys regulate the quantities of water and electrolytes leaving the body so that they are equal to the quantities of substances entering the body. Urine formation involves the following three processes: glomerular filtration, tubular reabsorption and tubular secretion. Cells in the body continuously carry out metabolic activities that produce waste. If allowed to accumulate, metabolic waste eventually reaches toxic concentrations and threatens homeostasis. To prevent this, metabolic waste should be excreted quickly. The excretion process involves the separation and elimination of substances harmful to the body. The skin, lungs, liver, large intestine and kidneys perform excretion. The main metabolic wastes are water, carbon dioxide and nitrogen waste, including urea, uric acid and creatinine (Cr). Nitrogen is derived from amino acids and nucleic acids. The amino acids break down in the liver, and the group of amino acids containing nitrogen is removed. The group of amino acids is then converted into ammonia, which is chemically converted into urea. Uric acid is formed from the breakdown of nucleic acids. Both urea and uric acid are transported from the liver to the kidneys by the vascular system. Creatinine is nitrogen waste produced from phosphocreatin into muscles. Clinical symptoms of a patient with specific renal pathology may be nonspecific. Therefore, a patient with symptoms of kidney infection, renal failure or disease may undergo a number of laboratory tests to help the clinician determine the cause of the problem. A patient's history of infection, previous problems of the urinary tract (kidney stones), or hypertension or family history of renal cystic disease is useful information. A patient with a kidney infection or a disease process may have any of the following symptoms: flank pain, hematuria, polyuria, oliguria, fever, emergency, weight loss, or general edema. Urine analysis is essential for the detection of urinary tract disorders in patients whose renal function is impaired or absent. Most renal inflammatory processes introduce a characteristic exudate for a certain type of inflammation in the urine. The presence of an acute infection causes hematuria or red blood cells in the urine; pyuria is pus in the urine. Urine PH is very important in the management of diseases, such as and kidney stones. PH refers to the power of urine as a partially acidic or alkaline solution. Hydrogen abundance in a solution is called pH. If urine contains an increased concentration of hydrogen ions, urine is acidic. The formation of kidney stones depends in part on the pH of urine. Other conditions, such as renal tubular acidosis and chronic renal failure, are associated with alkaline urine. The specific severity is the measurement of the kidney's ability to concentrate urine. The concentration factor depends on the amount of dissolved waste. Excessive fluid consumption or decreased sweating can cause high urine production and a decrease in specific gravity. Low fluid intake, excessive sweating, or diarrhea can cause urine production to be low and the severity specific to increase. Specific severity is particularly low in cases of renal failure, glomerular nephritis and pyelonephritis. These diseases cause renal tubular damage, affecting the ability of the kidneys to concentrate urine. Hematuria is the appearance of blood cells in the urine; may be associated with early kidney disease. An abundance of red blood cells in the urine may suggest kidney trauma, neoplasm, calculus, pyelonephritis or glomerular or vascular inflammatory processes, such as acute glomerulonephritis and renal infarction. Leukocytes may be present whenever inflammation, infection or tissue necrosis originates from anywhere in the urinary tract. Hematocrit is the relative ratio between plasma and the volume of cells packed in the blood. Low haematocrit occurs with acute hemorrhagic processes secondary to the disease or blunt trauma. Hemoglobin is present in the urine whenever extensive damage or destruction of functional erythrocytes occurs. This condition inswells the kidney and can cause acute renal failure. When glomerular damage is evident, albumin and other plasma proteins can be overfiltered, allowing overflow to enter the urine, which decreases the concentration of albumin to the blood serum. Albuminuria is commonly found with benign and malignant neoplasms, calculus, chronic infections and pyelonephritis. Specific measurements of creatinine concentrations in urine and blood serum are considered an accurate index for determining the glomerular filtration rate. Creatinine is a byproduct of muscle energy metabolism; it is normally produced at a constant rate as long as the muscle mass of the body remains relatively constant. Creatinine normally passes through complete glomerular filtration without being reabsorbed by the renal tubules. Decrease in clearance of urinary creatinine indicates renal dysfunction, since the blood values of creatinine are constant and only decrease in renal function prevents normal excretion of creatinine. Blood urea nitrogen (BUN) is the concentration of nitrogen urea in the blood and is the end product of cellular metabolism. Urea is formed in the liver is transported to the kidneys through the blood to be excreted in the urine. Depreciation Impairment the function and increase of protein catabolism leads to the increase of BUN, which is relative to the degree of renal failure and the rate of excretion of urea nitrogen by the kidneys. Renal dysfunction also leads to increased serum creatinine. Serum creatinine levels in the blood are said to be more specific and sensitive in determining renal failure than BUN. Sonographic evaluation of the kidneys is a relatively inexpensive, reproducible non-invasive diagnostic test used to assess renal anatomy and pathology. In patients with renal colic without a history of kidney stones, a non-contrast computed tomography (NCCT) is usually performed. NCCT does not require patient training and is not dependent on the operator or patient. The main disadvantages of NCCT are the cost and use of ionizing radiation. Patients with a history of kidney stones require a simple film X-ray, and a renal sonogram with Doppler is usually the first diagnostic test performed. Magnetic resonance imaging (MRI) using magnetic resonance urography (MRU) is currently being investigated for the diagnosis of renal disease. MRU can evaluate renal function, in addition to diagnosing obstructive uropathy. MRI can evaluate other abdominal organs for the disease. A renal sonogram is able to identify the presence and location of both kidneys, identify congenital renal image abnormalities, determine renal size, present parenchymal details and delineate an abnormal lie of a kidney resulting from an extrarenal mass. In addition, sonography can demonstrate the acoustic properties of a mass or determine whether hydronephrosis is secondary to kidney stones. Sonography can also define collections of perineal fluids, such as a hematoma or an abscess, and detect dilated ureters and hydronephrosis. Kidneys are imaged by sonography as organs with smooth, thin outer contours, surrounded by reflected echoes of perirenal fat. The renal parenchyma surrounds the fatty central renal sinus, which contains the chalices, the infundibule, the pelvis, the vessels and lymphatics (Figure 15-5). Due to the fat interface, the renal sinus is illustrated as an area of intense echoes with variable contours. If two separate collections of renal sinus fat are identified, a double collection system should be suspected. FIGURA 15-5 Cross section of the abdominal cavity through the epiploic foramen. In general, patients are not given anything orally before performing a sonogram or other imaging examination. This state of dehydration causes the infundibula and renal pelvis to be collapsed and thus indistinguishable from the denexisting renal sinus fat. If, on the other hand, the bladder is remote from rehydration, Intranal collection will also become distended. An extrarenal pelvis can be seen as a structure full of medial kidney fluid on transverse scans. The normal variant of obstruction is differentiated by observing the absence of a distended intenus renal pelvis and infundibula. Dilation of the collection system was also observed in pregnant patients. (The right kidney is generally involved with a mild degree of hydronephrosis. This distension returns to normal shortly after delivery.) The patient should be in a supine and/or decubitus position using the liver as a window to image the right kidney (Figures 15-6 and 15-7) or through the spleen for the left kidney (Figure 15-8). Several alternative scanning windows can be used to image the kidneys. These include right rear oblique, right lateral decubitus, and left lateral decubitus views. Having the patient take in a deep breath will move the liver and distal spleen, which can create a better window to enhance the visualization of the kidneys. A subcostal or intercostal approach of the transducer may be used to visualize the upper and lower kidney stakes of the kidneys. FIGURA 15-6 A and B, Transversal scan of the normal upper pole of the right kidney photographed through the homogeneous liver. Scans are performed from the upper pole, from the middle pole to include the right renal vein (RRV), and from the lower cava vein (IVC) to the lower pole. C, Normal blood flow is seen through the right renal vein at IVC. D, A slight decubitus position allows the liver (L) to roll anteriorly to the right kidney (RK) and gallbladder (GB) for better viewing. FIGURA 15-7 Longitudinal scans through the long axis of the right kidney (RK) and the psoas muscle. Measurements shall be made along the maximum length of the right kidney from the upper pole to the lower pole. FIGURA 15-8 A, Longitudinal scan of the normal left kidney, this is illustrated by the homogeneous spleen. The psoas muscle is the posterior medial border of the kidney. B, Measurements shall be made along the maximum length of the kidney from the upper pole to the lower pole. C, The patient can be run in a straight side position decubit for a better view of the pyramids of renal medullary and parenchym. D, Splenomegaly (S) helps visualize the upper pole of the left kidney. The correct adjustment of time gain compensation (TGC) with appropriate sensitivity settings allows a uniform acoustic pattern throughout the image. The amplitude of the renal cortical echo should be compared with the normal amplitude of the hepatic parenchymal echo at the same depth in order to effectively set the TGC and sensitivity. If the patient has a substantial amount of perirenal fat, a high-frequency transducer may not provide the penetration needed to optimally view the area. Deeper areas of the kidney may occur hypoechoic. Kidney detail can also be hidden if the patient has hepatocellular disease, gallstones, costal interference (Figures 15-9 and), or other abnormal collections between the liver and kidneys. Using harmonic contrast enhancement or tissue image enhancement technology (Figure 15-11) can help optimize visualization Kidneys. FIGURA 15-9 Coasts may interfere with uniform visualization of the kidney. Variations in breathing help the sonographer find the best window through which to make his image of the renal parenchyma without costal interference. FIGURA 15-10 A, Longitudinal scanning of interlobary arteries facing renal pyramids and peripheral arches. B, the spectral form of the interlobar arteries. C, the spectral shape of the arched arteries. FIGURA 15-11 A, Transverse view of the right kidney with ascites in Morison's bag. B, Sagittal vision of the normal liver/kidneys using tissue contrast enhancement technology (TCE). (Courtesy of Siemens Medical Solutions USA, Inc.) The parenchyma is the area from the renal sinus to the outer renal surface (Figure 15-12). The arched arteries and interlobar vessels are found inside and are best demonstrated as intense specular echoes in the cross-section or oblique at the corticomedular junction. FIGURA 15-12 The thickness of the renal substance. A, Maxim in the polar regions, medium in the middle area. B, medial plane showing the developing pelvis through the hilum and the minimum anterior and posterior thickness. C, Hypertrophy. D, Normal adult proportions of renal substance. E, senile atrophy. F, Normal appearance in a 2-year-old. The cortex in general is of producing medium level echo (Figure 15-13) (although its echoes are less ecogenic than those of the normal liver), while the medullary pyramids are hypoechoic (Figure 15-14). The two are separated from each other by bands of cortical tissue, called Bertin columns, which extend inward to the renal sinus. FIGURA 15-13 Sagittal scan of the normal kidney. The cortex is the brightest of the echoes in the renal parenchyma. The medullary pyramids are echoless. The pyramids are separated from the cortex by bands of cortical tissue and Bertin's columns that extend inward to the renal sinus. FIGURA 15-14 Longitudinal image of a left neonatal kidney using an 18 MHz white arrow transducer pointing at normal hypoechoic renal pyramids. Kidney parenchyma diseases are those that accentuate cortical echoes, but preserve or exaggerate corticomedular junction (type I) and those that distort normal anatomy, obsitating corticomedular differentiation in a focal or diffuse mode (type II). Criteria for type I changes include the following: (1) The intensity of the echo in the cortex must be equal to or greater than that of the adjacent liver or spleen, and (2) the intensity of the echo in the cortex must be equal to that of the adjacent renal sinus. Minor signs would include loss of identifiable archvessels and emphasis on corticomedular definition. Type II changes can be seen in the focal interruption of normal anatomy with any mass lesion, cysts, tumors, abscesses and hematomas. Arteries are best observed with and left side decubitus views (right side up). The right renal artery extends from the lateral wall of the aorta to enter the central renal sinus (Figure 15-15). On longitudinal scanning, the right renal artery can be seen as a round anechoice structure posterior to the lower vena vein (Figure 15-16). The right renal vein extends from the central renal sinus directly into the lower cava vein (Figure 15-17). Both vessels appear as tubular structures in the transverse plane. FIGURA 15-15 The transverse image of the right renal artery (RRA) as it extends from the posterior lateral wall of the aorta (Ao) to enter the central renal sinus. FIGURA 15-16 When scanning longitudinally of IVC and aorta at renal bifurcation, the right renal artery (RRA) can be seen as a circular structure posterior to the lower vena vein (IVC). FIGURA 15-17 The right renal vein (VVR) extends from the central renal sinus directly into the lower cava vein (IVC). Kidney arteries have a central echo-free lumen with highly ecogenic edges, consisting of a wall of the vessel and around the retroperitoneal fat and connective tissue. They lie posteriorly to the veins and can be demonstrated with certainty if their junction with the aorta is seen. The left renal artery flows from the lateral wall of the aorta to the central renal sinus (Figure 15-18). The left renal vein flows from the central renal sinus, anterior to the aorta and posteriorto the upper mesenteric artery, to join the lower cava vein (Figure 15-19). It is seen as a tubular structure on the cross-scanning. FIGURA 15-18 Left renal artery (arrows) flows from the posterior lateral wall of the aorta (A) to the central renal sinus. FIGURA 15-19 The left renal vein (LRV) flows from the central renal sinus, anterior to the aorta (A) and posterior to the upper mesenteric artery (MSA), to join the lower cava vein. The diaphragmatic crura runs transversely in the para-aortic region. The crura is located posterior to the renal arteries and should be identified by their lack of pulsations and the absence of Doppler flow (Figure 15-20). They vary in ecogenicity, depending on the amount of surrounding retroperitoneal fat. They can occur hypoechoic, as the lymph nodes do. FIGURA 15-20 The crura of the diaphragm lies posteriorly to the renal arteries and should be identified by their lack of pulsations and lack of Doppler flow (arrows). The renal medulla consists of hypoechoic pyramids dispersed in a uniform distribution, separated by intervening parenchym bands that extend to the renal sinus. Pyramids are uniform in size, shape (triangular) and distribution. The top of the pyramid points to the sinus, and the base is adjacent to the renal cortex. The interlobar arteries are located along the pyramids, and the arches are at the base of the pyramids (see figures 15-2 and 15-10). Renal variants small changes in anatomy that may cause the sonograph to suspect an abnormality when it is indeed a normal variation. See Table 15-1 for a description of renal variants and abnormalities. Renal abnormalities and variants Type Location Sonographic aspect Differential considerations Distinctive characteristics Column of Bertin Medulla Renal sinus indentation Renal mass effect Similar to renal parenchyma; contiguous with the cortex Trombodary hump lateral border of the kidney Identical to the renal cortex Mass effect Usually observed on the left kidney Juncture parenchymamal defect Upper pole of the renal parenchyma Ecogenic triangular area Mass effect Best seen on sagittal scans fetal lobulation Area of kidney Indentations between calyces Mass effect Best seen on sagittal scans Lobar dysmorphism Middle and upper calyces Elongation of upper and middle calyces of Bertin Best seen on Column sagittal scans Duplex collection (complete) central renal sinus system Two ecogenic regions separated by moderate ecogenic parenchymal tissue Faceless mass effect; nici un pelvis renal ecogenic văzut pe vedere transversală la nivelul pelvisului renal midpole Bifid (duplicare incompletă) Sinusul renal central Calices mijlociu, două regiuni ecogenice Pseudomass efect Un ureter care intră în vezica urinară pe fiecare parte a vezicii urinare Extrarenal pelvis renal lung care se extinde în afara frontierei renale Regiunea chistică centrală care se extinde dincolo de frontiera renală medială Anevrism renal , dilated proximal ureter The best seen on a transverse view in the middle horseshoe kidney Kidneys seen more medial and anterior spine Fusion of the polar region, usually the lower poles Lower poles are located more medial, associated with pyecolocatesis, abnormal extrarenal pelvis, urinary calculus Bertin's columns are prominent invasions of the cortex located at different depths in the medullary substance of the kidneys. The hypertrophied columns of bertincontain contain renal pyramids and can be difficult to differentiate from an avascular renal neoplasm. Columns are most exaggerated in patients with complete or partial duplication (Figure 15-21). FIGURA 15-21 Longitudinal scan of the kidney with protruding Column of Bertin. The sonographic characteristics of a renal mass effect produced by a hypertrophied column of Bertin include the following: a lateral indentation of the renal sinus, a clear definition of the renal sinus or a maximum size not exceeding 3 cm. Contiguity with the renal cortex is evident, and general ecogenicity is similar to that of the renal parenchyma. A dromedary hump is a lump of cortical tissue on the lateral surface of a kidney (usually left), which resembles the hump of a dromedare camel. It is observed in whose spleen or liver presses down. It's a normal variant, but it can look like a kidney neoplasm. On sonography, sonography, ecogenicity is identical to the rest of the renal cortex, and a renal pseudotumor should be considered (Figure 15-22). FIGURA 15-22 Coronary vision of the left kidney. Dromedary hump is a cortical swelling that appears on the lateral edge of the kidney, usually on the left more than on the right. A junctional parenchymal defect is a triangular, ecogenic area, usually located anteriorly and superiorly. It is the result of partial fusion of two embryonic parenchymal masses called renunciations during normal development (Figure 15-23). FIGURA 15-23 The junctional parenchymal defect (arrows) is a triangular area in the upper pole of the renal parenchyma. Junctional parenchymal defects are best demonstrated on sagittal scans and should not be confused with pathological processes, such as parenchymal renal scarring and angiomiolipom. A lobar dysmorphism is a variant of lobar fusion in which renal lobe malrotation occurs. Middle and upper calyces can be splayed and moved, and the lower calix is deflected posteriorly. The dysmorphic lobe may resemble a prominent Bertin mass or column on a sonogram (Figure 15-24). FIGURA 15-24 A, Longitudinal scanning of lobar dysmorphism. B, transverse view of lobar dysmorphism. Fetal lobularism is a developmental variation that is usually present in children up to 5 years of age and can be persistent in up to 51% of adults. The surfaces of the kidneys are generally indentate between the chalices, giving the kidneys a slightly lobulated appearance (Figure 15-25). FIGURA 15-25 Remaining fetal renal lobules (an irregularly shaped renal border). Sinus lipomatosis is a condition characterized by the deposition of a moderate amount of fat in the renal sinus with parenchymal atrophy (Figure 15-26). In sinus lipomatosis, abundant fibrous tissue can cause the sinus region to expand with increased ecogenicity and regression towards the parenchymal center. Occasionally, a fatty mass is located in a single area; this is called the constituency lipomatosis. FIGURA 15-26 Cross (A) and longitudinal (B) scans of a patient with renal sinus lipomatosis. The normal renal pelvis is a triangular structure. Its axis indicates lower and medial. The intrarenal pelvis is almost completely within the limits of the central renal sinus. This is usually small and preshortened. The extrarenal pelvis tends to be larger with major long calyces. On sonography, the pelvis appears as a central cystic area that may be partially or entirely beyond the limits of the largest renal substance. Cross-sectional views are best for viewing continuity with the renal sinus. The dilated extrarenal pelvis will usually decompress when the patient is placed in the prone position (Figure 15-27). FIGURA 15-27 Extrarenal pelvis. A, Scanning with an extrarenal pelvis that appears as a cystic area that extends beyond the renal borders. B, Color Doppler confirming the extrarenal pelvis. Renal abnormalities include anomalies in number, size, position, structure or shape (figures 15-28 and 15-29) (see Table 15-1). Number abnormalities include agenesis, dysgenesis (defective embryonic development of the kidney) and the supernumerary kidney. The supernumerary kidney is an additional kidney to the usual present number, which is two. In some cases, the separation of the reduplicated organ is incomplete (melted supernumerary kidneys). Bifid means split, or divided into two parts. The Bifid renal pelvis is a common abnormality and is considered a normal variant. The renal pelvis may appear to be more prominent on the sonography. A pseudotumor is an excessive growth of cortical tissue that identifies the ecogenic renal sinus and can be mistaken for a renal tumor on the sonography. FIGURA 15-28 Variations in renal anatomy, position in the retroperitoneal cavity and pathology. A, horseshoe kidneys showed as two kidneys connected by an anterior isthmus to large and lower vessels to the lower mesenteric artery. B, kidney cake with a double collection system. C, pelvic kidney with a kidney in normal retroperitoneal position. D, extrarenal pelvis. E, double collection system in one kidney. F, polycystic kidneys. FIGURA 15-29 Longitudinal view of a malrotated right kidney with anteriorly oriented renal pelvis. Renal agenesis is the absence of the kidney or the failure of the kidney to form; bilateral or unilateral. Bilateral renal agenesis is very rare and is incompatible with life. Unilateral renal agenesis leads to a solitary kidney. Congenital absence of a kidney is rare and is commonly associated with other congenital abnormalities, such as seminal vesical cyst, vaginal agenesis or bicorn uterus. Renal compensatory hypertrophy (enlargement) generally occurs with a solitary kidney (Figure 15-30). FIGURA 15-30 Solitary kidneyenlarged with unilateral renal agenesis. Renal hypoplasia is the incomplete development of the kidney, usually with less than five chalices. Functionally and morphologically, the kidney is normal and should be differentiated from a kidney secondary atrophy of pyelophephrosis or stenosis of the renal artery. Usually, the pyelonephritis kidney is scarred and ecogenic, and the small kidney resulting from renal artery stenosis has abnormal Doppler parameters (tardus and waveform parvus). A common renal abnormality with a duplication of the renal pelvis and a ureter is considered a normal variant. Incomplete or partial duplication is the most common congenital abnormality in the newborn. Duplication consists of two collection systems and two ureters, with a single ureter entering the bladder. The two ureters join together and form a single ureter anywhere between the kidneys and the bladder. complete is the rare state of a duplex duplex System. This anomaly leads to two separate collection systems, each with its own ureter that enters the bladder. In cases of double ureter, the ureter at the upper pole of the kidney usually opens below and medial to the lower pole (Weigert-Meyer rule). The lower calix ureter is inserted into the upper and lateral bladder at the normal location of the vesicoureteral orifice with a short intramural portion. This short intramural portion of the ureter increases the chance of prevesicoureteral reflux. The ureter in the upper pole calix is inserted into the medial and distal bladder at the normal location of the vesicoureteral orifice. Low insertion of the ureter into the bladder causes an ectopic posterior insertion of the urethra with posterior displacement of the vagina, which increases the risk of urethral obstruction through a stricture or ureterocele, vesicoureteral reflux or both. The way to confirm a complete collection system is to demonstrate two ureteral jets entering the bladder on the same side. The rinichiduplex is usually extended with smooth edges. The central renal sinus appears as two ecogenic regions separated by a crack of moderately ecogenic tissue similar in appearance to normal renal parenchyma. In transverse view, the area separating the renal pelvis is called faceless, because the tissue is homogeneous, without the central ecogenic renal pelvis. Hydronephrosis of the upper pole with ureterocele or hydronephrosis of the upper pole and the lower pole chalices may be present (Figures 15-31 and 15-32). FIGURA 15-31 A, kidney Bifid. B, Transverse view of the ecogenic tissue separating the renal sinus (faceless). C, Power Doppler duplex collection system. D, double right ureteral jets confirm a complete duplex collection system. FIGURA 15-32 A, Longitudinal scanning of a duplicate right collection system with severe upper moieciu hydronephrosis. B, right ectopic distal ureter. C, Longitudinal scanning of a right collection system duplicated with moderate hydronephrosis of superior meety. D, ureterocele of the ureter as distal (Weigert-Meyer rule).

E&F, longitudinal scanning of a left collection system with severe upper meety, hydronephrosis, and ectopic ureter. Renal ectopia, or ectopic kidney, describes a kidney that is not located in its usual position, renal fascia. This results when the kidney fails to climb from its origin into the true pelvis or from an upper upper kidney located in the thorax. The pelvic kidney, also called the sacral kidney, is the most common renal ectopia and should not be misdiagnosed as a primary pelvic tumor. It is almost always malrotated; the renal pelvis is previously confronted and is prone to reflux, infection, ureteropelvic obstruction (UPJ) and stone formation (Figure 15-33). Kidney can be bilateral, bilateral, This is very rare. A thoracic kidney migrates through the diaphragm into the thoracic cavity. It is a rare finding and is not easy to diagnose with ultrasound. Other renal ectopia include intraoracic and abdominal kidneys (iliac ridge) kidneys. FIGURA 15-33 Ectopic kidneys found in the pelvis, just the posterior bladder distended. Two types of cross renal ectopia may occur: melted and unfused. Both are associated with malrotation. Melted cross renal ectopia occurs more frequently than non-topyted and most often on the right side. In most cases of cross renal ectopia, ureters are not ectopic. Cystoscopy reveals a normal trigone, and the incidence of associated congenital abnormalities is low. Kidney stones are the most common complications. Sonography shows both kidneys located on the same side, with most demonstrating fusion (Figure 15-34). FIGURA 15-34 A, Cross kidney on the right side of the body. Sonogram (B) and IVP (C) of the left cross-melted kidney. D, kidney cake. Kidney horseshoe is the most common abnormality of renal fusion. The fusion of the lower poles occurs in 96% of cases, the ureters previously passing to the renal parenchyma and the variation of the venous blood supply of the arterial field. The isthmus, or connecting bridge, usually consists of renal parenchymal tissue; rarely is fibrotic tissue. The most common complications associated with horseshoe kidneys are renal malrotation, urolithiasis, UPJ obstruction, and infection. The isthmus of the kidney is located before the spine and can simulate a solid pelvic mass or enlarged lymph nodes (Figure 15-35). FIGURA 15-35 Cross-sectional scanning of the horseshoe kidney with isthmconnecting each pole. Before starting sonographic examination for renal mass assessment, the sonograph should review the patient's chart, including laboratory results and previous diagnostic examinations, which may include a simple abdominal X-ray, computed tomography (CT) or MRI. Whenever possible, these films should be obtained before the sonogram is done, so that the examination can be adapted to address the clinical problem. The sonographer must evaluate the sonographic images to determine the shape and size of the kidney and the location of the mass lesion, to observe the distortion of the renal or ureter structure, and to look for calcium stones or gases in the kidneys. Kidney masses are classified as cystic, solid, or complex by a sonographic evaluation. A sonographic cystic mass displays several characteristic features: (1) smooth, thin, well-defined border; (2) round or oval shape; (3) sharp interface between the cyst and the renal parenchyma; (4) without internal (anechoic) echoes; and (5) increase in posterior acoustic accessory. A solid lesion is projected as ungeometric with irregular edges, a poorly defined interface between mass and kidneys, low internal level a weak posterior border caused by increased mass attenuation and poor transmission. Areas of necrosis, hemorrhage, abscess or calcification within the mass may alter the classification and cause the lesion to fall into the complex category. This means that the mass has characteristics associated with both cystic and solid lesions. Sonography allows the sonograph to carefully evaluate the renal parenchyma at many stages of breathing. If the mass is very small, respiratory movement can cause it to move in and out of the field of vision. Careful evaluation of the best respiratory phase, combined with the use of the cine-loop feature, will allow the sonograph to adequately remember most of the renal masses to determine their characteristic composition. Most renal masses that met the criteria for a simple cystic mass do not require the aspiration of the ace. Bosnian classification of cysts is used to determine the appropriate activity for a cystic mass (Table 15-2). An aspiration of the needle may be recommended to obtain fluid from the lesion to assess its internal composition. Bosnian Cyst Categories, Criteria, and Workup Category Criteria Workup Simple Cyst (I) thin, smooth wall, anechoic, round or oval shaped; increased by transmission No slightly complex cyst (II) Thin septum or calcified wall 2-3 months follow-up with CT or light complex sonogram (IIF) Atypical features; does not fall into category II 6-12 months follow-up Indeterminate lesion (III) Multiple septa, thickened septum, internal echoes Biopsy or partial nephrectomy—increased risk of malignancy Malignant lesion (IV) Solid component, irregular walls Nephrectomy Patient should be placed in a prone position with sandbags or rolled sheets under the abdomen to help push the kidneys towards the posterior abdominal wall and to provide a scan of the flat surface. The sterile technique is used for suction and biopsy procedures. The transducer must be gas sterilized. The sterile lubricant is used to coupling the transducer with the patient's skin. Renal mass should be located in the transverse and longitudinal planes, with mid-inspiration scans. Gently hold the transducer on the scanning surface so that you do not compress the subcutaneous tissue. The depth of the mass should be observed from its posterior to the anterior edges, so that the exact depth can be given to help place the pin. Compression of subcutaneous tissue leads to an incorrect measurement of depth. When the suction area is contoured on the patient's back, the distance is measured from the posterior surface to the middle of the lesion. A bevelled needle causes several echoes inside the walls of the lesion. If the needle is slightly bent, many echoes appear until bent is completely outside the transducer path. The higher the gauge of the pin, the stronger the reflection. The patient's skin is is cu tinctură de benzalconiu (Zephiran) și se aplică draperii sterile. Un agent anestezic local este administrat pe zona de interes, iar traductorul steril este utilizat pentru a muta leziunea. Acul este introdus în miezul central al chistului. Oprirea acului ajută la asigurarea faptului că acul nu trece prin chist. Lichidul este apoi retras conform calculelor volumului. Volumul chistului poate fi determinat prin măsurarea razei masei și folosind următoarea formulă: V = 4/3πr 3 . Diametrul masei poate fi aplicat acestei formule: <SPAN role=presentation tabIndex=0 id=MathJax-Element-1-Frame class=MathJax style=POSITION: relative data-mathml='V = d3/2'>V = d3/2V = d3/2 V = d 3 /2 Ureteral narrowing due to fibrosis is a common form of ureteral stricture. Ureteral strictures may also result from inflammatory disease, tuberculosis, localized periureteral fibrosis, impacted ureteral stone, schistostomiasis, iatrogenic ureteral injury, or radiation therapy. Other causes include amyloidosis, adjacent malignancies, metastases, extrinsic compression due to primary retroperitoneal tumors, enlarged lymph nodes, and medial lower pole renal masses (Box 15-1). Causes of Narrowing of the Ureter Internal causes Fibrosis Inflammatory disease Tuberculosis Localized periureteral fibrosis Impacted ureteral stone Schistosomiasis Iatrogenic ureteral injury Radiation therapy Amyloidosis Extrinsic compression Adjacent malignancies Metastases Primary retroperitoneal tumors Enlarged lymph nodes Medial lower renal pole mass A ureterocele is a cystlike enlargement of the lower end of the ureter (Figure 15-36) caused by congenital or acquired stenosis of the distal end of the ureter. Ureteroceles are usually small and asymptomatic, although they may cause obstruction and infection of the upper urinary system. If large, a ureterocele may cause bladder outlet obstruction. Ureteroceles are found more often in adults than in children and may be unilateral or bilateral. On sonography, a cobra head appearance is seen in sagittal view. FIGURE 15-36 A, Normal right kidney, no hydronephrosis. B, Large right ureterocele protruding into urinary bladder. C, In gray scale the white arrow is pointing to the continuous ureteral jet known as the candle sign. A large ureterocele may fill the urinary bladder and have the same sonographic appearance as diverticula. If the patient can partially empty the bladder, a better diagnostic-quality image will be produced, as the ureterocele will be empty. One of the advantages of ultrasound is dynamic imaging; alternate filling and emptying of the ureterocele as the result of peristalsis may be demonstrated. Calculi may also be present. Ectopic ureteroceles are rare and are found more commonly in children and young adults, especially in females. They usually are associated with complete ureteral role=presentation tabindex=0 class=MathJax style=POSITION: relative data-mathml='V = d3/2'>V = d3/2V = d3/2 V = d 3 /2 Ureteral narrowing due to fibrosis is a common form of ureteral stricture. Ureteral strictures may also result from inflammatory disease, tuberculosis, localized periureteral fibrosis, impacted ureteral stone, schistostomiasis, iatrogenic ureteral injury, or radiation therapy. Other causes include amyloidosis, adjacent malignancies, metastases, extrinsic compression due to primary retroperitoneal tumors, enlarged lymph nodes, and medial lower pole renal masses (Box 15-1). 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The ureterocele sac can obstruct the exit of the bladder or may prolapse through the urethra. An ectopic ureterocele appears on the sonography as a round, thin-walled cystic structure that may contain prominent remnants in the bladder. Ultrasound is not the imaging method of choice to examine the bladder. Cystoscopy is usually used to examine the bladder because of its ability to diagnose early neoplasms. Transabdominal sonography will allow the visualization of most lesions greater than 5 mm. An intravesical transurethral sonographic approach has been used to assess bladder tumors. The bladder should be examined at the same time as the upper urinary tract. A complete revision of the patient's chart, including previous diagnostic imaging procedures, should be performed before the start of the sonographic examination of the bladder. A sonogram of the bladder is obtained with a distant bladder. The patient is in a supine position. A right or left decubitus position can be used to demonstrate the movement of the calculations. Proper adjustment of the TGC allows to minimize the reverberations of the anterior wall and anechoic bladder, with posterior acoustic accessory. The depth of the image should be set to view any structure that can stand posteriorly or caudal to the bladder. A 3.5 MHz transducer is usually used. In very thin patients, a 5 MHz transducer may be used. The transducer should be placed in the middle of the filled bladder and tilted sideways, lower and upper. The walls of the bladder should be smooth and thin (3 to 6 mm). The bladder must be median and must not be deflected on one side or by irregular or asymmetrical indentation. Sonography is used to assess the volume of residual bladder in patients with obstruction of flow. The postvoid bladder is scanned in two planes: anteroposterior and transverse. Measurements are obtained in three planes: anteroposterior, transverse and longitudinal. Images and measurements are obtained at the largest sizes. Because the shape of the bladder varies, any measurement of volume can be used to approximate the volume. A residue of less than 20 ml of urine is considered normal in an adult. Ureteral jets should be identified as Doppler color flashes enters the bladder from the lateral posterior edge of the bladder and cursorizing the upper and medial. An enlarged prostate, enlarged uterus, pelvic mass, or filled loop of the intestine can indent and displace the bladder. Box 15-2 lists under which the bladder cannot completely empty. Only golden members can continue to read. Log in or Register to continue