Ultrasonography in Pediatric Renal Masses

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KEYWORDS

- Ultrasonography • Renal masses
- Color Doppler ultrasonography • Wilms tumor

Ultrasonography is usually the initial modality for imaging for a child with a suspected renal mass. Availability of excellent high-resolution scanners and color Doppler ultrasonography (CDUS) facilities has dramatically changed the diagnostic approach in pediatric patients. Pediatric patients normally have minimal abdominal wall fat and hence ultrasound beam penetration becomes easier. High-frequency curvilinear and linear transducers provide excellent resolution helping to characterize a particular abnormality. The overwhelming attractiveness of pediatric ultrasonography is its real-time imaging ability and its lack of ionizing radiation.

This article reviews the usefulness of ultrasonography and CDUS in evaluating children with a suspected renal mass. At ultrasonography, it is possible to locate the site, size, shape, and extent of the mass. Furthermore, the mass can be differentiated as solid or cystic. CDUS helps in establishing the presence or absence of vascularity in the mass, the relationship with large blood vessels, and the presence of thrombus within the renal vein.

NORMAL SONOGRAPHIC ANATOMY OF THE KIDNEY

Neonatal and infant kidneys have a different appearance from the kidneys of older children (**Fig. 1**). In infants, the echogenicity of renal cortex is increased and usually equal to or slightly greater than that of the adjacent liver or spleen. In older children, the cortex is hypoechoic relative to these structures. This is thought due to the increased relative number and cellularity of the glomeruli, leading to more acoustic interfaces in infants.[1] The medullary pyramids are hypoechoic and prominent in neonates and infants because they have smaller cortical volume as compared with older children. The ratio of cortex to medulla is 1.64:1 in neonates compared with 2.59:1 in adults.[1,2] The echogenicity of the central sinus is slighter in neonates and infants compared with adolescents due to the increase in renal sinus fat as the age advances.[1,2]

NORMAL VARIANTS

It is of particular importance in children to recognize a normal variant to avoid misinterpretation as a renal mass.

Fetal Lobulation and Column of Bertin

The normal kidney is formed from fusion of multiple lobes. These lobulations form an undulating margin along the cortical border, which sometimes persist in postnatal life (**Fig. 2**).[3] The adjacent cortices of contiguous renal lobes fuse to form a thick layer of cortex, termed a column of Bertin. A column of Bertin has echogenicity equal to or slightly higher than the cortex, extending from the interpyramidal region and projecting into the renal sinus.[4] Ultrasonography demonstrates continuity with the renal cortex, and on CDUS and power Doppler, a vascular pattern identical to the normal renal parenchyma is demonstrated (**Fig. 3**).[5]

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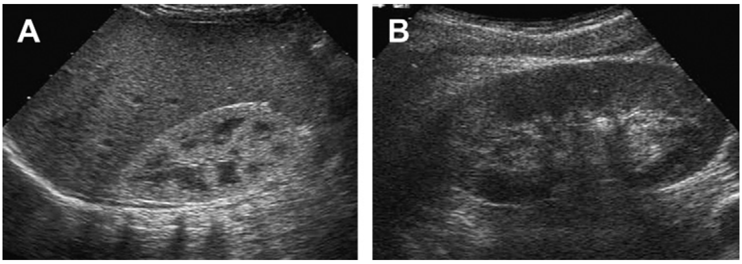

Fig. 1. (*A*) Normal pediatric kidney. The cortex appears hyperechogenic compared with adjacent liver or spleen. The renal pyramids appear more prominent in comparison with normal adult kidney. (*B*) Normal adult kidney for comparison.

Dromedary Hump

A dromedary hump is a bulge in the lateral margin of the midpole of the left kidney due to the extrinsic impression by the spleen on the upper half of the kidney. A dromedary hump has the appearance of normal renal parenchyma and CDUS demonstrates normal vascular architecture (**Fig. 4**).

Junctional Parenchymal Defect

A junctional parenchymal defect appears as a triangular echogenic focus near the junction of the upper and middle thirds of the kidney. A junctional parenchymal defect and inter-renicular septum represent the plane of fusion of renal lobes. The septum is seen as a thin echogenic line connecting the junctional parenchymal defect with the renal sinus (**Fig. 5**).[6,7]

RENAL MASSES

Renal masses are the most common abdominal masses in neonates, infants, and older children. In neonates and infants, most renal masses are usually benign, the most common being hydronephrosis.[8] In older children, malignant masses are more common.

Benign Renal Masses

Congenital hydronephrosis

Congenital hydronephrosis is the most common benign renal mass in neonates and infants. The most common cause is a pelviureteric junction (PUJ) obstruction.[9] The degree of dilatation is dependent on the severity and duration of obstruction. The cause is controversial but is believed due to abnormal development of the ureteral smooth muscle at the PUJ. Extrinsic factors, such as bands, adhesions, or aberrant vessels, have also been implicated. The characteristic ultrasonographic findings include multiple cystic structures of uniform size (dilated calyces) communicating with each other and with a larger cystic structure that represents the renal pelvis (**Fig. 6**). There is renal parenchyma of varying thickness seen around these cystic areas with no visualization of the upper ureter. Chronic severe obstruction can lead to thinning and dysplastic changes in the renal parenchyma. The parenchyma becomes

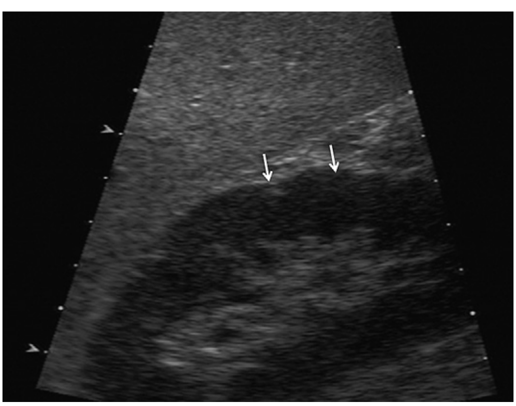

Fig. 2. Fetal lobulations (*arrows*). Persistent lobulated margins of the renal cortex due to fusion of embryonic renunculi.

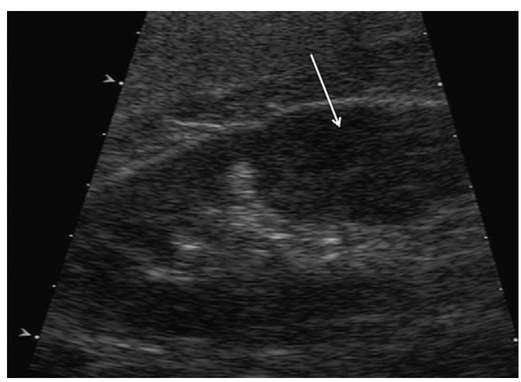

Fig. 3. Column of Bertin (*arrow*). The contiguous renunculi fuse to form a thick band of cortical echogenicity without any cortical bulge, seen to extend from renal sinus up to medulla.