Diagnosis of Vescicoureteric Reflux and Reflux Nephropathy

**FIGURE 8-12**
International system of radiographic grading of vesicoureteral reflux (VUR). The severity of VUR is most frequently classified according to the International Grading System of Vesicoureteric Reflux, using a standardized technique for performance of voiding cystourethrography. The definitions of this system are illustrated in Figure 8-4 and are as follows. In grade I, reflux only into the ureter occurs. In grade II, reflux into the ureter, pelvis, and calyces occurs. No dilation occurs, and the calyceal fornices are normal. In grade III, mild or moderate dilation, tortuosity, or both of the ureter are observed, with mild or moderate dilation of the renal pelvis. No or only slight blunting of the fornices is seen. In grade IV, moderate dilation, tortuosity, or both of the ureter occur, with moderate dilation of the renal pelvis and calyces. Complete obliteration of the sharp angle of the fornices is observed; however, the papillary impressions are maintained in most calyces. In grade V, gross dilation and tortuosity of the ureter occur; gross dilation of the renal pelvis and calyces is seen. The papillary impressions are no longer visible in most calyces [18].

**FIGURE 8-13**
Grading of renal scarring associated with vesicoureteral reflux. Reflux renal parenchymal scarring detected on intravenous pyelography can be classified according to the system adopted by the International Reflux Study Committee consisting of four grades of severity. In grade 1, mild scarring in no more than two locations is seen. More severe and generalized scarring is seen in grade 2 but with normal areas of renal parenchyma between scars. In grade 3, or so-called backpressure type, contraction of the whole kidney occurs and irregular thinning of the renal cortex is superimposed on widespread distortion of the calyceal anatomy, similar to changes seen in obstructive uropathy. Grade 4 is characterized by end-stage renal disease and a shrunken kidney having very little renal function [19].

Parenchymal scarring detected by radionuclide renal scintigraphy is classified similarly: A, In grade 1, no more than two scarred areas are detected. B, In grade 2, more than two affected areas are seen, with some areas of normal parenchyma between them. C, Grade 3 renal scarring is characterized by general damage to the entire kidney, similar to obstructive nephropathy. D, In grade 4, a contracted kidney in end-stage renal failure is seen, with less than 10% of total overall function [14].

**FIGURE 8-14**
Voiding cystourethrogram demonstrating bilateral grade 5 vesicoureteral reflux. Voiding cystourethrography is performed by filling the bladder with radiocontrast material and observing for reflux under fluoroscopy, either during the phase of bladder filling or during micturition. Contrast material is infused through a small urethral catheter under gravity flow.
Radionuclide cystogram demonstrating bilateral vesicoureteral reflux (VUR). This method using 99mtechnetium pertechnetate is useful in detecting VUR. Advantages of radionuclide cystography include lower radiation exposure, less interference with overlying bowel contents and bones, and higher sensitivity in detection of VUR. Radionuclide cystography is useful in follow-up examinations of patients known to have VUR, as a screening test in asymptomatic siblings of children with reflux and girls with urinary tract infections, and in serial examinations of children with neuropathic bladders at risk for developing VUR. Disadvantages of this method include less anatomic detail and inadequacy in evaluating the male urethra, making it unsuitable for screening boys for urinary tract infections [7].

Intravenous pyelogram and, nephrotomogram demonstrating grade 2 reflux nephropathy. Historically, this testing modality has been the one most commonly used to evaluate reflux nephropathy [7]. Irregular renal contour, parenchymal thinning, small renal size, and calyceal blunting all are radiographic signs of reflux nephropathy on intravenous pyelography [17]. Radiographic changes may not be visible immediately after renal infection, because scars may not be fully developed for several years [20]. The advantages of intravenous pyelography in evaluating reflux nephropathy include precision in delineating renal anatomic detail and providing baseline measurements for future follow-up evaluations, renal growth, and scar formation.

Posterior and, anterior views of 99mtechnetium-dimercaptosuccinic acid (DMSA) renal scan showing bilateral grade 2 reflux nephropathy. This nephropathy is characterized by focal areas of decreased radionuclide uptake predominantly affecting the lower renal poles.
Reflux and Obstructive Nephropathy

FIGURE 8-18

Prenatal detection of vesicoureteral reflux (VUR). A, Ultrasonography showing mild fetal hydronephrosis. B, Postnatal voiding cystourethrogram (VCUG) showing grade 4 VUR. C, Graph showing small renal size in the same infant. Vesicoureteral reflux has been identified in neonates in whom prenatal ultrasonography examination reveals hydronephrosis [21–28]. Normal infants do not have VUR, even when born prematurely [29,30]. The severity of reflux often is not predictable on the basis of appearance on ultrasonography [22,31]. Hydronephrosis greater than 4 mm and less than 10 mm in the anteroposterior dimension on ultrasound examination after 20 weeks' gestational age has been termed mild fetal hydronephrosis. Mild fetal hydronephrosis is associated with VUR in a significant percentage of infants [26,31]. Despite the absence of a previous urinary tract infection, many kidneys affected prenatally exhibit decreased function [22,24,32,33]. Unlike the focal parenchymal scars seen in infection-associated reflux nephropathy, the parenchymal abnormalities seen in prenatal VUR are most commonly manifested by a generalized decrease in renal size (reflux nephropathy grade 3 or 4) [34,35].