Information for Parents about Hydronephrosis

Hydronephrosis is a term used to describe a kidney with more than a usual amount of urine inside. In the normal urinary tract, two kidneys filter the blood to produce urine which drains through a funnel system within the kidney called the renal (kidney) calyces and pelvis. Urine then travels from the kidney pelvis through the ureter (a muscular conduit) to the urinary bladder. A one-way flap valve at the bottom of the ureter (ureterovesical junction) allows urine to pass into the bladder freely, but prevents any urine from going backwards up the ureter to the kidney (vesicoureteral reflux). The bladder stores urine until it is eliminated through the urethra outside the body with periodic voiding.

How is hydronephrosis identified?
Renal ultrasonography is the diagnostic test that most frequently identifies hydronephrosis. Although ultrasonography is only useful for demonstrating anatomy, some estimation of renal function can often be made by noticing the quality of the renal parenchyma (solid portion of the kidney). Markedly thinned, hyperechoic (dense) or cystic renal parenchyma hints that the function of that kidney may be impaired. Hydronephrosis can also be clearly identified on CT (computed-tomography) and MR (magnetic resonance) imaging.

Prenatal Detection
Frequently, hydronephrosis is initially identified on prenatal ultrasonography (as early as 20 weeks gestation), and then monitored by a perinatologist with periodic ultrasonography for the remainder of the pregnancy. Approximately 1% of prenatal ultrasound evaluations demonstrate some abnormality present, and roughly half of

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these abnormalities involve the urinary tract. Radiographic evaluation after delivery includes a renal ultrasound to determine the severity of hydronephrosis present, and a VCUG (voiding cystourethrogram) to assess for vesicoureteral reflux. Anatomic obstruction (UPJ-obstruction or UVJ-obstruction) and vesicoureteral reflux are detected in about 60% of infants with significant prenatal hydronephrosis (30% each), with the remaining 40% of infants demonstrating physiologic (normal) urinary tract distension without obstruction or vesicoureteral reflux.

**Evaluation after urinary infection or hematuria (blood in urine)**
Radiographic evaluation by renal ultrasound and VCUG is also indicated after urinary infection or episodes of visible hematuria. Hydronephrosis due to urinary obstruction, vesicoureteral reflux and urinary calculus (stone) is commonly detected, but these tests also contribute valuable information regarding the size and position of the kidneys, distension of the ureters, thickness of the bladder wall, caliber of the urethra and distension of the colon and rectum.

**What causes hydronephrosis?**
Hydronephrosis is present when the renal pelvis and calyces are enlarged. Hydroureter indicates significant dilatation of the entire ureter. Causes include:

**Males and Females:**
- Ureteropelvic-junction (UPJ) obstruction (hydronephrosis)
- Ureterovesical junction (UVJ) obstruction (hydroureteronephrosis)
- Ureterocele: a form of UVJ-obstruction (hydroureteronephrosis)
- Vesicoureteral reflux (hydronephrosis or hydroureteronephrosis)
- Physiologic dilatation (hydronephrosis or hydroureteronephrosis)
- Multicystic-dysplastic kidney (nonfunctional kidney with multiple cysts)

**Males only:**
- Posterior urethral valves (bilateral severe hydroureteronephrosis with renal insufficiency and bladder wall thickening with poor compliance)

All of these conditions occur more commonly when **ureteral duplication** (double ureter for one or both kidneys) is present. In some cases, combinations of conditions can occur (ureteral duplication with upper-pole ureterocele and high-grade lower-pole vesicoureteral reflux). Vesicoureteral reflux, ureteral duplication and UPJ-obstruction can be hereditary in up to 30% of infants. **Antibiotic prophylaxis** is generally recommended until surveillance voiding cystourethrography (VCUG) is completed, and may then be continued if vesicoureteral reflux or UVJ-obstruction are present.

**UPJ-obstruction** results from a kink or curl at the uppermost portion of the ureter, and occurs approximately ten times more frequently than UVJ-obstruction. Both forms of obstruction cause hydronephrosis, but UVJ obstruction also leads to significant distension of the entire ureter (hydroureter). **UVJ-obstruction** (obstructed megaureter) typically results when the muscular bundles at the lowest few millimeters of ureter develop in a circular and stenotic (narrowed) fashion, but such an obstructed megaureter can also develop when **ureterocele** (a cystic dilatation of the distal portion of the ureter) is present. UVJ-obstruction can present as a low-grade partial obstruction with slowly progressive dilatation of the ureter, or

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as a high-grade severe obstruction with massive distension of the ureter. Surgical repair of these conditions may be required for definitive management, but surgery is rarely necessary in the newborn period.

**Vesicoureteral reflux** results when a short and inadequate ureteral tunnel through the bladder wall allows urine to pass back through the flap-valve mechanism of the ureterovesical junction into the ureter and up into the kidney. This inefficient clearance of urine promotes distension of the kidney and ureter, and also significantly increases the risk for urinary infection and pyelonephritis (severe kidney infection that can result in renal scarring, hypertension and proteinuria). Urinary infections associated with vesicoureteral reflux are especially hazardous during the neonatal period when immune defense are developing, and when kidneys are growing rapidly. **VCUG** is a radiographic test (requiring a urinary catheter) that is designed to detect vesicoureteral reflux during bladder filling and during spontaneous voiding of urine.

**Physiologic hydronephrosis** indicates that neither obstruction nor vesicoureteral reflux is present. This may result from residual renal and ureteral distension present from transient obstruction during development, that has since fully resolved. Pressure from a full bladder or from fecal distension of the colon and rectum can be transmitted to the kidney causing variable degrees of hydronephrosis on sequential ultrasonography examinations.

Another form of hydronephrosis is produced when the kidney and ureter do not form a proper connection during fetal development. This results in a **nonfunctional** (produces no useful urine) combination of large and small (sometimes microscopic) cysts called a **multicystic-dysplastic kidney (MCDK)**. The majority of these MCDK tend to slowly disappear over the first 12 months of life as these thin-walled cysts deflate. The **hydronephrotic variant of MCDK**, however, has much thicker cyst walls and tends to persist and may even increase in size with growth of the child. These hydronephrotic MCDK are most often removed surgically (laparoscopic nephrectomy) in order to avoid the attendant risk of hypertension and neoplasm.

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Multicystic-dysplastic kidney
variable obstruction at the prostate level
**Posterior urethral valves** occurs only in boys. Small flaps of tissue that normally disappear during development can persist and can cause urethral obstruction below the level of the prostate. These flaps form a transparent obstruction that can range from mild to severe, preventing efficient voiding of urine and effective bladder emptying. The bladder muscle then becomes thicker and more muscular as it is forced to work harder to empty the urine from the bladder. Eventually, this can cause urine to back up to the kidneys and can cause hydronephrosis in one or both kidneys.

**What testing is necessary for fetal hydronephrosis?**
Sequential ultrasonography is helpful in monitoring both the degree of hydronephrosis present in one or both kidneys, and the amount of amniotic fluid present (amniotic fluid index or AFI). **Even if both kidneys become enlarged and hydronephrotic, treatment or early delivery of the fetus should not be necessary if the AFI remains normal.**

**What can I expect after my baby’s birth?**
After your baby is born, a renal and bladder **ultrasound** should be completed while your baby is still in the hospital. Since 20% of postnatal ultrasound examinations are different from the prenatal ultrasound result, it may be necessary to repeat the ultrasound several days or weeks after the first one. Most often, the **VCUG** can also be completed while you and your baby are still in the hospital. If vesicoureteral reflux or UVJ-obstruction (obstructed megaureter) is detected, then prophylaxis with a low-dose of antibiotic (amoxicillin) is appropriate to prevent neonatal sepsis (severe infection). Breast feeding and circumcision also lower this risk.

A **nuclear medicine renal scan (renogram)** may be important to determine the differential function of each kidney and to assess for anatomic obstruction. This test requires an intravenous (iv) line to administer a radionuclide that is carried by the blood to the kidneys, which can then be imaged on a gamma camera. Good hydration, good iv access, limited movement and more mature renal function are important in order for this test to be interpreted properly. If necessary, a nuclear renogram is generally scheduled four weeks after birth.

Decisions regarding the need for surgical intervention or simply ongoing ultrasound surveillance can be made once the initial testing has been completed. Although a diagnosis of hydronephrosis can provoke apprehension, an accurate assessment of the anatomy and function of the urinary tract allows an effective treatment plan tailored to your child’s specific condition. **Early detection allows timely correction of problems to best preserve overall urinary tract function.**

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