Information for Parents About Vesicoureteral Reflux

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. This backward flow of urine is called **vesicoureteral reflux (VUR)**. Urine is pushed through the ureterovesical junction at intervals by muscular contraction of the ureter (peristalsis). Each ureter enters the bladder at an angle that creates a tunnel through the bladder wall muscle. Pressure on the side of this tunnel from urine within the bladder lumen collapses the tunnel during bladder filling and emptying, effectively preventing backflow. The bladder stores urine until it is eliminated through the **urethra** outside the body with periodic voiding.

![Normal urinary tract anatomy](image1)

![Vesicoureteral reflux with Hydroureter](image2)

VUR itself cannot be felt and rarely causes symptoms, but can promote pyelonephritis (kidney infection) and renal scarring by rapidly transporting bacteria to the most susceptible parts of the kidney during urinary infection. In rare cases, renal damage can lead to hypertension and renal insufficiency requiring kidney transplantation for management. High-grade VUR and recurrent urinary infection can also cause significant damage to the bladder, resulting in a thickened and inelastic bladder that generates higher storage pressures and that empties inefficiently. **Prevention of pyelonephritis, kidney and bladder damage is of paramount importance.**

VUR can only be reliably detected by filling the bladder with some form of contrast material and then monitoring the ureters and kidney to identify backward flow of the contrast material during bladder filling and spontaneous voiding. Typically an x-ray contrast study (voiding cystourethrogram or **VCUG**) is recommended because it affords accurate imaging of the bladder and ureters, as well as indicating the degree of bowel fullness and bladder compression present. Alternatively, a **nuclear**

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cystogram can be completed if only surveillance for higher grade VUR is necessary. VUR presents in varying degrees of severity ranging from Grade I (mild filling of ureter only) to Grade V (massive distension of kidney and ureter), and may be present in only one or both ureters. **Although the grade of VUR is used most commonly to describe the significance of the VUR present, the timing of contrast appearance within the ureter and the volume of contrast material transmitted to the kidney are actually the most important details to notice when considering management options.** Surveillance renal ultrasound imaging is useful in monitoring kidney anatomy and identifying appropriate interval renal growth over time. DMSA nuclear renography is useful to assess for renal scarring and to determine differential renal function present (functional health of the kidneys).

VUR is more commonly detected in girls than boys (2:1 ratio) at most ages except during the neonatal period. Imaging of the urinary tract by VCUG is typically performed for evaluation of prenatal hydronephrosis (kidney dilation noted on ultrasonography during pregnancy) or after treatment of urinary infection. Although **VUR occurs in only 1% of the general population**, VUR is detected in approximately **30% of infants with prenatal hydronephrosis**, and is detected in more than **40% of children following febrile urinary infection**. VUR is also detected (on VCUG imaging) in younger siblings of children with VUR in 30%, and in children of mothers with VUR in 50%.

**Treatment recommendations** vary depending on the age of your child, the grade of VUR present and the frequency of febrile urinary infection. Spontaneous resolution of low-grade VUR can often occur in infants and young children (estimated resolution rate approximately 10% per year) as the base of the bladder (trigone) grows and effectively elongates the ureteral tunnel. This is especially evident in the first two years of life due to maturation of bladder function and toilet-training. Persistent VUR present in older children, (especially after four or more years of radiographic surveillance) is much less likely to resolve spontaneously, suggesting only limited potential for additional incremental growth of the ureteral tunnel.

**Breakthrough urinary infection** (occurring while treated with prophylactic antibiotic therapy) and **persistence of VUR or progression of the grade of VUR** on surveillance VCUG are indications for surgery. Surgical treatment is designed to either functionally ([Deflux®](#)) or anatomically (ureteral reimplantation) elongate the refluxing ureteral tunnel to correct VUR.

**Low-grade Vesicoureteral Reflux:** Usually a child with Grade I - III reflux will be treated nonoperatively after the diagnosis is made. Low dose prophylactic antibiotic therapy is recommended for several months as part of a comprehensive program to help lower the risk for recurrent urinary infection. Other helpful measures include,
use of a powdered fiber supplement (Benefiber or Miralax) to improve efficiency of bowel evacuation and to lower pelvic and bladder storage pressures, and use of Cranberry or Blueberry products or probiotics (live microorganisms which when administered in adequate amounts confer a benefit on the host) to promote healthy colonic bacteria. Surveillance radiology studies (renal ultrasound and VCUG) are generally completed within a year after diagnosis.

Urine cultures should be obtained to detect infection during a febrile illness, especially if there is no obvious source. Symptoms of lower abdominal discomfort, urinary urgency, frequency and burning (dysuria) typically suggest urinary infection, however, these symptoms can also occur with a negative urine culture when significant constipation is present. Foul-smelling urine suggests urinary infection, but may also be associated with vaginal pooling of colonized urine in girls with a dysfunctional elimination pattern. For that reason, a catheterized urine culture may be critical for accurate identification of urinary infection. High fever (> 101F), vomiting and flank pain are highly suggestive of a severe urinary infection (pyelonephritis).

**High-grade Vesicoureteral Reflux:** When VUR is identified as grade IV or V, a higher volume of urine reflexes into the kidney and ureter earlier during bladder filling, and indicates an extremely short ureteral tunnel. This portends a much greater risk for recurrent pyelonephritis and renal damage. Spontaneous improvement or resolution of high-grade VUR is quite possible during the first year of life, but becomes increasingly unlikely thereafter. Prophylactic antibiotic therapy and adjunctive treatments to limit the risk for urinary infection are clearly important, but surgical treatment will likely be required if high-grade VUR is persistently present on surveillance VCUG imaging.

**Surgical Options**

Ureteral reimplantation (ureteroneocystostomy) allows anatomical elongation of the ureteral tunnel to correct VUR. A small (4-5 cm) transverse lower abdominal incision is created at the level of the lowest inguinal crease, and then the abdominal muscles are separated in the midline exposing the bladder. The ureter is then surgically moved in relation to the bladder muscle to create a longer tunnel and an effective flap valve mechanism. The operation usually takes less than two hours to complete, and no artificial materials are used. A urethral catheter is left to drain the bladder overnight. Discharge to home from the hospital the day after surgery is anticipated for most children.

Endoscopic injection of Deflux® is an attractive alternative to ureteral reimplantation, because it can be performed as a day surgery procedure without an incision. Deflux® is a cross-linked complex polysaccharide compound (80 micron beads) in paste form that can be injected into the bladder mucosa through a long, thin needle passed through a cystoscope. This small mound of paste serves to support the ureteral orifice in the bladder and to functionally elongate the ureteral tunnel effectively preventing VUR from occurring. A prominent mound is necessary as some settling occurs after the injection is completed when the hyaluronic acid carrier fluid is reabsorbed. Placement and persistence of the mound can easily be detected on ultrasound imaging. The operation usually takes less than 30 minutes to complete.

**Comparison of Surgical Options to correct VU Reflux**

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<tr>
<th>Deflux injection</th>
<th>Ureteral reimplantation</th>
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<tbody>
<tr>
<td>William Strand MD</td>
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### North Texas Pediatric Urology Associates

<table>
<thead>
<tr>
<th>Length of stay</th>
<th>day surgery</th>
<th>overnight hospitalization</th>
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<tbody>
<tr>
<td>Incision</td>
<td>none</td>
<td>transverse lower abdominal</td>
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<tr>
<td>Urethral catheter</td>
<td>none</td>
<td>urethral catheter overnight</td>
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<tr>
<td>Success rate</td>
<td>80-90%</td>
<td>nearly 100%</td>
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<tr>
<td>Conditions treated</td>
<td>low-grade VUR (1-3)</td>
<td>high-grade VUR (3-5)</td>
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<tr>
<td></td>
<td>Duplex (double) ureters</td>
<td>Bladder diverticulum</td>
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**Reference sites:**
- [www.deflux.com](http://www.deflux.com)
- [www.vurinfo.com](http://www.vurinfo.com)

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Refluxing right ureteral orifice

Right ureteral orifice after Deflux injection

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