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Review Article

Treatment of vesico-ureteral reflux in infants and children using endoscopic approaches

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Abstract: Vesicoureteral reflux (VUR) represents one of the most significant risk factors for acute pyelonephritis in children. Endoscopic treatment of VUR dates back to 1981 when Matouschek first described injection of the ureteral orifice in an attempt to correct VUR. In addition, also Politano and colleagues and McDonald described successful correction of reflux using endoscopic techniques. After these reports subureteral Teflon injection (STING) came to be appreciated as a viable new way to less invasively correct one of the most common pediatric urologic problems. The technique is technically easy to perform and is usually performed as an outpatient procedure. It is performed in general anesthesia in children and may require repeat injections, particularly in patients with high-grade reflux. As for endoscopic technique, a main problem existed. The success in children with high grade reflux was less than reported for open or laparoscopic reimplant techniques. However, in the past 10 years, newer products have become available that are changing the indications for endoscopic correction. In these review, we analyzed the papers published in the literature on this topic to give to the readers an updated overview about the results of endoscopic treatment of VUR after 30-years of his first description.

Keywords: Vesicoureteral reflux (VUR); endoscopic treatment; children

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Introduction

Vesicoureteral reflux (VUR) is present in approximately 1% of children in North America and Europe and is associated with an increased risk of pyelonephritis and renal scarring (1,2). In children with urinary tract infection, the incidence is as high as 29% to 50% (1,3). When reflux coexists with urinary tract infection and intrarenal reflux, the child is at significant risk of renal scarring.

Low-grade reflux frequently resolves, whereas high-grade VUR usually persists (4). The resolution rate for VUR is dependent on the initial grade. In general, about 80% of low-grade reflux resolves with medical management (5). Often, however, this takes considerable time. It seems that in children resolution of VUR grades I to III was 50% 3.5 years after diagnosis (2,6). Grade IV VUR resolved much less frequently, with resolution in 50% in children after about 11 years (7). Sterile reflux does not cause renal damage, but persistent reflux of infected urine may cause renal damage (8,9).

Medical management is generally safe and effective in the absence of high voiding pressures. The International Reflux Study (IRS) in children, a multinational prospective study, compared medical and surgical management in children

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with grades III and IV VUR. No advantage of surgical over medical treatment could be found with regard to renal scarring or renal function at the conclusion of the study (10). As for surgical treatment, ureteral reimplantation in open surgery or in laparoscopy in the hands of the pediatric urologist is safe and effective.

Thus, management of children with VUR can be divided between medical and surgical therapy, with medical therapy usually offered initially, and surgery reserved for patients in whom medical management is unsuccessful. Most patients "fail" medical management because of persistent reflux into adolescence, or to continue to develop urinary tract infections, or they failure to comply with maintenance prophylactic regimens.

Technical and surgical considerations

According to VUR guidelines, after a diagnosis of VUR, all children are placed on antibiotic prophylaxis (1,11,12).

In general, patients with VUR are nearly always followed for at least 1 year, regardless of reflux grade. In many of these children, the grade of reflux will be lowered as the infection is controlled and the children begin to void more comfortably (5,13).

As a result of reduced severity of reflux and increased bladder volume, anti-reflux surgery is safer and more effective in older infants. After the first year, the child undergoes follow-up nuclear cystography, which measures the bladder volume when the bladder is filled to capacity, the bladder volume at which reflux is first noted, and the volume of urine refluxing into either ureter (7,14).

We carefully ask about the child's voiding pattern, urgency, or infrequent voiding, all of which can be suggestive of dysfunctional voiding, must be identified prior to surgery. If symptoms of dysfunctional voiding can be elicited, care should be taken to improve the coordination of voiding before proceeding to surgical treatment of reflux, since the failure rate following anti-reflux surgery in these children is greater. If high-volume reflux persists at the second study and the patient is not a dysfunctional voider, surgical correction should be considered.

We underline that medical management in the absence of infection is safe but may not be the most effective way to manage the patient with high-volume VUR. Considering the prospect of numerous radiologic studies and years of antibiotic prophylaxis without good odds of spontaneous resolution of VUR, many families elect to proceed with surgery, particularly if a relatively less morbid (i.e., laparoscopic or endoscopic) approach is available. There are now 3 different techniques available to correct surgically the VUR (6,15). The open approach, that consist in to open the bladder and to reimplant the ureter according to Cohen or Politano technique, this technique now is indicated rarely only in high grade reflux when a ureteral tailoring is necessary. Laparoscopy ureteral reimplantation according to Lich-Gregoire technique is indicated in reflux grade II to IV, and this technique has the advantage to do not open the bladder and to reimplant the ureteres extravesically with a wonderful post-operative period (4,6,16). Endoscopic treatment of VUR has obvious advantages over conventional approaches. Endoscopic correction is usually done on an outpatient basis-The hospital stay is short, and there is no surgical scar.

As a result, overall hospital charges are decreased. Because of the lower morbidity of endoscopic surgery and lower costs compared to open procedures, one could argue that additional patients should be offered surgery rather than prophylaxis as the initial treatment. Alternatively, Stenberg and colleagues recently recommended that most children with VUR managed conservatively with antibiotics for longer than 1 year be offered endoscopic treatment, specifically with dextranomer/hyaluronic acid copolymer, as an alternative to long-term antibiotic prophylaxis or open surgery (6,13,17,18).

Unfortunately, because endoscopic repair is less successful in patients with high-grade primary VUR, multiple procedures are frequently necessary. This translates into additional costs and hospital stays for repeat surgery.

In addition, even after successful endoscopic correction, reflux can recur. As a result, there is a risk that the child who is removed from antibiotic prophylaxis and suffers a recurrence may return with pyelonephritis and a new scar, the very thing we try to prevent with anti-reflux surgery. For these reasons, we tend to offer endoscopic correction only to the few with low-grade primary VUR in whom medical management has failed or to the few who have persistent VUR after ureteroneocystostomy. On the other hand, endoscopic correction is an attractive alternative for some more complicated cases in which ureteroneocystostomy is probably unnecessary (18,19).

Pre-operative work-up

Nearly all patients undergo ultrasonography as the initial study to assess the shape of the kidney and the presence of scarring. If significant scarring exists, the volume of

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renal parenchyma is small, the kidney looks echo dense, or the cortico-medullary junctions are obscure, a renal scan is obtained to further assess preoperative function and drainage (7,19,20).

If function is poor (<10%), consideration should be given to removal of the kidney and ureter rather than correction of the VUR (8,21). Before any kind of surgery for VUR a cystography is mandatory, we have 2 possibilities: the classical cystography that gives a perfect morphological picture of the bladder, of the ureters and permits a clear classification of the VUR but with the disadvantage of an high quantity of radiations. The second option is the cystoscintigraphy that is less morphological accurate but it gives less radiations that the classical cystography.

Rarely, a secondary ureteropelvic junction (UPJ) obstruction exists (9,21). If a UPJ obstruction is suspected to coexist with reflux, correction should be made prior to, or at the time of, anti-reflux surgery if the obstruction appears to be primary (5,22). Otherwise, UPJ obstruction suspected to be secondary to high-grade VUR should be carefully monitored following anti-reflux surgery (2,23). Patients with posterior urethral valves, neuropathic bladder, or severe dysfunctional voiding should be considered for anti-reflux surgery only after very careful deliberation.

Vesicostomy is usually a better option. In many cases, high-volume VUR effectively improves capacity in the valve bladder and should be allowed to remain as long as the patient has no upper urinary tract infection. Whether attempting endoscopic or open or laparoscopic repair of VUR, the bladder volume must be adequate to allow for low-pressure storage following voiding.

If bladder capacity is suspect, attempts to correct reflux by any means usually fail. Because successful subureteral injection requires at least some type of submucosal ureteral tunnel in which to place the implant, lower grades of reflux are more easily corrected than higher grades of reflux (12,24). If subureteral correction is planned in a patient with high-grade VUR, the patient and his or her family must be cautioned that additional attempts may be necessary to correct the problem. Specifically, the risks of persistent treflux and the possible need for additional surgery should be outlined and compared with the risks of open surgical repair (3,7,25). The risk of obstruction of the ureter, both transient and long term, should also be outlined, along with the steps needed to correct such an eventuality. Urinary tract infection, bleeding, obstruction, and persistent reflux can occur following endoscopic or open surgery (3,24,26). Risks specific to the implant material are particularly important considerations prior to planning endoscopic surgery. The relative risks and benefits of each substance are considered under the description of each substance (6,27,28).

Patient preparation

In children, general anesthesia is administered via endotracheal intubation or laryngeal mask airway with no additional special requirements. The patient is placed in the dorsal lithotomy position. The legs should be separated enough to provide easy access even to a very lateral ureteral orifice. Special imaging equipment is not necessary. Endoscopic camera equipment is helpful because it allows the assistant and the surgeon to coordinate their efforts during the injection.

Instrumentation

Cystoscopes and needles

Cystoscopic equipment varies with the implant. In general, the most widely used substances, require little in the way of extensive equipment. Substance can be injected through a needle as small as 3.7 or 5 French without too much difficulty with a hand-held conventional syringe. No special equipment other than conventional endoscopic equipment is needed. The majority of pediatric urologists prefer to use a 9.5–10 French pediatric operative cystoscope with a working channel of 5Ch to allow the needle to be inserted without problem.

In general, the larger the needle the easier the injection. Using a hand-held gun to increase the force of injection can help for some substances that are denser than the others. Many practitioners are using conventional endoscopes with a flexible needle some others prefer to use a rigid needle, but this choice remains a surgeon preference.

Implant substances

Over the years, endoscopic enthusiasts have researched many substances, But only few materials are widely used. The following are a few of the more commonly. Used materials and substances of historical and experimental interests.

Deflux

One of the greatest advances made for the endoscopic

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correction of VUR was developed by Stenberg and Läckgren and is now the most widely used implant. Deflux is a suspension of dextranomer microspheres (80 to 120 μm) in sodium hyaluronate solution (NaHa) (1,5-7).

The dextranomer particles are cross-linked dextran polymers, and the NaHa is an endogenous polysaccharide (5,7,10).

In most cases, implant volume of 0.5 to 1.5 mL is effective in correcting VUR (7,18,28). Deflux was approved for use in the United States in 2002. Since that time, its use in North America has exploded, and now, nearly all pediatric urologists have some experience with it (6,19,23).

Polytef

O'Donnell and associates developed the technique and popularized it in1991, O'Donnell estimated that more than 3,000 ureters had been treated in Europe and the United States (5,7,10,18). Its injection characteristics allow relatively easy implantation even in laterally placed ureters.

Polytef is a 50% suspension of Teflon particles in glycerol. The Teflon particle size ranges from 4 to 100 μm, with more than 90% smaller than 40 μm (19,23,28). Perhaps more disturbing, migrated particles in animal model as large as 80 μm were found in the pelvic lymph nodes, kidneys, spleen, and lung and in the subarachnoid space of the brain stem and cerebral hemispheres. The tissue reaction associated with the migrated particles was variable (7,10,18).

Information regarding migration in humans is less clear. No substance had been as easy to use up until 2002 when the US Food and Drug Administration (FDA) approved Deflux for use in the United States. At that time, even those with large experiences using Polytef paste migrated over to the use of Deflux (7,10,18).

Collagen (Zyplast)

Because of the uncertainty surrounding the long-term effects of particle migration and local tissue reaction to Polytef paste and recognizing the efficacy of the subureteral Teflon injection (STING), Peters and Jeffs began experimenting with a glutaraldehyde cross-linked bovine collagen preparation (Zyplast) as an alternative (5,6,7,10,28).

Cross-linked bovine collagen had been widely used for years in cardiac valves as a hemostatic agent and, in the injectable form, as a soft tissue substitute (7,10). Zyplast is bovine corium collagen, which is solubilized by exposure to pepsin in acetic acid and purified by ultrafiltration and ionex change chromatography (6,18).

Following purification, he collagen is reconstituted in a pH-neutral solution, harvested, and re-suspended in saline solution to provide non-cross-linked collagen. To this substance is added purified glutaraldehyde in a final concentration of 0.0075% to cross link the reconstituted collagen fibrils (18,23,28). The added glutaraldehyde binds adjacent collagen fibrils to improve the integrity of the implant after injection (23).

Zyplast elicits little local tissue reaction and no granuloma formation when injected beneath the urothelium. Zyplast is more fluid than Polytef (7,10,18). Despite a relatively rapid increase in popularity in collagen in the late 1980s and early 1990s, by the end of the 1990s, most centers that were initial enthusiasts of collagen injections began to perceive that the implant was breaking down relatively quickly after 24 months following initial and repeat injections (5,6,23,28).

Particulate silicone microimplants (Macroplastique)

In an effort to reduce migration of implant particles while maintaining a durable implant, Schulman began to experiment with particulate silicone macroparticles (Macroplastique) (6).

Macroplastique is 40% vulcanized polydimethylsiloxane particles in a 60% water-soluble carrier medium composed of low-molecular-weight polyvinylpyrrolidone (6,7,10). The advantage of this substance over Polytef is that it contains few small particles. Since the largest macrophages are approximately 80 μm, particles smaller than 80 μm can migrate via the macrophage to distant organs (6,28). Macroplastique implant particles range in size from 16 to 409 μm (average 171 μm) (10,28). This results in fewer particles small enough to migrate.

Despite the larger average particle size, limited migration of a few smaller particles to the lung in rabbits and to the spleen in dogs has been reported (18,23,28).

Despite the small number of migrated particles, even minimal migration is cause for concern and prevented Macroplastique from gaining popularity in the United States, although it has been used in Europe and Canada with success that approaches that of Deflux (6,23).

Technique of injection

The first report of a technique of injection was reported by O'Donnell and Puri (5). The principle of the STING is identical to that of open ureteroneocystostomy—to create a solid support behind the refluxing intravesical ureter (5,7). With the STING, this support is created by injection of the

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implant beneath the affected ureteral orifice (19).

The patient is placed in the dorsal lithotomy position and cystoscopy is performed. The patient's legs should be wide enough apart to provide good visualization and access to each ureter. The location and configuration of the ureteral orifice are carefully evaluated. Lateral or gaping ureteral orifices are more difficult to treat, particularly with less viscous substances.

After cystoscopic examination, the bladder is drained to provide just enough distention to allow inspection of the trigone. With the bladder less full, the ureteral tunnels are easier to inject (5,7).

The appropriate needle is primed to prevent injection of air or irrigant at the implant site and advanced into the orifice at the 6-o'clock position (19). The needle is then advanced the appropriate distance to support the trigone but not so far as to result in injection outside Waldeyer's sheath into the detrusor or extravesical space (5,7). The needle must be just under the urothelium (19). The initial injection should be made very gently to assess the location of the implant.

If an immediate hump is not identified, the needle is either buried too deep in the trigone or advanced too far into Waldeyer's sheath and should be repositioned (5). The injection is then continued to raise an implant appropriate to close the ureteral orifice and provide significant backing to the ureter (19). As the injection proceeds, the distal ureter flattens and the orifice closes, assuming a slit-like configuration near the top of the implant mound at the conclusion of the procedure. Depending on the substance, the implant should slightly overcorrect (or over-close) the ureteral orifice. The delivery agent (glycerin, saline solution, or sodium hyaluronate) is absorbed within the first month, leaving the implant behind (5,7).

This may reduce the precision of the injection somewhat, but this phenomenon is readily overcome as one becomes familiar with the technique (19). Most refluxing ureters require 1.0 mL of implant, and many need as little as 0.05 to 0.2 mL (5,7). The needle should be kept in position for 30 to 60 s after injection to prevent extrusion of the implant. A ureteral catheter can be helpful in laterally placed ureters or in those with gaping orifices (5,7). The catheter is used to elevate the ureteral orifice to allow more precise placement of the needle just beneath the urothelium.

Duplex systems can be injected without difficulty (19). The injection is placed just superficial to the wall of the upper-pole ureter. Care must be taken to prevent perforation of the upper-pole ureter, which will not always be apparent. Placement of a ureteral catheter is particularly helpful in duplex systems. The injection is identical to that for single-system ureters and a similar appearance at the end of the injection is desirable.

Repeat injections may be necessary. If reflux recurs or if, despite several attempts to correct it, reflux still exists, a second or even a third or fourth injection may be necessary. At the time of repeat injection, the previous implant is often seen lateral or proximal to the ureteral orifice. The same injection technique can then be used to correct the reflux. In some cases, the second injection may be more satisfactory than the first since scar-ring beneath the ureteral orifice may tend to stabilize the implant site and make extravasation outside Waldeyer's sheath less likely (5,7).

Patients with persistent VUR following ureteroneocystostomy may also be treated. Following unsuccessful ureteral advancement procedures, the implant should be placed as previously described, just beneath the ureteral orifice. Following an unsuccessful cross-trigonal reimplantation, the injection should be at right angles to the path of the ureter at or near the ureteral orifice (19).

The technique employed by Kirsch and colleagues for implantation of dextranomer/hyaluronic acid copolymer is so similar to the STING procedure described above that they named their technique the "modified STING" (10,18,22). A 9.5 or 10 French pediatric cystoscope with an offset lens allowing for direct passage of the 3.7 French needle is preferred (10). The needle is thus inserted unbent and can then be properly manipulated without inadvertent damage to the mucosa of the bladder and bladder neck, causing bothersome bleeding. The bladder is filled to half or three-quarters volume, permitting visualization of the ureteral orifice and intraluminal ureter (22).

This volume will prevent distortion and tension of the ureteral submucosa caused by overdistention. Hydrodistention of the ureter is performed by directing a pressurized jet of irrigant at the ureteral orifice to open it before injection (22). This maneuver allows for identification of the ureteral submucosal injection site (18).

With hydrodistention, the needle is inserted (with the bevel up) approximately 4 mm into the submucosa of the mid to distal ureteral tunnel at the 6-o'clock position (18). The needle used has been modified to have a black mark 4 mm proximal from the bevel. A small amount of implant (less than 0.1 mL) is injected to confirm location. To avoid leakage of material and ensure good visualization, continued irrigation is avoided. The cystoscope is then brought back to the bladder neck with care not to dislodge the needle (22).

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This cystoscope position allows for observation of ineffective caudal, medial, or lateral tracking of the implant that might not otherwise be noticed if only the ureteral orifice and tunnel are in the visual field (18).

The needle tip can be repositioned for another injection if optimal implantation is not achieved, but multiple needle holes can lead to leakage of material (10).

A fully coapted ureter is the end result of a proper implantation. Kirsch and colleagues emphasize that the most critical part of the procedure is to place the needle in the submucosal plane so that material can travel cephalad within the ureteral submucosa, maximizing the length of ureteral coaptation. Volume of injected material ranges from 0.5 to 1.5 mL per ureter (10,18).

Hydrodistention of the ureter after injection should reveal a properly coapted ureter. Observation for efflux from the ureteral orifice to confirm antegrade flow of urine is not necessary because Kirsch and his colleagues have not had any incidents of hydronephrosis from this modified STING technique (22). The modified STING had significantly improved the reflux-free rate to 92% from 79% for the standard STING (10,18).

A learning curve was observed by Kirsch and colleagues with their previous injection technique (22).

Postoperative care

Patients are continued on antibiotic prophylaxis for about 3 months, at which time a voiding cystogram is obtained. If reflux is no longer present, antibiotic prophylaxis is discontinued, and the patient is followed closely for signs of infection.

It is essential that the patient and his or her family be aware that reflux may return if migration or breakdown of the implant occurs.

The child's family is instructed to return if the child shows signs of febrile urinary tract infection. No subsequent voiding cystograms are obtained unless signs of upper urinary tract infection are present. Ultrasound imaging of the kidneys and bladder is performed annually to assess the position, size, and location of the implant.

Results

Despite the array of substances emerging for correction of VUR, only four—Deflux, Polytef, collagen, and Macroplastique—have been used in humans in large enough numbers to enable assessment of effectiveness (5,7).

As for Deflux**,** in the first-ever human trial with Deflux, Stenberg and Läckgren 40 noted excellent success in both low and high grades of reflux (1,6,7,18,28).

Their initial report involved patients with primarily grade III and IV reflux with an overall success in 62.7% of ureters with a single injection was reported in this initial series (7,19).

Kirsch and colleagues recently reported a 76% reflux-free rate for 137 cases treated with a single injection with at least 3 months of follow-up (10,18). Puri and colleagues had even better results, with 86% cure rate after a single injection with median follow-up of 6 months. These findings suggest that Deflux is safe for use in children with VUR (5,19). Because of its organic composite, large particle size, and minimal local tissue reaction, Deflux may be a more attractive choice for injection than Polytef or Macroplastique (6,18,28).

As for Polytef was the most widely used substance (1). Puri and colleagues reported treatment in 12,251 ureters in 8,332 children from 53 pediatric urologists and pediatric surgeons at 41 centers worldwide (5,7). This study included patients with all grades of VUR, but 61% of the ureters were grade III or IV (5,7). Collectively, 89% of ureters were rendered reflux-free with up to four injections (19).

Nearly all (93%) patients underwent STING as an outpatient procedure (19).

Most centers have obtained cystograms at 3 months, 1 year, and 3 years after implantation. Seventy percent of all patients treated have remained cured after 1 year. Puri and colleagues report a 93% persistent cure rate in infants followed from 1 to 9 years (5,6,7,19).

As for Collagen results following collagen injection have not been as favorable as those with Deflux or Polytef. Leonard and colleagues reported 75% of ureters corrected at 1 month. Of that group, 79% had a persistent cure at 1 year, for an overall success rate of 61% in primary non duplicated ureters. Success was not as good for higher grades of reflux (5). A few patients were cured at 1 month and had recurrent reflux at 1 year (7,19).

Frey and colleagues reported recurrence rates of up to 50% following collagen injection with many late recurrences, but not one episode of pyelonephritis was noted in their large series (7).

Morbidity from endoscopic injection of collagen is minimal. The theoretical risk of an autoimmune response with collagen injection is probably unfounded. As for Macroplastique an interesting sudy reported that it has been injected in 114 children with grade II to IV reflux (6,7,19).

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An initial report quoted a cure rate higher than 90% with follow-up between 6 and 30 months.

More recently, other colleagues reported a similar cure rate of 92% using a single injection with an average follow-up of 12 months. Like Polytef, however, concerns of particle migration will likely prevent widespread popularity in the United States (1,19,23,28).

Discussion

Various options are available for the treatment of children with vesicoureteral reflux (VUR). For many years, ureteral reimplantation has been considered the gold standard in the treatment of high-grade VUR (6). However, it is an invasive procedure and results in longer hospital stay, and also is not free of complications such as vesicoureteral obstruction (1,6).

In the past 30 years, the therapeutic approach to children with VUR has undergone a dramatic evolution from mainly surgery, as soon as VUR was detected, toward a conservative approach with continuous antibiotic prophylaxis to a minimally invasive approach using endoscopic or laparoscopic approach, or to an active surveillance without prophylaxis in asymptomatic patients without infections (6,10).

Analyzing the international literature, it is evident that the treatment selection and decision for treating VUR in a child is an individualized process. As for currently available surgical approaches, there are the classic open approach using Cohen or Politano-Leadbetter ureteral reimplantation, the endoscopic approach using bulking agents, and the laparoscopic approach using extravesical reimplantation according to Lich Gregoir, or laparoscopic intravesical reimplantation described by Yeung and Valla (6,16,25).

A recent meta-analysis of randomized controlled trials concluded that little benefit from additional surgery over antibiotics alone is measurable (6,9,14,19,23).

Although successful correction of reflux was associated with fewer febrile urinary tract infections, it was difficult to measure a surgical benefit in terms of fewer renal scars, even with long-term follow-up. With this in mind, surgeons must continue to compare the value of endoscopic VUR correction to that of the standard laparoscopic or open reimplant (17,21).

Until we have a technique and a substance that equals or surpasses the 95% success rate following open surgical repair, endoscopic correction will continue to be considered an alternative to ureteroneocystostomy, despite the increased pain, hospital stay, and scarring following an open repair (6,18).

Even with widespread experience, the success rate in high-grade reflux with a single injection of any of the available substances still fails to equal that following open or laparoscopic ureteroneocystostomy.

The initial results following a single injection for each of the current substances are still too low for many parents.

A meta-analysis conducted by Elder and colleagues showed success rates of 57% to 77% for a single injection of the four most widely used substances (4,18). The overall resolution rate was 72% (4,18). Combining these data, about 50% of children with a high grade of reflux will not be cured without multiple injections (4,6,18). Additional treatments, however, improve the success rates. Elder's meta-analysis reports a success rate of 85% with multiple treatments (4,18).

With these results, despite the need for additional anesthetics, many families elect an endoscopic treatment approach to avoid the trauma of open surgery. Even if the cure rate does not equal that of open surgical correction, additional protection may be provided from ascending infection while awaiting spontaneous resolution of reflux.

When one considers the multiple factors resulting in renal scarring, suggesting minimal benefit of open surgery over prophylactic antibiotics, it becomes more and more difficult to recommend ureteroneocystostomy as an alternative for those families wishing to discontinue antibiotic prophylaxis (15,24). The substantial increase in pain and duration of hospitalization may not be worth the convenience afforded by the open approach of being off prophylactic antibiotics. In a study from Italy, 80% of the parents with children diagnosed with grade III VUR chose endoscopic treatment over prophylactic antibiotics (5%) or open reimplant (2%) (6,7,9,22). The parents were given detailed information (including expected risks, benefits, cure rates, and mechanisms of action) on all three treatment options prior to completing a treatment preference questionnaire (6,7,9,22).

More than 3 decades have passed since the initial report by O'Donnell and Puri of the use of STING in their first 13 patients (5,7). The technique is sound. The debate over optimal implant material appears to be over, as previously differing camps and proponents of other substances have adopted the use of dextranomer/hyaluronic acid copolymer throughout the world. Use of other materials has become less common as the use of Deflux gains momentum, but more experience and long-term follow-up are needed.

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With continued acceptance, success, and minimal to no side effects from the use of bulking agents, endoscopy will gain a permanent and prominent place in the treatment of VUR.

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Footnote

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