

Retrograde and urinal cystourethrography in the evaluation of vesicoureteral reflux

Vincenzo Ciccone¹; Fabio Grazioli^{1*}; Domenico Magliacane²; Rosario Gnazzo³; Francesco Negri⁴; Giorgio Ronca³; Daniela Tomeo³; Alessandro Menichini³; Davide D'Ambrosio³; Alessandro Desiderio³; Roberta Buonocore¹

1. Diagnostic Imaging Department, AOU "San Giovanni di Dio e Ruggi D'Aragona", Salerno (Italy)
2. Emicenter, Naples (Italy)
3. Università degli studi di Salerno (Italy)
4. Università degli studi del Molise (Italy)

* Corresponding author.

E-mail address: fabiograzioli11@gmail.com

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ABSTRACT

Retrograde and micturition cystourethrography is the radiologic investigation of the bladder and urethra performed by retrograde opacification by administering an iodine-based contrast agent through a catheter. This technique is essential in the anatomical study of the bladder, urethra, and as a functional investigation to detect reflux (abnormal passage of urine from the bladder into the ureters). It may be indicated in the study of certain urethro-vesical pathologic conditions (stones, diverticula, complicated cystitis, vesicoureteral reflux, tumors). A consensus conference on renal transplantation in patients with lower urinary tract abnormalities proposed criteria for investigation in both pediatric and adult patients. The indications for performing urodynamic examination are the following conditions:

- renal insufficiency due to urinary tract obstruction;
- history of bladder emptying phase dysfunction, especially in association with vesicoureteral reflux;
- low capacity with high bladder pressures and obstruction of ureteral outflow;
- doubtful cases about the etiology of renal failure.

INTRODUCTION

Vesico-ureteral reflux (VUR) is an abnormality of the urinary tract, either primary or secondary to other malformations, frequently seen in pediatric age and much rarer in adulthood. VUR is present in many children with urinary tract infections (UTIs) and may be associated with scarring lesions of the kidneys. VUR is the retrograde-direction transit of urine from the bladder to the ureters. Reflux may be primary or associated with another pathology affecting the urinary tract: urethral valves, mega-ureters, and functional bladder changes. Among the different classifications of VUR, the most widely used is that of the International Grading System (Fig. 1):

- Grade I: urine refluxes only into the ureter;
- Grade II: urine refluxes into the ureter, pelvis, and calyces, which appear morphologically normal;
- Grade III: urine refluxes into the collector system; the ureter appears moderately dilated and there is evidence of initial rounding of the calyces;
- Grade IV: urine refluxes into the collector system; the ureter appears moderately dilated and the calyces appear rounded;
- Grade V: urine refluxes into the collector system; the pelvis appears severely dilated and the calyces deformed into a club shape; the ureter appears very dilated and has a tortuous course.



Fig.1

International Grading System



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The most common form of congenital VUR is “primary” VUR, a term that identifies a dysfunction of the vesicoureteral junction, in the absence of another bladder pathology, with the passage of urine against the flow. In adults, VUR persists over time. Acquired or secondary VUR results from the development of elevated intra-bladder pressures during bladder contraction, following anatomic or functional cervico-urethral obstruction. Cystitis can also be a cause of temporary VUR due to edema of bladder tissues with involvement of the uretero-vesical junction.

Functional forms include those due to neurological bladder, abnormalities in bladder emptying, and a previous surgical maneuver. In cases of neurologic bladder, detrusor muscle hypertrophy, recurrent infections, stones, and the frequent coexistence of bladder diverticula contribute to reflux. The severity of VUR appears to be correlated with the likelihood of developing complications, including reflux nephropathy (RN) and anatomical and functional renal damage. Retrograde and micturition cystourethrography, represents the fundamental examination for the study of urethral strictures, and no surgical intervention on the urethra can be planned without first performing this examination.

METHODS

Retrograde Cystourethrography: Retrograde and micturition cystourethrography is the radiologic investigation of the bladder and urethra performed by retrograde opacification through the administration of an iodine-based contrast agent through a

catheter. Because this is an examination that exposes to ionizing radiation its use should be avoided in the absence of a specific clinical indication; in addition, women of childbearing age should exclude ongoing pregnancies. This technique is essential in the anatomical study of the bladder, urethra, and as a functional investigation to highlight possible reflux (Fig. 2). It may also be indicated in the study of certain urethro-vesical pathological conditions (stones, urethral strictures, diverticula, complicated cystitis, vesicoureteral reflux, tumors). A small catheter is introduced into the urethra through which contrast medium is injected; the bladder is then distended, and then the patient is asked to urinate. All these steps are documented with radiographic images. The examination is usually not dangerous; it is an outpatient examination so anesthesia or sedation are not necessary. In some cases, there may be temporary burning on the first urination following the examination and infection or minor injury due to catheter insertion. Patient preparation involves fasting the patient. It is generally advisable for the patient to perform antibiotic coverage to reduce the risk of infection. It is not necessary to discontinue any ongoing drug therapies (e.g., for hypertension or diabetes). In case of allergies, the patient should notify the physician before undergoing the examination and, if necessary, follow the appropriate desensitizing protocol. When performing the examination, the bladder should be empty and the patient should uncover the pelvis, at which level there should be no objects or clothing covering the organs being examined.



Fig. 2

Acquisition technique: The examination begins with a panoramic acquisition of the abdomen in the inspiratory phase, prior to retrograde contrast medium administration. Preliminary direct examination, in standard projections (AP and LL), allows detection of any morphostructural changes in the pelvic cavity. After that, the patient is laid down, partially rotated on either hip, with the leg in contact with the crib bent at 90°, while the other is extended. An occluding catheter is applied to the urethral meatus, then contrast medium is injected into the urethra until the bladder is filled (Fig. 3). During this “retrograde” phase, the rise of the contrast medium is monitored by the X-ray machine. This phase adequately studies the anterior portion of the urethra and, when fully filled, the bladder walls and passive ureteral refluxes. Study of the male urethra, through oblique projections, is required to reveal any imperviousness and stenosis (Fig. 4). For adequate visualization, it is recommended to inject about 25-30 ml of contrast medium in infants and up to 180-220 ml in adult patients (14 years and older). After adequate bladder filling, images (static or dynamic) are acquired in orthostatism during bladder emptying (urinary phase). This part of the examination can adequately study the posterior urethra and bladder neck and identify active reflux in the ureters. The examination is concluded by performing a panoramic postmicturitional radiogram.



Fig. 3

Summary of radiograms:

- 1st radiogram at small bladder filling;
- 2nd radiogram at medium bladder filling;
- 3rd radiogram at maximum bladder filling;
- 4th and 5th radiograms: patient is in the first oblique position, (fencer or OAD) with the left leg flexed and then in the second oblique position (boxer or OAS) with the right leg flexed;
- 6th radiogram position of the patient in latero-lateral left or right;
- 7th radiogram micturition projection;
- 8th radiogram postmicturitional projection

CONCLUSIONS

A urodynamic evaluation in kidney transplant candidates allows the identification of those who will benefit from rehabilitative, pharmacological, or surgical (reconstructive or corrective) therapy so that renal transplantation can be performed in further safety. Retrograde and urinal cystourethrography is the optimal method for the diagnosis of malformative and functional abnormalities of the lower urinary tract. It allows both morphologic and dynamic study of the bladder and urethra under physiologic conditions (micturition), which are necessary for the detection of vesicoureteral reflux and urethro-vaginal reflux. It may also be indicated in the study of certain urethro-vesical pathological conditions (stones, urethral strictures, diverticula, complicated cystitis, vesicoureteral reflux, tumors).



Fig. 4



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