

Voiding Cystourethrography: How I do it

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Abstract Voiding cystourethrography (VCUG) is the most commonly performed fluoroscopic examination for paediatric patients. VCUG however, can be a distressing radiological examination for the patient, parent and medical personnel. We describe our method in performing VCUG and discuss ways in which it could be done safely and effectively.

Key words Children; Radiography; Urinary bladder; Vesico-ureteric reflux; Voiding cystourethrography

Introduction

The voiding cystourethrography (VCUG) is the most commonly performed fluoroscopic examination for paediatric patients. Properly performed VCUG can provide useful information on anatomical and functional integrity of the lower urinary tract. It is commonly performed in children after urinary tract infection (UTI) or antenally detected hydronephrosis. It is used in children with congenital anomalies of renal or lower urinary tract such as posterior urethral valve (PUV), bladder neck trauma, urolithiasis and assessment of unstable bladder; it is the reference investigation for the study of vesico-ureteric reflux (VUR).

VCUG can be a distressing radiological examination for the patient, parent and medical personnel. The VCUG is the most stressful urological investigation performed on children,¹ with up to 27% of patients experiencing severe distress.² Up to a third of a large cohort of children with grade I, II or III reflux were lost to followup, presumably in large part because of the need for repeated VCUG.³ Although other imaging modalities such as radionuclide cystourethrography (RCU) and voiding sonourography (VUS) have been vigorously studied to replace VCUG, none has the same degree of accuracy and reproducibility.

In this article we will discuss how we do VCUG and outline ways in which the examination can be done efficiently with maximum diagnostic value. Paediatricians should familiarise with examination details so that they can explain to patient and parents before the examination.

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Patient and Parent Preparation

The anxiety and distress associated with VCUG is often due to ill prepared parents and patients.^{1,4,5} Good understanding of the examination is the most essential preparation. Examination details should be explained by the referring paediatrician when the test is being booked. The information should be candid and comprehensive emphasizing the necessity and indication of the examination. Examination details including urethral catheterization should

be well informed to the child and parents. Comprehensive on-line guide about the procedure is provided by the American Urological Association (Website: www.urologyhealth.org).

There has been a lot of debate on the optimal timing of VCUG relative to urinary tract infection. The common consensus is that VCUG should not be done when there is fever or persistent UTI. Referring paediatrician should ensure that urinary tract infection is adequately treated before the test is performed. We usually perform the examination 4-6 weeks after a UTI to prevent false positive reflux from mucosal oedema at the orifices.

Although catheterization and VCUG is done aseptically, antibiotic prophylaxis is advocated. Statistically significant increase in post-procedural UTI is noted in those who did not receive prophylactic antibiotics.⁶ Child with prosthetic heart valve, valvular lesion, septal defect or patent ductus should receive prophylactic antibiotics to prevent endocarditis. The test is contraindicated in children with known hypersensitivity to contrast medium.

The Examination

We will interview the parents and children again before the examination to ensure that they understand the indication, catheterization and the respective role of parents and child. We encourage parents to participation in the examination. The need for parental assistance in the form of praise or distraction cannot be overemphasized. Distraction technique has been shown to reduce stress and help the child cope with the situation.⁵

We encourage the referring paediatrician to attend the VCUG examination. Good rapport between radiologist and paediatrician will ensure the best result. Their presence can alleviate the anxiety of parents and children in an unfamiliar environment. They will be helpful when difficult catheterization is encountered.

We prepare our own contrast recipe by diluting equal amount of contrast medium (300 mg iodine/ml) and saline. For children less than 1 year, 200 ml will be enough. For larger children, we prepare at least 400 ml solution. The contrast solution is warmed to body temperature as the level of distress experienced in children is significantly reduced.⁷ It has been shown that infusing cold liquid initiates an increased detrusor tone in young children and subsequently causes the bladder to empty at smaller volumes than warm liquids.⁸

Contrast medium should be instilled via the gravity drip method and never by hand injection. This prevents transmucosal contrast medium absorption and consequent contrast reactions.⁹ Contrast solution is slowly infused as quick injection will cause a sudden rise of bladder pressure, which stimulates an unwanted premature bladder contraction at low volume. This could underestimate any pathology and reduces the examination time of the urethrogram, which may result in inconclusive findings.

We prefer to use feeding tube instead of Foley catheter since it has a smaller lumen relative to its outer diameter and is not suitable for VCUG. 5-F feeding tube is appropriate in children under 1 year. For older children we use 8-F feeding tube.

Placement of catheter is always of great concern to parents and to children old enough to understand an explanation of the procedure. Catheterization should be done by experienced personnel using strict aseptic technique. We preferred not to use sterile lignocaine lubricant¹⁰ as it is an irritant. For physiological phimosis, we made no attempt to expose the meatus but to pass the catheter directly into the preputial opening. Labial adhesion should be corrected before examination. The catheter should not be advanced any further than 1-2 cm after urine is obtained in order to reduce the likelihood of inadvertently placing the tip in the ureter or it becoming knotted.¹¹ The external portion of the tube is securely taped while allowing easy non-tender removal. Whereas sedative such as oral or nasal midazolam¹² or 50% nitrous oxide¹³ has been advocated in relieving distress, we found it unnecessary in most children.

Urine obtained by transurethral catheterization is unlikely to be contaminated and therefore the preferred specimen for documentation of UTI. Some paediatricians would like to send the urine specimen obtained during catheterization for bacterial analysis.

Imaging

One principle disadvantage of VCUG is the radiation burden. Paediatricians should reveal the radiation burden to parents. For radiologist they should observe the 'As Low As Reasonably Achievable' (ALARA) principle. We do VCUG with low dose digital fluoroscopy using low-frequency pulse fluoroscopy.¹⁴ Using this technique the radiation dose is reduced without compromising image quality.¹⁵⁻²⁰ The reduction in skin dose can be as high as 87% without any appreciable deterioration in spatial or

contrast resolution.²¹

Children are screened at steep oblique view to best visualize the distal ureter and urethra. Folded towels are helpful positioning tools. Intermittent screening should take place throughout the study for low grade reflux which occurs intermittently. Routine images are taken including bladder view, voiding urethra view and post-void bladder view. We routinely obtain renal view after voiding in order to determine extent of reflux.

We emphasize obtaining a good voiding urethral view as approximately 20% of reflux will be missed if voiding does not occur.²² In boys we advocate removing the catheter when taking the urethral voiding view. We found that this will best demonstrate posterior urethral valve and other filling defects such as ureteroceles (Figure 1). This is obtained by turning the child to the right or left oblique position to demonstrate the natural curve of the urethra. Urethral disease is exceedingly rare in girls, and one anteroposterior image of the urethra is usually sufficient.

We routinely fill the bladder and void in 2 cycles, with the catheter removed for urethrogram in boys in the second cycle. This has been shown to increase the detection of VUR and PUV significantly.^{23,24} The increased detection rate can be as high as 19.5%. Second cycle can also increase the

grade of reflux that was detected on the first void.^{23,24} Dose reduction technique should be implemented in order to reduce the additional radiation as a result of longer screening time.

Complications

Dysuria and perineal discomfort are uncommon and usually transient. It relates to catheterization and not to contrast medium.²⁵ Statistically significant increase in post-procedural UTI is noted in those who did not receive prophylactic antibiotics. Sepsis and death following VCUG have been described.²⁶ Therefore we advocate prophylactic antibiotics in all children undergoing VCUG. Oral hydration should be encouraged after VCUG.

Perforation of the bladder²⁷ may also occur, although this is exceedingly rare and usually confined to patients with chronic renal failure or unused bladders. Catheters may be inadvertently placed into the vagina, via the ureterovesical junction into the ureter,²⁶ into a utricle, or into a ureteroceles.²⁸

We have never encountered hypersensitive reaction though anaphylactoid reactions have been described.²⁹

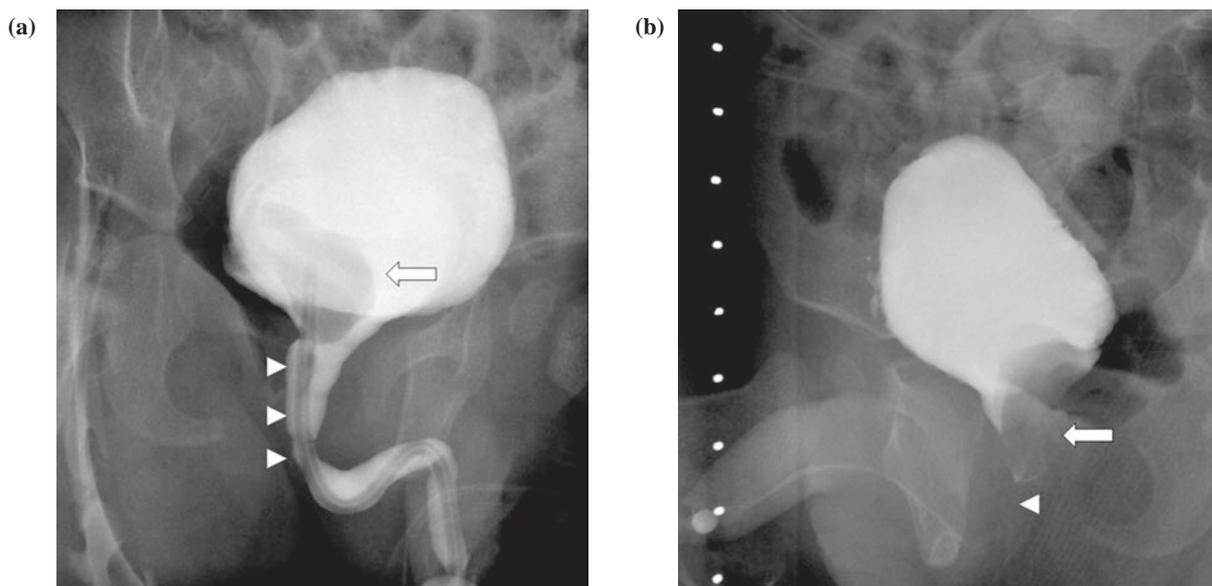


Figure 1 Prolapsing ureterocele causing bladder neck obstruction: (a) VCUG with urethral catheter (arrow head). Catheter prevents prolapse of ureterocele (block arrow); (b) VCUG repeated with catheter removed illustrating prolapse of ureterocele (block arrow). Note bladder neck obstruction (arrow head). This is only demonstrable after catheter removed.

Conclusion

VCUG is not a pleasant examination. Reducing anxiety and distress in children who attend for VCUG should be a priority amongst all medical personnel involved in the examination. Prior preparation and proper technique ensured that high quality, patient acceptable and clinically useful VCUG can be done safely and effectively. Good cooperation of paediatrician and radiologist is essential to ensure that the examination is done only in appropriate children in the least traumatic manner. The role of paediatricians is summarised in Table 1.

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Table 1 Role of paediatrician

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- Comprehensive explanation of examination details to parents and children including catheterization, radiation and possible complications. This should be done at time of booking
 - Ensure urinary tract infection is well treated
 - Prescribe antibiotic cover
 - Paediatrician presence at VCUG examination encouraged
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