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Expert Corner

Videourodynamic Evaluation: An Introduction for Clinicians - Laborie

Expert Dr. Mikel Gray introduces videourodynamic evaluation for urodynamic clinicians. Discover everything about the process and its clinical applications.

Introduction

The term urodynamics was coined by David M. Davis in 1954; the term videourodynamics was coined by Richard Turner-Warwick around 1979; it is defined as a study that combines urodynamic traces with imaging of the urinary tract using fluoroscopy or ultrasonography.[1-3] The prefix "video" was used because the original systems used a camera that simultaneously recorded analog traces alongside fluoroscopic images via a video-camera that was recorded onto a videocassette for playback and interpretation. In contrast, 21st century computer based videourodynamic systems that combine urodynamic traces with digital images, greatly enhancing our ability to collect, store, and interpret fluoroscopic (or ultrasonic) images along pressure, flow and electromyography. This combination provides the most detailed and sophisticated means for understanding lower urinary tract function and dysfunction. While several guidelines exist that describe indications for complex, multichannel urodynamic testing[4-6]; guidance for choosing which patients will benefit from videourodynamic versus standard multichannel urodynamic testing is less well developed. The purpose of this Expert Corner is to describe the usual imaging sequence when performing videourodynamic testing, and to discuss situations when videourodynamic testing enhances evaluation of lower urinary tract dysfunction.

Typical Imaging Sequence

Videourodynamic testing using contrast enhanced fluoroscopy begins with a scout (initial) image of the pelvis prior to bladder filling with contrast. This image is generated as the radiologic technologist identifies the area for additional images during urodynamic evaluation. I routinely review this image and find it useful for identification of unanticipated findings in the pelvis or lower spine such as dilated bowel loops indicating constipation or neurogenic bowel dysfunction, potential bladder calculi, or supportive hardware in the lower spine that is not always well documented in the history provided at the time of urodynamic testing. A low volume image (around 30-65 mL in adults) is taken to identify filling defects such as an intravesical masses, ureterocele, radiolucent bladder calculi, or foreign objects in the bladder. Imaging is routinely completed during stress testing for urodynamic stress UI to determine the response of the bladder neck, urethra, and bladder base to coughing or straining, along with presence and volume of urine (contrast) loss.

Routine imaging is also completed during micturition to visualize the bladder neck and urethra, with particular focus on the proximal urethra. Additional images may be taken as sustained detrusor pressure reaches 30 cm H2O or higher in patients with low/poor bladder wall compliance, when vesicoureteral reflux is suspected, or when bladder or suburethral diverticula are identified. Minimization of radiation exposure for both the patient and care providers is paramount; including limiting fluoroscopic exposure time, spot images, and repeat imaging during sequential testing. Diagnosing the presence of significantly reduced bladder capacity, impressive detrusor overactivity, and/or loss of bladder compliance not only better defines the bladder storage disorder, it helps predict whether or not the patient's OAB symptoms may persist or even worsen following surgery.

Imaging in the Evaluation of Urinary Incontinence

The role of videourodynamic testing in the evaluation of urinary incontinence is limited. Specifically, urodynamic is not recommended for routine evaluation of women with stress, urge and mixed incontinence prior to initiation of conservative and/or pharmacotherapy[4,5]; nevertheless, it is useful for detection of low volume stress incontinence that is not easily visualized or detectable on a uroflow placed below that patient. It is even more useful in women with higher grade pelvic organ prolapse when occult stress urinary incontinence is suspected. Videourodynamic imaging also provides an excellent means to differentiate stress urinary incontinence accompanied by descent of the bladder base versus leakage in patients with a fixed bladder neck/base. Videourodynamic testing is also useful for identifying leakage from a vesicovaginal fistula (observed as presence of contrast in the vagina that is not attributable to abdominal forces or overactive detrusor contraction), versus incontinence due to severe intrinsic sphincter deficiency or a patulous (stovepipe) urethra.

Finally, I assert that that videourodynamic testing is useful for identification of the rare cases of women who live with an ectopic ureter into adolescence of adulthood. Though this situation is quite rare, I have identified more than 10 cases of ectopic ureters that open into the vaginal vault, causing continuous leakage and not detected until adolescence or adulthood. In these cases, leakage is visualized, either directly from the vagina or in the genital area that is not attributable to abdominal forces or detrusor overactivity. In contrast to a fistula, contrast is not seen in the vaginal vault since the leakage source is an ectopic ureter opening into the vaginal vault.

Incomplete Bladder Emptying and LUTS due to Obstruction versus Underactive Bladder

I find the advantages of videourodynamic versus traditional multichannel urodynamic testing are even more apparent when evaluating patients with incomplete bladder emptying due to bladder outlet obstruction, underactive bladder, or a combination of these factors. Videourodynamic testing not only allows differentiation of obstruction versus underactive detrusor function; it also allows localization of obstruction and its likely cause.

For example, benign prostatic hyperplasia (BOH or BPE) creates narrowing and/or elongation of the entire proximal urethra. In contrast, bladder neck dyssynergia creates a comparatively short, narrowed segment isolated in the bladder neck. Videourodynamic testing is the gold standard for diagnosing this condition in males and females.[7,8] The case of detrusor sphincter dyssynergia is particularly interesting application for traditional versus videourodynamic evaluation; in addition to analysis of pelvic floor EMG response during voiding, I find visualization of the membranous urethra in males or midurethral in females particularly informative.

This strategy has also been advocated by Dr. Victor Nitti. A diagnosis of detrusor sphincter dyssynergia is established when the striated sphincter is visualized as both open and closed during a single voiding event. Finally, videourodynamic testing is also invaluable in detecting characteristics of urethral strictures that may affect any portion of the urethra, from the meatus to the bladder neck. Videourodynamic testing is useful in evaluation of patients with incomplete bladder emptying and large diverticula. Imaging during the filling cystometrogram allows evaluation of the size of the diverticulum relative to the size of the bladder vesicle, its location, and its contribution to residual volume. For example, in some patients imaging of the lower urinary tract reveals an empty bladder vesicle, indicating robust contractility, as compared to a post void image that reveals residual contrast in both the bladder vesicle and diverticulum seen in those with underactive detrusor function.

Neurogenic Lower Urinary Tract Dysfunction (NLUTD)

The recent guideline for evaluation and management of NLUTD from the American Urological Association and the Society of Urodynamics and Female Urology provides evidence-based guidance for urodynamic testing.[6] I have found that videourodynamic testing is most valuable for patients classified in this guideline as having unknown or high risk of renal damage including those with suspected detrusor sphincter dyssynergia such as spinal cord injury, multiple sclerosis affecting the spine, transverse myelitis and related conditions. Videourodynamic evaluation is also useful in patients with NLUTD and recurring urinary tract infections (UTIs) or a history of urosepsis. Imaging enables the clinician to identify and grade vesicoureteral reflux, characterize obstruction, and identify the presence of diverticula or bladder stones that may be contributing to bacteriuria and UTI risk.

Videourodynamic testing is especially valuable when low (poor) bladder wall compliance has been diagnosed on previous studies or is suspected. Low/poor bladder wall compliance is known to impair upper urinary tract function, leading to ureterohydronephrosis, vesicoureteral reflux, and deterioration of renal function.[9] Videourodynamic testing allows assessment trabeculation of the bladder wall, identification of the number and size of diverticula, and presence and grade of vesicoureteral reflux, including the magnitude of dilation of refluxing ureters. In addition to patients with NLUTD, I advocate videourodynamic evaluation for any person with a history or pelvic radiation therapy, chronic bladder outlet obstruction, tubercular or parasitic infections, or other conditions linked to inflammation or fibrosis of the bladder wall.

Future Trends

This discussion has focused on use of fluoroscopic imaging based on intravesical installation of contrast into the bladder. Ultrasonic imaging is a viable alternative that has several potential advantages when compared to fluoroscopy; the most clinically relevant is the lack of ionizing radiation. Despite these advantages, ultrasonic imaging has not gained widespread use for videourodynamic testing due to multiple technical factors such as the need for suprapubic or transrectal probe placement during micturition[10], and loss of imaging quality in adults with higher BMI. Development of ultrasonic contrast that uses microbubbles has led to renewed interest in the use of ultrasound for videourodynamic testing, particularly in children. Initial findings of a study that compared fluoroscopic and ultrasonic imaging in a group of 28 children found no clinically relevant differences in diagnostic outcomes[11]; additional research in pediatric and adult patients is needed to determine the role of ultrasound as an alternative to fluoroscopy for videourodynamic evaluation.

Biography

Dr. Mikel Gray is a Professor and Nurse Practitioner with the Department of Urology (School of Medicine) and the Department of Acute and Specialty Care at the University of Virginia in Charlottesville. He is the Editor in Chief of the Journal of Wound, Ostomy, and Continence Nursing and is a board member of the Society's Center for Clinical Investigation. He has authored or co-authored 3 books and authored more than 50 chapters and 200 articles in peer reviewed journals. He has both lectured nationally and internationally on topics related to neurologic urology, and urodynamic testing, urology nursing, wound, ostomy, and continence nursing and evidence-based practice. Dr. Gray is a past president of both the Society of Urologic Nurses and Associates (SUNA) and the Certification board for the Urologic Nurses and Associates. He has received awards for contributions to Urologic and WOC nursing respectively and is a National Association for Continence Care Champion.

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