Neurogenic Lower Urinary Tract Dysfunction

How, When, and with Which Patients Do We Use Urodynamics?

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KEYWORDS

• Neurogenic bladder • Spinal cord injury • Myelodysplasia • Urodynamics • Autonomic dysreflexia

KEY POINTS

- Neurogenic lower urinary tract dysfunction (NLUTD) affects a large population of patients with variable bladder behaviors depending on extent of disease.
- Videourodynamics can be useful to evaluate outlet and upper tracts during filling and voiding.
- Monitoring blood pressure during urodynamics (UDS) for autonomic dysreflexia is especially important for patients with spinal cord injury (SCI).
- UDS in patients with NLUTD are challenging because of the inherent lack of sensation and lack of correlation of symptoms to upper tract disease.
- Patients with SCI undergo a period of spinal shock after injury usually lasting 4 to 6 weeks; initial study should be delayed until after bladder reflexes return.

WHO: EPIDEMIOLOGY OF NEUROGENIC LOWER URINARY TRACT DYSFUNCTION

Neurogenic lower urinary tract dysfunction (NLUTD) (also referred to as neurogenic bladder [NGB]) is a condition in which neurologic disease manifests by alteration of bladder and sphincter activities through abnormal bladder innervation. NLUTD affects a large population of patients suffering from various conditions, including spinal cord injury (SCI), stroke, traumatic brain injury, brain tumor, meningomyelocele, cerebral palsy, multiple sclerosis, disk disease, Parkinson disease, and other diseases with long-term neurologic dysfunction, such as diabetes, pernicious anemia, and tabes dorsalis. Bladder behavior in each subset of patients is unique depending on extent and length of disease and may require close monitoring for symptomatic control and evaluation for potential upper tract deterioration.

Historical Perspective

Before the late 1970s, it was well recognized that patients with NGB developed bladder dysfunction and obstructive uropathy slowly in the first 5 years after injury, followed by a faster progression to eventual renal failure, hypertension, stone formation, incontinence, vesicoureteral reflux (VUR), autonomic dysreflexia (AD), and even death.[1] The recognition that bladder storage pressure is related to upper tract damage was first published in 1978 by Light and colleagues,[2] who reported upper tract deterioration in children with myelodysplasia. This

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was followed by the more familiar work of McGuire and colleagues,[3] in 1981, who described more definitively that myelodysplastic children with elevated detrusor leak point pressure (DLPP) are at risk to develop upper tract disease. This landmark study evaluated 42 pediatric subjects with spinal dysraphism. These subjects underwent urodynamics (UDS) and 68% of subjects with a DLPP greater than 40 cm of water were found to have VUR and 81% had dilated upper tracts on excretory urography. In contrast, none of the subjects with a DLPP less than 40 cm of water had VUR and only 9% had dilation of upper tracts. Subsequently, in 1989, Ghoniem and colleagues[4] described the relationship between high DLPP and poor bladder compliance leading to renal dysfunction, thus prompting the use of pharmacologic therapy in conjunction with intermittent catheterization or procedures, such as bladder neck incision, to decrease outlet resistance.

HOW: PERFORMING UDS IN A PATIENT WITH NLUTD

Preparation for the Study

Many patients with NLUTD also have neurogenic bowel with a home bowel regimen. If the patent is not on a bowel regimen, bowel evacuation may be necessary before the study to allow for accurate rectal catheter pressure readings.[5] If patients are already on a bowel program, rectal suppositories or enemas should be administered with enough time before the study to allow the medication to take effect and avoid bowel movements during the procedure.

The study can be performed in the supine, sitting, or standing positions, or during ambulation.[6] Many patients with NLUTD have limitations in mobility, not allowing them to sit or stand at a commode. These patients do not usually void into a toilet and, therefore, it is acceptable to do the study in the supine position during the test. Patients should be comfortable regardless of position and care should be taken to avoid excess pressure on the limbs and to protect skin from breakdown. If patients volitionally void, the study should be performed in the position in which they usually void (standing or sitting) to allow for optimal pressure-flow measurement. If using fluoroscopy, it is ideal that the patient is positioned so that oblique images can be captured to adequately visualize the bladder neck. To perform the pressure-flow portion of the study, urine may be collected into a wide-bore drainpipe with length to reach the flowmeter. Multiple positions might be required, especially when expected results are not achieved in the supine position.

Filling Rate

Patients with NLUTD tend to be more sensitive to the speed of filling. A voiding diary is often helpful to determine if the filling rate should be decreased. A voiding diary that reveals low volumes and/or consistent leakage with or between each void or catheterization warrants lower filling rates. Generally, starting at a low rate of 10 mL/min or less is advised.[7] If no increase in detrusor pressure is seen, the rate may be increased slowly. If the detrusor pressure continues to increase with filling, decreasing the filling rate or stopping the infusion can help determine if the increase in pressure is due to a detrusor contraction or impaired compliance. In a child with NLUTD, the rate can be calculated as 2% to 10% of the child's age-related bladder capacity.[8,9] Filling rates greater than 20% of estimated bladder capacity have been shown to artificially raise detrusor pressures.[10]

Electromyography

Electromyography (EMG) during UDS is very useful in patients with NLUTD because it may confirm denervation of the pelvic floor musculature or identify discoordination of the external urethral sphincter. In patients with sensation, pad surface electrodes can be placed around the anus. The surface EMG is described as an indirect measure of external sphincter activity. Needle electrodes that more directly assess sphincter function are often used with patients with SCI who have no sensation.[11]

EMG is especially important in evaluation of patients with neurologic lesions suggestive of detrusor external sphincter dyssynergia (DESD) or other evidence of impaired bladder emptying. DESD is seen during the voiding phase of the UDS (**Fig. 1**). During DESD, the external (voluntary) sphincter contracts (signified by increased EMG activity on UDS), which impairs the ability to empty the bladder by obstructing the outlet and may prevent a sustained bladder contraction, further impairing bladder emptying. EMG is also useful in monitoring patients who have undergone sphincterotomy (see later discussion).

Videourodynamics

Fluoroscopic imaging at the time of videourodynamics allows for the visual evaluation of the entire urinary tract during filling and voiding phases of the study. This imaging identifies anatomic and functional abnormalities of the urinary tract. Fluoroscopy may be performed on a radiograph table in the supine position, or in an radiograph-compatible UDS chair. Patients with NLUTD often