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Evaluating incontinence in women

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Urinary incontinence in women includes a spectrum of disorders ranging from "simple" stress incontinence to bladder instability to neurological disorders, and it may often involve these problems in combination. Unfortunately, a patient's reported symptoms are often unreliable in defining the precise nature and severity of urinary incontinence [1–3]. By performing a physical examination, urinalysis, voiding diaries and pad tests, cystoscopy, and videourodynamics, the physician can develop a detailed, individualized understanding of the patient's symptoms and their degree of bother to her. Given the widespread and increasing prevalence of urinary incontinence in women (20–30% during young adult life, 30–40% in middle age, and 30–50% thereafter) [4], it is vital for clinicians to be adept with the available diagnostic techniques and their indications.

History and physical examination

Obesity [5], parity [6], smoking, fluid intake, medications (ie, diuretics, alpha-adrenergics), menopause, previous incontinence surgery, and possibly hysterectomy [6] are risk factors for incontinence, and they should be evaluated in the medical history [7]. Acute and reversible causes of incontinence, especially in the elderly, are elegantly summarized by Resnick's 1996 mnemonic "DIAPPERS": delirium, infection, atrophic vaginitis, pharmaceuticals, psychologic problems, excess urine output, restricted mobility, and stool impaction [8]. The physician should inquire about the frequency, timing, and severity of episodes of incontinence, precipitating factors, association with the urge to urinate, and the duration of the incontinence and its degree of bother to the patient.

Physical examination of a woman complaining of incontinence must include an evaluation of the abdomen and pelvis, as well as thorough neurologic testing. If the patient arrives with a full bladder, she can be examined with a full bladder, in the lithotomy position and standing. An attempt is made to precipitate stress incontinence by asking the patient to cough or perform a Valsalva maneuver. Rare causes such as vesicovaginal fistula may be revealed on pelvic exam.

A vaginal exam is performed using a speculum, and the vaginal walls and cervix are evaluated. Careful attention should be paid to signs of urogenital atrophy in the postmenopausal patient, as it can contribute to urinary dysfunction. Asking the patient to strain or cough can allow the examiner to visualize the descent of the uterine cervix, if present, and can also provoke stress incontinence if the patient's bladder is full. Using only the posterior blade of the speculum, the examination is repeated, visualizing the anterior vaginal wall for signs of cystocele or hypermobility. The anterior vaginal wall is examined digitally in order to palpate for the attachment of the vaginal wall to the pelvic floor, specifically attempting to distinguish between lateral and central defects in support. Digital rectal exam is used to assess the strength of the posterior vaginal wall and the presence of rectocele or posterior enterocele, as well as anal sphincter tone. The patient is asked to contract her pelvic floor muscles while the examiner's

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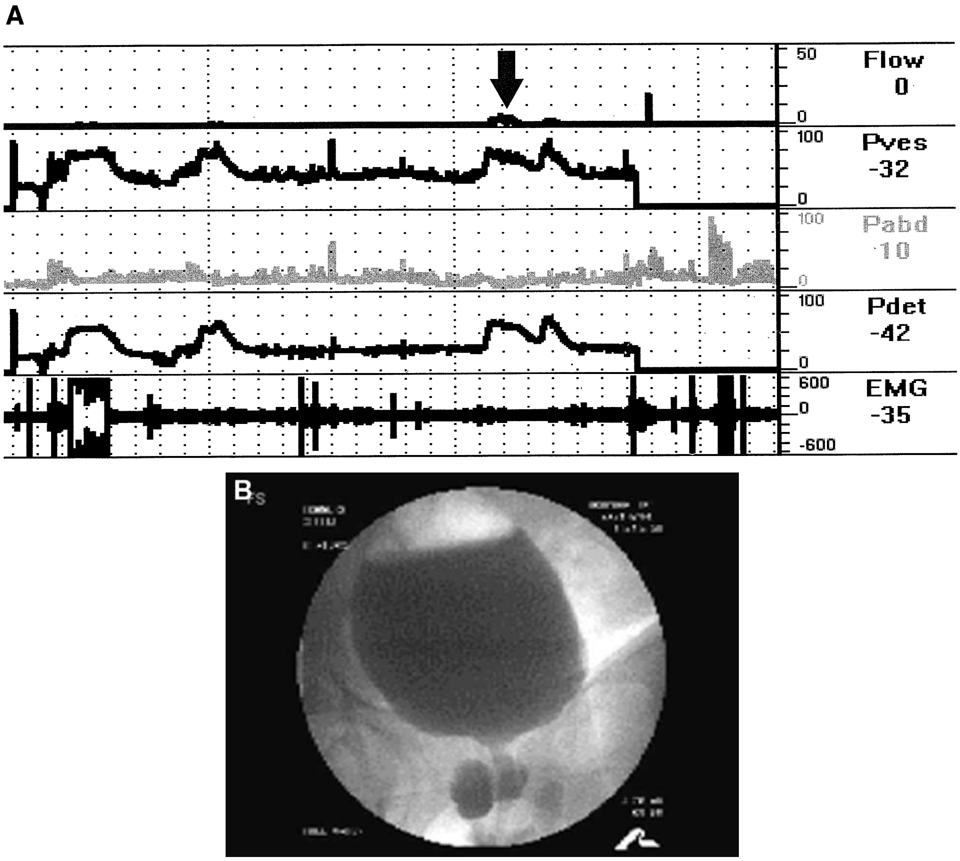

Fig. 1. (A) A 66 year old woman complained of dysuria and frequency. On videourodynamic study (VUDS) she had a uroflow of less than 5 ml/s with a detrusor pressure of 75 cm H_2O, indicative of urethral obstruction. Flow = uroflow, Pves = bladder pressure, Pabd = abdominal pressure, Pdet = detrusor pressure, EMG = electromyography, VH_2O = infused volume of water. (B) voiding cystourethrogram taken at the arrow in figure 1A shows the point of obstruction to be a multilocular urethral diverticulum. (Courtesy of J.G. Blaivas, MD.)

fingers are in the vagina and rectum; this enables the examiner to assess the strength and tone of the pelvic floor muscles. Finally, the uterine fundus and adnexae should be palpated to rule out the presence of masses, both with respect to their contribution to urinary symptoms and for the sake of the patient's general gynecologic health. This is more easily done after the patient has emptied her bladder.

When uterovaginal prolapse is present, reducing the organs to their proper position can reveal stress incontinence in patients in whom the prolapse is effectively providing urinary obstruction [9,10]. The judicious use of a vaginal pessary can be an invaluable diagnostic and therapeutic tool in the incontinent woman with prolapse.

A cotton swab test can be used to quantify urethral hypermobility, and there are those who consider urethral hypermobility as a prognostic indicator for surgical outcome [11–13]. The presence of a hypermobile urethrovesical junction is not, however, in itself diagnostic or predictive of incontinence [14–16]. Imprecision in measuring the change in angle, as well as dependence on patient effort and questionable reproducibility, can undermine the utility of this easily performed test.

Neurologic testing

Pre-existing, occult, and learned neurologic dysfunction can trigger incontinence, and there-

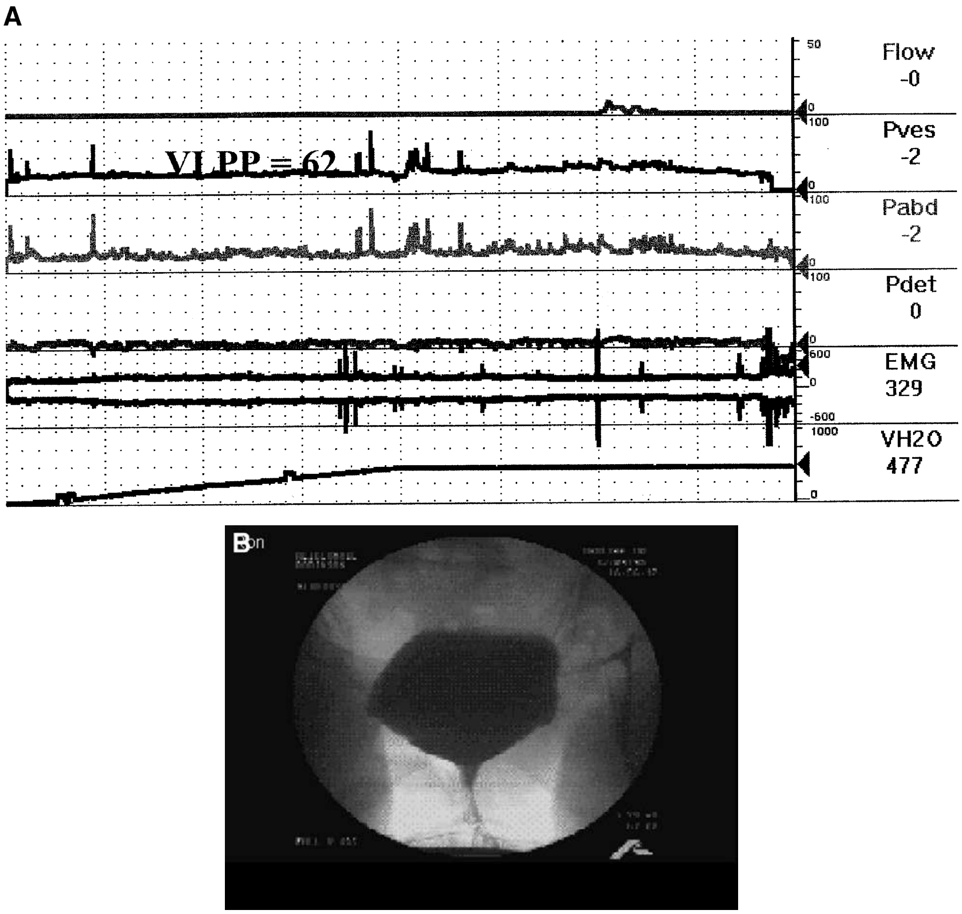

Fig. 2. (A) A 76-year-old woman had persistent stress incontinence when coughing. Note also low uroflow indicating impaired detrusor contractility. This woman might be at risk for obstruction following PVS surgery. Pdet = detrusor pressure; EMG = electromyogram; Pabd = abdominal pressure; Pves = vesicle pressure; Q = flow; VH_2O = infused volume of water; VLPP = vesical leak point pressure. (B) Videourodynamic image, taken at VLPP in above VUDS, showing open bladder neck and sphincteric incontinence. (Courtesy of J.G. Blaivas, MD.)

fore, a thorough neurologic evaluation is an essential part of the care of the incontinent woman. Neurologic disorders can be associated with detrusor hyperreflexia and sphincteric incontinence [17–19]. In the patient who is already known to have neurologic disease, it is important to obtain information about her baseline capability and function so this information can guide therapy and clinical surveillance. A neurologic evaluation can reveal unsuspected systemic illness in the patient who presents with incontinence, and it can reveal reversible learned causes of urinary tract dysfunction in others. If the patient is not known to have neurologic disease, it is important to ask about double vision, muscular weakness, paralysis or poor coordination, tremor, and numbness and tingling.

Neurologic examination includes assessment of deep tendon reflexes in the lower extremities as well as sensation. A rectal examination should be performed to evaluate sphincter tone and control, perianal sensation should be assessed, and the bulbocavernosis reflex, elicited by sudden pressure on the clitoris and exhibited by tensing of the anal sphincter, should be checked. Electromyogram (EMG) evaluation at the time of urodynamics can assess external sphincter activity [20].

Multiple sclerosis is a neurologic disease that can have a profound impact on the urinary system; most patients will present with irritative symptoms

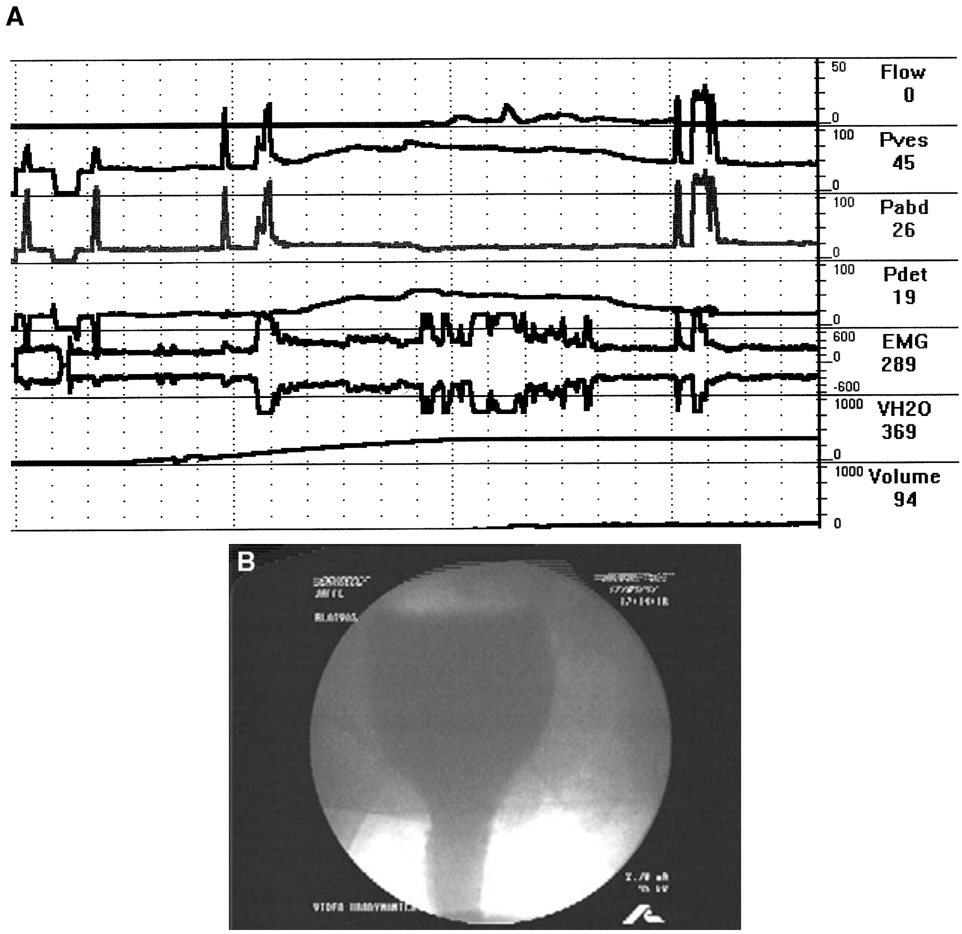

Fig. 3. (A) This 84-year-old patient had an involuntary detrusor contraction and was unable to abort the contraction despite muscular activity. She had a prominent cystocele. (B) Videourodynamic image taken during the preceding study, showing the bladder with large prolapsing cystocele. (Courtesy of J.G. Blaivas, MD.)

such as frequency and urgency but may also have urge incontinence and will exhibit detrusor hyperreflexia on urodynamic examination [21,22].

Urinalysis

Though the primary clinician must be prepared to encounter unusual and difficult problems related to urination, the rule that "common things occur commonly" applies to urinary complaints as well. The national center for health statistics estimated that 6 million patient-visits annually are related to urinary tract infection [23]. Cystitis and urinary tract infection are risk factors for urgency and urge incontinence, and it is essential to rule out this pathology prior to initiating any more intensive workup. The presence of hematuria can be a sign of tumors, stones, and foreign bodies in the bladder.

Voiding diary

Among the many benefits of a voiding diary is the information it gives about the patient's typical urinary habits, compared with information derived from a clinical examination during which the patient's physical or emotional discomfort may substantially influence her ability to communicate and to urinate. The precise format and composition of the diary has not been optimally determined, but generally the patient is asked to

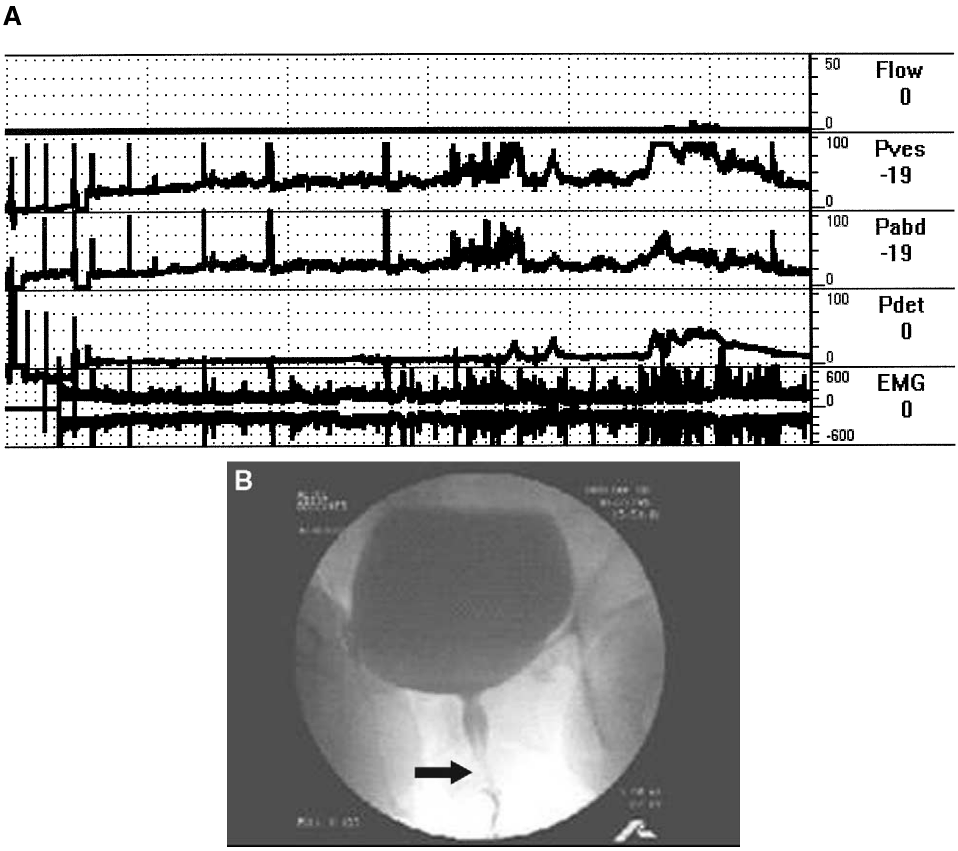

Fig. 4. (A) A 64 year-old woman complaining of frequency and urgency. The urodynamic tracing demonstrated urethral obstruction characterized by a sustained detrusor contraction of 50 cm H_2O and a flow that was barely measurable. During the detrusor contractions there were sporadic contractions of her sphincter shown by increased EMG activity, believed to be the cause of her obstruction. (B) Voiding cystourethrogram taken during sphincteric contraction at videourodynamic study above shows narrowing of the distal urethra. Failure of the bladder neck and distal urethra to open widely is typical of uncoordinated micturition. (Courtesy of J.G. Blaivas MD.)

record information about voiding time and volume, and she may also be asked to provide information about fluid intake and physical activity over a variable interval, usually 24–72 hours. Groutz et al found a 24-hour diary appropriate for research purposes [24]. A recent study by Nygaard and Holcomb [25] showed that the first 3 days of a 7-day diary correlated well with the final 4 days, and it concluded that 3 days, which were also found to be reproducible, were sufficient for collecting valid information. This is a vital part of diagnosis in the incontinent woman, as it provides estimates of 24-hour urine volume, voiding frequency, nocturia, and functional bladder capacity. These estimates have been found to be reliable indicators of a patient's urinary status [24]. Instruction and encouragement are essential parts of obtaining the voiding diary with patient compliance highly dependent on the length of investigation and on encouragement.

Pad test

In conjunction with a voiding diary, a pad test provides additional objective information concerning the severity of the patient's urinary incontinence, and in particular, information that is substantially more accurate than subjective assessment of urine loss [2]. There are a variety of available methodologies for performing a valid pad test, and testing interval varies from hours to days and may or may not be performed in conjunction with an exercise program [26–28]. The increased

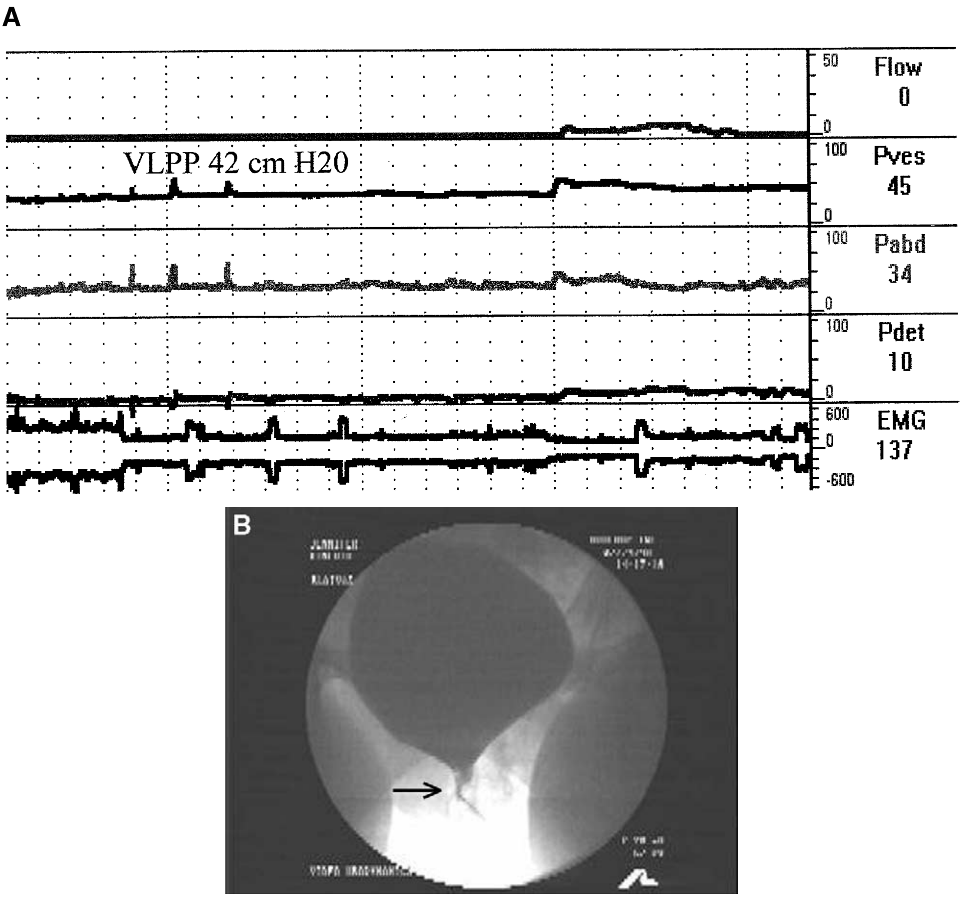

Fig. 5. (A) Stress incontinence in a 31-year-old woman who failed a vaginal wall sling. She has a vesical leak point pressure of 42 cm H_2O. Impaired detrusor contractility is evidenced by an obstructed-appearing flow curve with a maximum flow of 6 cm H_2O and a detruson contraction of 15 cm H_2O. (B) Cystogram obtained during bladder filling in the preceding VUDS showed an open vesical neck at rest. (Courtesy of J.G. Blaivas, MD.)

standardization from an instilled bladder volume, however, comes at a cost of increased invasiveness and discomfort for the patient. It is our practice to use a 24-hour pad test concurrent with the voiding diary; there is evidence that longer pad tests increase reliability at the cost of patient compliance [24]. The patient is instructed to wear vaginal pads for the test period, changing them as necessary because of wetness. When changed, each pad is placed in a separate plastic bag and sealed. After the patient returns to the office, the weight of each pad is compared with the dry weight of a control pad, and the difference in grams provides an estimate of the total amount of moisture lost into the pads over the test period. Though evaporation loss is minimized by weighing the pads within 72 hours of the test [29], delay of even up to a week or more may be acceptable [30,31]. A weight gain of up to 8 g in 24 hours is considered normal [30–32]. The assessment of urine loss by this method provides an objective quantification of losses from incontinence and can be used to measure the success or failure of therapy. In women where excessive pad weight gain is suspected to be caused by vaginal discharge or perspiration, administration of pyridium or other agents to color the urine can be useful [33].

Uroflowmetry

Noninvasive uroflowmetry is an easy test to perform that is also the first among these preced-

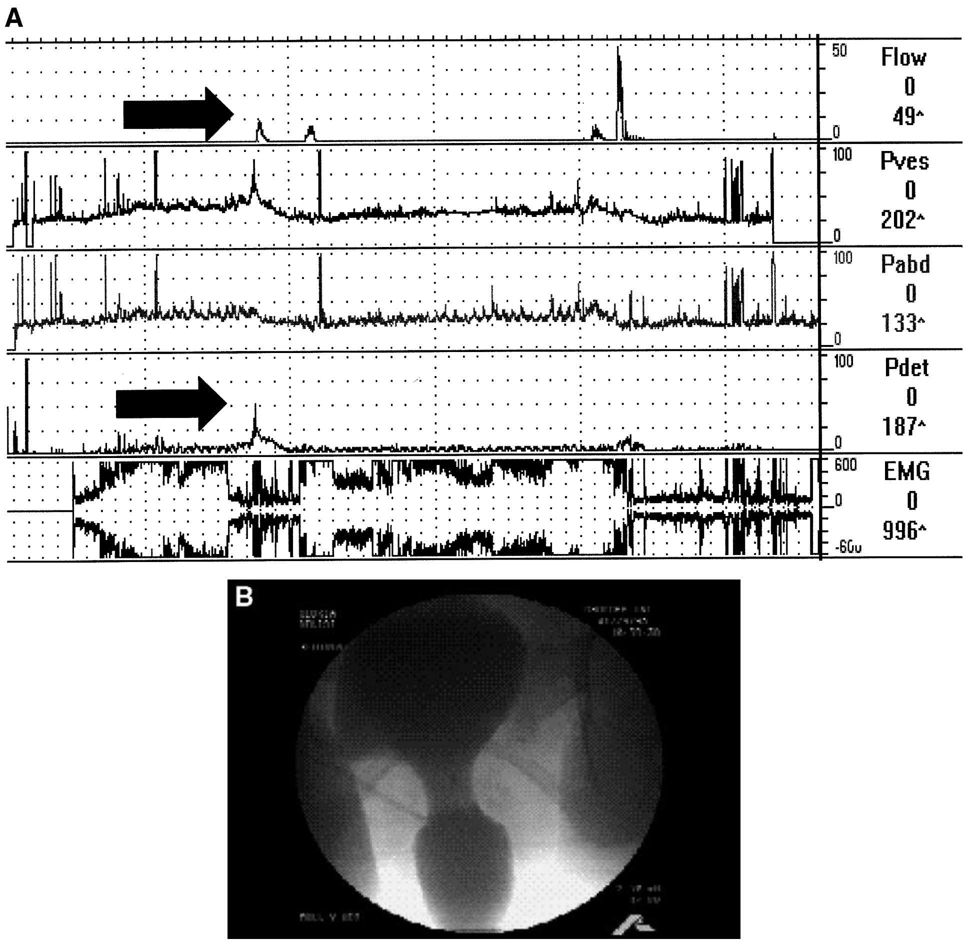

Fig. 6. (A) A 65 year-old woman with grade IV cystocele. At the arrows, she voids with a detrusor pressure of 50 cm H_2O and a flow of 6 ml/s, indicating urethral obstruction. (B) Voiding cystourethrogram taken at the arrow shows a large cystocele obscuring the urethra and causing obstruction. (Courtesy of J.G. Blaivas, MD.)

ing components of the work-up that can provide dynamic functional information about the urinary tract. Free flow is preferred over flow measured during urodynamic evaluation, as the presence of even a small urinary catheter has a marked impact on measured flow rate and may therefore provide misleading information [34]. Normal flow rates for women vary according to volume voided and age (Q max roughly 20–36 mL/s), and, in both men and women, they are dependent on detrusor pressure and bladder outlet resistance. Flow is particularly useful as a screening test in patients with bladder overactivity to detect urethral obstruction. Flow measurements can suggest further examination and can provide a baseline against which any changes can later be measured.

Postvoid residual urine measurement

Measurements of postvoid residual urine are known to have low test-retest reliability and are highly variable in different patients [35]. Less than 50 mL of residual urine is considered normal, and persistent residual urine of more than 200 mL is considered abnormal and should be investigated [36]. The presence of large residual volumes in the setting of incontinence may suggest outlet obstruction with overflow incontinence; however, further clinical investigation is needed to confirm the diagnosis.

Urodynamic testing

For optimal results, urodynamic testing must be an interactive process between patient and

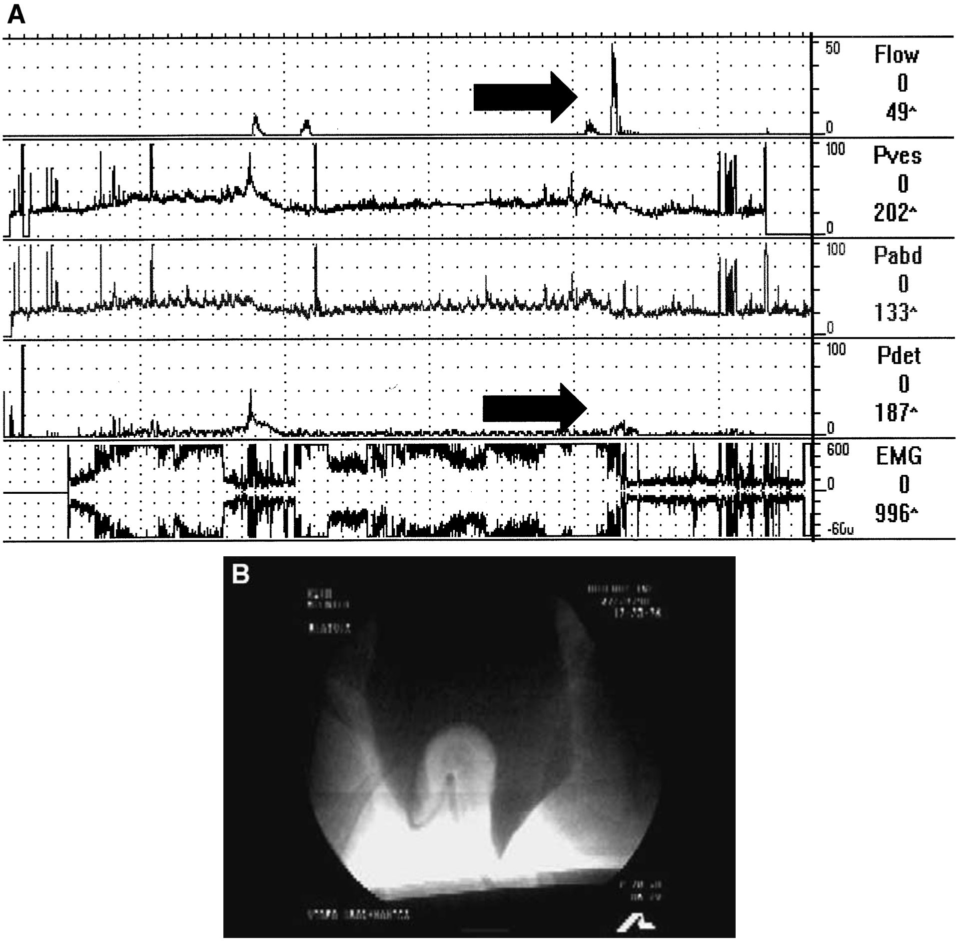

Fig. 7. (A) The same patient as in Figure 6. With the prolapse reduced, the obstruction is relieved, and occult stress incontinence is apparent. She voids with a maximum flow of 49 ml/s and a detrusor pressure of < 10 cm H_2O. Leak point pressure was about 90 cm H_2O. (B) Prolapse reduced; high flow at low detrusor pressure. (Courtesy of J.G. Blaivas, MD.)

examiner. Prior to performing a urodynamic evaluation on a patient, the examiner should have a suspected clinical diagnosis. The patient's diary and pad test should be reviewed in order to guide the examiner during the videourodynamic study. If a patient becomes incontinent at a volume three times her functional bladder capacity as estimated by her diary, this is of limited significance. If a patient's suspected stress incontinence cannot be demonstrated at videourodynamics but her pad test shows 200 g of loss in 24 hours, there is something clinically inconsistent. The information gained from these evaluations should therefore work synergistically to help the clinician make an accurate diagnosis.

Urodynamic testing incorporates a variety of techniques and procedures that in conjunction can measure the functional parameters of the bladder including detrusor pressure and capacity, provide anatomic information regarding the bladder outlet and the presence of prolapse or diverticula, and evaluate the involvement of or risk of harm to the upper urinary tract. These techniques often provide valuable functional parameters that can later be used in monitoring treatment success or failure. Methodology ranges from equipment-intensive videourodynamics with fluoroscopy and ambulatory urodynamic monitoring to the simple "eyeball" urodynamics using a standard catheter and an understanding of basic principles of fluid mechanics. There are those who advocate urodynamic testing in all patients with incontinence [1]; others have observed no clinical differences in outcome following retropubic surgery in younger patients with simple stress incontinence (excluding those who had "significant incontinence suggesting intrinsic sphincter deficiency (ISD)" (leak point pressure <60 cm H_2O) or who had complex symptoms [37]. We believe that videourodynamic studies offer the most comprehensive assessment of lower urinary tract function and advocate it in all women with persistent incontinence. This is not to say that incontinence cannot be accurately diagnosed without videourodynamics, but rather that the clinician's diagnosis is rendered more accurate using the additional information provided by the urodynamic study.

For "eyeball" urodynamics, the patient is catheterized with a Foley catheter and a large syringe with the plunger removed is attached to the free end. The bladder is then filled with fluid gradually, and the vesical pressure can be estimated by observing the number of centimeters of water in the column rising above the level of the symphysis pubis. Bladder contractions will raise the fluid level or slow the rate of inflow in the catheter. It is important when using this method to distinguish true detrusor contractions from abdominal straining that will have the same effect on the fluid level and flow; this can be done by palpation of the abdomen while instilling the liquid.

Multichannel urodynamic studies provide more objective information than any other kind of urologic investigation, although this is not without its drawbacks. Through the simultaneous measurement of the patient's abdominal, detrusor, and bladder pressures, along with the imaging of the urinary tract, disorders of bladder filling, storage, and emptying can often be diagnosed. Urodynamic testing is the preferred method of demonstrating the involuntary detrusor contractions associated with overactive bladder, and it is essential for the diagnosis of bladder outlet obstruction in women. Simultaneous video imaging can identify focal narrowings of the bladder outlet, urethral mobility, prolapse, vesicoureteral reflux, and bladder diverticula, all of which can cause or contribute to problems with urinary continence.

Catheters are placed in the rectum and bladder to measure the ambient pressures. After the catheters are placed, they are zeroed to atmospheric pressure and to the level of the symphysis pubis to provide a baseline for recording. The bladder is gradually filled with fluid containing radiographic contrast. Automated subtraction of bladder pressure from abdominal pressure provides a dynamic measurement of detrusor pressure. Increases in vesical pressure when pressure in the abdomen is constant are documented detrusor contractions. A urinary flowmeter measures any urine leakage during the examination, and it allows flow rate to be correlated with detrusor pressure (noting the above understanding that the presence of the catheter interferes with measurement of ideal uroflow).

Electromyographic measurement can be obtained as well, providing information about the timing of muscular contractions.This is invaluable in patients with neurogenic bladder dysfunction but can be of use in patients in whom neurologic disorders are not suspected. Groutz et al reviewed 1015 consecutive urodynamic studies to assess the prevalence of learned voiding dysfunction, defined as EMG or fluoroscopic detection of external urethral sphincter contractions during micturition in the absence of neurologic or anatomic defects. The incidence was 2% [38].

It has recently been questioned whether ambulatory urodynamics, which has shown that it has the potential to increase the detection rate of involuntary detrusor contractions in the subject population [39,40], provides clinically valuable information. Gorton and Stanton suggested that this newer technique of urodynamic monitoring may not have substantial clinical utility [41].

Urodynamic testing can provide vital information to distinguish between cases of urge incontinence and stress incontinence that can have similar history and that can be difficult to reproduce during a pelvic exam. Between one third and one half of women who have stress incontinence also complain of urinary frequency, and or urinary urgency and urge incontinence [17]; urodynamic testing can also be vital in separating cases of pure stress incontinence from mixed stress and urge incontinence and thus has the potential to influence the success of treatment in the long term.

The intrinsic strength of the urinary sphincter mechanism can be measured; a low maximal urethral closure pressure (<20 cm H_2O) was identified by McGuire in 1981 as a risk factor for failed incontinence surgery [42]. The Valsalva leak point pressure was described by McGuire and is measured by filling the bladder until the patient is comfortably full. The lowest bladder pressure associated with leakage is recorded, and a low leak point pressure (<60 cm H_2O) is statistically associated with a low maximal urethral closure pressure (MUCP) and with intrinsic sphincter deficiency [43]. We prefer the term "vesical leak point pressure," as it identifies where the pressure is being measured. Petrou and Wan reviewed the evolution and usage of the vesical leak point pressure VLPP in clinical practice and found that it correlates well with the symptom of stress incontinence [44]. In contrast, Bump et al observed the difficulty in defining ISD based on these parameters [45]. Peschers et al's observations regarding VLPP compared with CLPP (cough leak point pressure) suggest that the precise diagnosis of incontinence from ISD requires more than these tests can currently provide [46].

Finally, though we have noted the utility of urodynamic testing in the female patient with incontinence, it is important to acknowledge that variations in technique and intrinsic variability of the physical factors being tested can undermine the overall value of urodynamic testing [47]. Though urodynamic testing is essential for detecting phasic bladder contractions and classifying them [48], and cystometric examination is the standard method of investigating the overactive bladder [49], the relationship between the urodynamic findings in specific "overactive" bladder conditions and the therapies for these conditions is not yet clearly elucidated [50]. The utility of urodynamic evaluation in a patient with overactive bladder symptoms is inextricably tied to our ability to interpret the patient's clinical signs and symptoms [51] as well as our ability to describe objectively the outcome of the investigation. The length of the urodynamic study, patient instruction, patient acclimation to urodynamics, and patient positioning and learning or instruction [49,52] may all influence the presence of clinical signs in a particular group of patients [51], and even healthy volunteers have been noted to exhibit phasic bladder contractions. In order to achieve the best results for the patient, urodynamic testing should be performed in a targeted fashion that attempts to reproduce the conditions under which the patient has experienced incontinence, rather than as a generalized method of collecting numeric data and tracings that in themselves may contribute neither diagnostic nor therapeutic value.

Videourodynamic cases

Figs. 1–7.

Cystoscopy

Cundiff and Bent found that cystoscopic investigation changed the course of management in 7% of incontinent women in their series [1]. It is our practice to undertake cystoscopic evaluation in women with complaints of urinary urgency and urge incontinence in order to detect the potentially dangerous presence of intravesicular tumors and the rare but treatable bladder calculi. There are those who believe that the discomfort and expense of this procedure outweigh the likely benefit in simple cases of incontinence, and that this methodology should be reserved for patients who are suspected of having lower urinary tract pathology [53].

Summary

Urinary incontinence in women has a multitude of presentations and can be a pure and simple entity or a complicated combination of overlying disorders. The diagnosis and work-up of the incontinent woman should proceed from the classic tools of medical treatment, as well as the history and physical exam, and should incorporate modern techniques of dynamic imaging. It is vital to remember that it is often not until a simple treatment has failed that we appreciate a patient's complex problem, and, for this reason, we advocate appropriate use of the available technologies in order to separate more carefully the straightforward disorder from the intricate and convoluted problems. A thorough investigation of the multiple dimensions of urinary incontinence in the female patient, using subjective and objective testing, is the key to diagnostic and clinical success.

References

[1] Cundiff GW, Harris RL, Coates KW, Bump RC. Clinical predictors of urinary incontinence in women. Am J Obstet Gynecol 1997;177:262–7.

[2] Ryhammer AM, Laurberg S, Djurhuus JC, Hermann AP. No relationship between subjective assessment of urinary incontinence and pad test weight gain in a random population sample of menopausal women. J Urol 1998;159(3):800–3.

[3] Stanton SL, Ozsoy C, Hilton P. Voiding difficulties in the female: prevalence, clinical and urodynamic review. Obstet Gynecol 1983;61:144–7.

[4] Hunskar S, Arnold EP, Burgio K, Diokno AC, Herzog AR, Mallett VT. Epidemiology and natural history of urinary incontinence. Int Urogynecol J 2000;11:301–19.

[5] Burgio KL, Matthews KA, Engel BT. Prevalence, incidence, and correlates of urinary incontinence in

healthy, middle-aged women. J Urol 1991;146(5): 1255–9.
[6] Milsom I, Ekelund P, Molander U, et al. The influence of age, parity, oral contraception, hysterectomy, and menopause on the prevalence of urinary incontinence in women. J Urol 1993;149(6): 1459–62.
[7] Zorn B, Steers WD. Incontinence: urinary risk factors in women. Contemp Uro 2000;12(1):44–9.
[8] Resnick NM. Geriatric Incontinence. Urol Clin North Am 1996;23(1):55–75.
[9] Nichols DH. Vaginal prolapse affecting bladder function. Urol Clin N Amer 1985;12:329.
[10] Ward JN, Lavengood Jr RW, Draper JW. Pseudo bladder neck syndrome in women. J Urol 1998; 99:65.
[11] Bergman AA, Koonings PP, Ballard CA. Negative Q-tip test as a risk factor for failed incontinence surgery in women. J Repro Med 1989;34:193.
[12] Handa VL, Jensen JK, Ostergard DR. The effect of patient position on proximal urethral mobility. Obstet Gynecol 1995;86:273–6.
[13] Montella JM, Ewing S, Cater J. Visual assessment of urethrovesical junction mobility. Int Urogynecol J 1997;8:13–7.
[14] Bergman A, McCarthy TA, Ballard CA, Yanai J. Role of the Q-tip test in evaluating stress urinary incontinence. J Repro Med 1987;32:273–5.
[15] Bhatia NN, Ostergard DR, McQuown D. Ultrasonography in urinary incontinence. Urology 1987; 29:90–4.
[16] Brandt FT, Albuquerque CDC, Lorenzato FR, Amaral FJ. Perineal assessment of urethrovesical junction mobility in young continent females. Int Urogynecol J 2000;11:18–22.
[17] Blaivas JG, Olsson CA. Stress incontinence: classification and surgical approach. J Urol 1988;139: 727–31.
[18] Nitti VW. Evaluation of the female with neurogenic voiding dysfunction. Int Urogynecol J 1999;10: 119–29.
[19] Wein AJ. Classification of neurogenic voiding dysfunction. J Urol 1981;125:605–9.
[20] Labib KB, Bauer SB, Blaivas JG. External sphincter electromyography in a comprehensive urodynamic evaluation. Archives Phys Med & Rehab 1977;58:521.
[21] Blaivas JG. Management of bladder dysfunction in multiple sclerosis. Neurourology 1980;30(2):12.
[22] Rackley RR, Appell RA. Evaluation and management of lower urinary tract disorders in women with multiple sclerosis. Int Urogyn J 1999;10: 139–43.
[23] National Center for Health Statistics: 1985 Summary. Adv Data 1985;128:1–8.
[24] Groutz A, Blaivas JG, Chaikin DC, Resnick NM, Engleman K, Anzalone D, et al. Noninvasive outcome measures of urinary incontinence and lower urinary tract symptoms: a multicenter study of micturition diary and pad tests. J Urol 2000;164: 698–701.
[25] Nygaard I, Holcomb R. Reproducibility of the seven-day voiding diary in women with stress urinary incontinence. Int Urogynecol J 2000;11: 15–7.
[26] Persson J, Bergqvist CE, Wolner-Hanssen PW. An ultra-short perineal pad test for evaluation of female stress urinary incontinence treatment. NUUD 2001;20:277–85.
[27] Ryhammer AM, Djurhuus JC, Laurberg S. Pad testing in incontinent women: a review. Int Urogynecol J 1999;10:111–5.
[28] Lose G, Rosenkilde P, Gammelgaard J, Schroeder T. Pad-weighing test performed with standardized bladder volume. Urology 1988;23(1):78–80.
[29] Wilson PD, Mason MV, Herbison GP, Sutherst JR. Evaluation of the home pad test for quantifying incontinence. Br J Urol 1989;64:155–7.
[30] Lose G, Jorgensen L, Thunedborg P. 24-hour home pad weighing test versus 1-hour ward test in the assessment of mild stress incontinence. Acta Obstet Gynecol Scand 1989;68:311–5.
[31] Versi E, Orrego G, Hardy E, Seddon G, Smith P, Anand D. Evaluation of the home pad test in the investigation of female urinary incontinence. Br J Obstet Gynecol 1996;103:162–7.
[32] Mouritsen L, Berild G, Hertz J. Comparison of different methods for quantification of urinary leakage in incontinent women. NUUD 1989;8: 579–87.
[33] Wall LL, Wang K, Robson I, Stanton SL. The pyridium pad test for diagnosing urinary incontinence. A comparative study of asymptomatic and incontinent women. J Reprod Med 1990;35: 682–4.
[34] Groutz A, Blaivas JG, Sassone AM. Detrusor pressure uroflowmetry in women: effect of a 7F transurethral catheter. J Urol 2000;164:109–14.
[35] Stoller ML, Millard RJ. The accuracy of a catheterized residual urine. J Urol 1989;141:15–6.
[36] Fantl JA, Newman DK, Colling J, et al. Urinary incontinence in adults: acute and chronic management. Clinical Practice Guideline No. 2: Update; 1996. Rockville, MD: US Department of Health and Human Services, Public Health Service, Agency for Health Care Policy and Research. AHCPR, Publication #96–0682.
[37] Thompson PK, Duff DS, Thayer PS. Stress incontinence in women under 50: does urodynamics improve surgical outcome? Int Urogyn J 2000;11: 285–9.
[38] Groutz A, Blaivas JG, Pies C, Sassone AM. Learned voiding dysfunction (non-neurogenic, neurogenic bladder) among adults. Neurourol Urodyn 2001;20(3):259–68.
[39] Heslington K, Hilton P. Ambulatory monitoring and conventional cystometry in asymptomatic female volunteers. Brit J Obstet Gynecol 1996;103:434–41.

[40] Swithinbank L, James M, Shepard A, Abrams P. The role of ambulatory urodynamic monitoring in clinical urologic practice. NUUD 2000;18:215–22.
[41] Gorton E, Stanton S. Ambulatory urodynamics: do they help clinical management? Br J Obstet Gynecol 2000;107:316–9.
[42] McGuire EJ. Urodynamic findings in patients after failure of stress incontinence operations. Prog Clin Biol Res 1981;78:351–60.
[43] McGuire EJ, Fitzpatrick CC, Wan J, et al. Clinical assessment of urethral sphincter function. J Urol 1993;150:1452–4.
[44] Petrou SP, Wan J. VLPP in the evaluation of the female with stress urinary incontinence. Int Urogynecol J 1999;10:254–9.
[45] Bump RC, Coates KW, Cundiff GW, Harris RL, Weidner AC. Diagnosing intrinsic sphincter deficiency: comparing urethral closure pressure, urethral axis, and Valsalva leak point pressure. Am J Obstet Gynecol 1997;177:303–10.
[46] Peschers UM, Jundt K, Dimpfl T. Differences between cough and Valsalva leak-point pressure in stress incontinent women. NUUD 2001;19:677–81.
[47] Vereecken RL. A critical view on the value of urodynamics in non-neurogenic incontinence in women. Int Urogynecol J 2000;11:188–95.
[48] Fall M, Ohlsson BL, Carlsson CA. The neurogenic overactive bladder. Classification based on urodynamics. BJU 1989;64:368–73.
[49] Homma Y, Kondo Y, Takahashi S, Kitamura T, Kawabe K. Reproducibility of cystometry in overactive detrusor. Eur Urol 2000;38:681–5.
[50] Zinner NR. Clinical aspects of detrusor instability and the value of urodynamics. Eur Urol 1998; 34(suppl 1):16–9.
[51] Griffiths D. Clinical aspects of detrusor instability and the value of urodynamics: a review of the evidence. Eur Urol 1998;34(suppl 1):13–5.
[52] Blaivas JG, Groutz A, Verhaaren M. Does the method of cystometry affect the incidence of involuntary detrusor contractions? A prospective randomized urodynamic study. Neurourol Urodyn 2001;20:141–5.
[53] Payne CK. Epidemiology, pathophysiology, and evluation of urinary incontinence and overactive bladder. Urology 1998;51(suppl 2a):3–10.