

VALSALVA LEAK POINT PRESSURE IN THE EVALUATION OF STRESS URINARY INCONTINENCE

T.M. LANE, P.J.R. SHAH

Institute of Urology and Nephrology, London, England

ABSTRACT

Videourodynamics probably represents the most precise method of classifying stress urinary incontinence and without doubt is our preferred investigation of choice. It both confirms the demonstrable loss of urine from the urethra during a stress manoeuvre (when the vesical pressure exceeds urethral pressure in the absence of a detrusor contraction) and the severity of sphincteric dysfunction once the diagnosis of SUI has been established. Whilst few would argue with the importance of the videourodynamic examination it does necessitate simultaneous fluoroscopic examination of the lower urinary tract as well as multi-channel urodynamics. These facilities are not always readily available. Given that cystometrograms and urethral profilometry fail to provide the requisite information regarding the bladder neck and proximal urethra there arose the need for an easily reproducible method (not requiring access to more complex and expensive equipment) which could identify sphincteric dysfunction.

Observations during thousands of urodynamics demonstrated that 76% of those classified as having type III SUI (intrinsic sphincter deficiency) were recorded as having consistently low leak point pressures (less than 60 cm H₂O). The significance of this lies principally in the ease with which Valsalva leak point pressure (VLPP) can be established with only basic urodynamic equipment and without necessary recourse to formal videourodynamic examinations. It has over the last few years evolved as an easily performed and reliable test to determine the ability of the urethra to resist the expulsive force of the bladder generated by increased intra-abdominal pressure. The VLPP represents the lowest bladder pressure at which urethral leakage occurs during a prompted stress manoeuvre. It represents a dynamic test, which documents the abdominal pressure required to induce incontinence.

Perhaps a more convincing attestation to the potential clinical utility of VLPP represents the change in values before and after anti-incontinence procedures. Bladder neck collagen injection for example results in an elevation in VLPP measures, which is commensurate with the clinical improvement in symptoms.

Given the VLPP utility in identifying pre-operatively those patients in whom there is an appreciable level of sphincter dysfunction then it offers the opportunity (even for those without ready access to videourodynamics examinations) for improved selection of patients for particular (and appropriate) surgical interventions aimed at dealing with urethral coaptation with or without bladder neck re-approximation.

Key words: urinary incontinence, urodynamics, diagnosis, urethra, bladder

Braz J Urol, 26: 420-425, 2000

INTRODUCTION

The term valsalva (or abdominal) leak point pressure (VLPP) represents a measure of the intravesical pressure that is required to overcome urethral resistance during a stress manoeuvre such as coughing or straining. As a dynamic test, it is a

reflection of the stress competence of the urethra, which ultimately mirrors its ability to resist abdominal pressure as an expulsive force (1). Detrusor leak point pressure (DLPP) by contrast is the pressure at which detrusor stretch or contraction generates sufficient force to induce involuntary urinary leakage. Whilst the latter has found importance in its ability

to predict upper tract deterioration (2) in those with neuropathic bladders (an integral part in the pressure-based management of such patients) VLPP has found increasing utility as a simple surrogate for the more complex videourodynamics (VCMG) in that it provides an indication as to the extent to which intrinsic sphincter dysfunction (ISD) is responsible for incontinence.

THE EVOLUTION OF VALSALVA LEAK POINT PRESSURE

The inability of the anterior repair to make a significant long-term contribution to the management of stress urinary incontinence (SUI) saw its eventual demise. An era of more accurate patient selection and the more efficacious retropubic procedures was soon ushered in and was reflected by ever-improving clinical outcomes. There remained however a significant proportion of patients, who despite adequate bladder-neck re-approximation, continued to have SUI. In this group of patients sphincteric dysfunction appeared as a recurrent feature in those failing surgical intervention. Poor urethral closing pressures (in those performing urethral profilometry) was a frequently noted finding with maximal urethral closure pressures (MUCP) inevitably below 20 cm H₂O (3). As such MUCP measurements of less than 20 cm H₂O became widely (and perhaps erroneously) regarded as a measure of intrinsic sphincter deficiency.

ISD represents an inability of the urethra to maintain mucosal coaptation either at rest or in the presence of minimal physical stress and consequently, incontinence results. Bladder neck suspension procedures in patients with ISD unsurprisingly have a high incidence of failure because the underlying pathology is that of urethral dysfunction and poor coaptation (none of which are addressed by re-approximation). Stress incontinence (as a result of bladder neck descensus) by contrast develops because of a pressure transmission discrepancy between the bladder neck and urethra and is therefore appropriately managed by bladder neck suspension.

The role of MUCP measurements has until recently (especially in the Gynaecological literature)

been regarded as an appropriate investigation in those with suspected ISD. Unfortunately, data, which appeared to suggest that a low MUCP was diagnostic of ISD, was (for the large part) entirely retrospective and based on a series of patients investigated following failed retropubic procedures (4). MUCP estimation involves the automated withdrawal of a microtip transducer through the urethra and recording the highest value obtained. Unfortunately however the procedure is more an evaluation of urethral sphincter function at rest and consequently represents a measure of the passive resistance of the urethra (5). It critically fails to provide information about the function of the bladder neck and proximal urethra. Perhaps the greatest denial of ISD classification by urethral profilometry is that the patient is not required to become incontinent during the study and as such has been widely criticised by the International Continence Society (ICS) as a means of establishing the diagnosis (6). As a static study, it has been seen to correlate better with age than any other parameter. It has an increasingly limited role in the assessment of SUI.

Videourodynamics in our view represents the most precise method of classifying stress urinary incontinence and without doubt is our preferred investigation of choice. It both confirms the demonstrable loss of urine from the urethra during a stress manoeuvre (when the vesical pressure exceeds urethral pressure in the absence of a detrusor contraction) and the severity of sphincteric dysfunction once the diagnosis of SUI has been established. Whilst few would argue with the importance of the videourodynamic examination it does necessitate simultaneous fluoroscopic examination of the lower urinary tract as well as multi-channel urodynamics. These facilities are not always readily available. Given that cystometrograms and urethral profilometry fail to provide the requisite information regarding the bladder neck and proximal urethra there arose the need for an easily reproducible method (not requiring access to more complex and expensive equipment) which could identify sphincteric dysfunction.

Observations made by Edward McGuire during thousands of videourodynamic examinations (7) demonstrated that 76% of those classified as having

type III SUI (intrinsic sphincter deficiency) were recorded as having consistently low leak point pressures (less than 60 cm H₂O). The significance of this lies principally in the ease with which VLPP can be established with only basic urodynamic equipment and without necessary recourse to formal VCMG. It has over the last few years evolved as an easily performed and reliable test to determine the ability of the urethra to resist the expulsive force of the bladder generated by increased intra-abdominal pressure (1). The VLPP represents the lowest bladder pressure at which urethral leakage occurs during a prompted stress manoeuvre. It represents a dynamic test, which documents the abdominal pressure required to induce incontinence. The DLPP by contrast documents the pressure at which leakage occurs driven by detrusor pressure. Swift & Ostergard (8) have shown a poor correlation between MUCP and ALPP (even to the extent that some patients with high MUCP values obtained at urethral profilometry leaked during stress manoeuvres and were subsequently recorded as having low VLPP values). Perhaps a more convincing attestation to the potential clinical utility of VLPP represents the change in values before and after anti-incontinence procedures. Bladder neck collagen injection for example results in an elevation in VLPP measures, which is commensurate with the clinical improvement in symptoms. MUCP measures however remain unaltered and to our knowledge fail to show a consistent improvement by any procedure designed to correct SUI.

Given the VLPPs utility in identifying pre-operatively those patients in whom there is an appreciable level of sphincter dysfunction then it offers the opportunity (even for those without ready access to VCMG) for improved selection of patients for particular (and appropriate) surgical interventions aimed at dealing with urethral coaptation with or without bladder neck re-approximation.

MEASUREMENT OF VALSALVA LEAK POINT PRESSURE

There is often considerable variability in the method of VLPP estimation and as such, there has

been increasing concern over the lack of standardisation between units. Nevertheless, most investigators in the field adhere to basic principles. Patients are generally positioned in the sitting or standing position and intra-vesical pressure recorded via a 10-Fr microtip pressure transducer catheter in the bladder. Intra-abdominal pressure is monitored via a rectal probe. The bladder is filled with saline or contrast material at a rate of 50 ml/min to a volume of 200 ml (or approximately one half the expected functional capacity). The patient is then instructed to make an increasing expulsive effort against a closed glottis (a progressive Valsalva manoeuvre) until leakage is demonstrated. We generally repeat the procedure and the lowest increase in vesical pressure, which results in leakage is designated the VLPP. In the absence of fluoroscopy urethral leakage has to be confirmed by direct vision and so appropriate patient positioning to facilitate this is essential. The corresponding pressure at the time of leakage is most accurately recorded by using an event marker generally available on even basic urodynamic equipment.

In the absence of leakage during a progressive valsalva manoeuvre the patient is requested to cough. However, determining an accurate VLPP during a cough is often difficult and is therefore generally tried only after a valsalva manoeuvre has failed to demonstrate incontinence. If vigorous coughing is ultimately necessary to cause leakage the VLPP is inevitably high.

As is readily apparent a variety of technical aspects of the procedure may influence the values obtained and accordingly there is justified concern over the reproducibility of measurements. The influence of bladder volumes on VLPP for example has been investigated by some authors. Faerber (9) determined the effects of vesical volume on the VLPP in an attempt to determine the optimum volume for VLPP determination. Previously Theofrastous & Miklos (10,11) had reported that VLPP decreased significantly with increasing vesical volume. After an elegant study Faerber concluded that vesical volumes of between 200-300 ml provided the most appropriate classification in the majority of women with SUI and that volumes in excess of 300 ml had

the potential to incorrectly classify type I or type II incontinence.

Catheter size used during VLPP estimation has similarly been cited as a possible confounding factor in the effort to standardise values between units (11). The catheter in effect acts as a barrier to urethral leakage and accordingly makes urine loss more difficult to provoke. This in turn raises the recorded level of VLPP. Some authors have proposed using an intra-vaginal catheter to estimate abdominal pressures (and with some success by Miklos et al., ref. 11) which has enabled lower VLPP measurements to be obtained.

Provocation testing is similarly poorly standardised. VLPP measurements obtained by provocation coughing as compared to a progressive valsalva manoeuvre are inevitably higher regardless of the difficulties in recording an accurate VLPP. Our own preference is for a graduated valsalva manoeuvre, which obviates some of the difficulties arising during cough-induced leakage. However, if this fails to demonstrate incontinence we recommend a 'six-cough' test. As with the progressive valsalva manoeuvre the patient is asked to cough with increasing force so as to record the lowest possible intra-abdominal pressure to cause leakage.

Pelvic prolapse can be a serious impediment to accurate VLPP estimation. Undiagnosed prolapsing tissue may act to dissipate the expulsive force on the urethra. It emphasises the pivotal role of an adequate pelvic examination despite the increasing reliance on urodynamics for a precise diagnosis. Prolapse necessitates manual reduction and repeat VLPP estimation to obviate the occlusive influence on the urethra. Frequently surgery is undertaken to correct pelvic prolapse only to reveal an underlying SUI and low VLPP. Non-physiological positioning may similarly have a role in values obtained as will the effect of co-existing detrusor instability and poor bladder compliance. Whilst our own preference for videourodynamics is clear those undergoing VLPP estimation in the absence of lower urinary tract fluoroscopy should undergo a filling cystometrogram prior to VLPP measurement.

CLINICAL UTILITY OF VALSALVA LEAK POINT PRESSURE

It is important to remember that less than half of those patients presenting with the complaint of urine loss with coughing, sneezing and other exertional activities ultimately have a diagnosis of SUI (12). Whilst SUI represents a powerfully emotive symptom and sign, it ultimately remains a urodynamic diagnosis. Blaivas & Olssen (13) emphasise the distinction between SUI due to anatomical factors (such as urethral hypermobility) and sphincter related problems (type III or ISD). The recommended procedure for ISD is a sling procedure (cadaveric or sheath harvest) or newer modalities such as the tension-free vaginal tape (TVT). Bulking agents such as collagen and Macroplastique remain a minimally invasive alternative. Under such circumstances there is a 95% success rate for a sling procedure and 65% success for urethropexy. Because it is the failure of the urethra to co-apt normally in ISD, suspension procedures (which do not address this deficiency) have a high incidence of failure and consequently are not recommended in this sub-group of patients. Unfortunately clear cut distinctions between urethral hypermobility and ISD rarely exist in clinical practice. For us it would seem a reasonable assumption that there exists a spectrum of bladder neck mobility which can co-exist independently with a spectrum of ISD in patients with demonstrable SUI. If the urethra leaks then it undoubtedly has a degree of pathology, the degree of pathology being on a continuum. VLPPs may have utility in establishing a ranking on that continuum (14). When combined with a negative filling cystometrogram and physical examination the VLPP adds significantly to the incontinence evaluation by assessing the presence and magnitude of ISD. At the very least it identifies those who might benefit from videourodynamics where this is not routinely available. A VLPP of 60 cm H₂O or less indicates a significant degree of ISD whereas a VLPP of 90 cm H₂O or more is normally associated with urethral hypermobility (given a history of SUI). There will of course be intermediate values and in these cases there is likely to be an element of hypermobility and ISD co-exist-

ing. If combined with a standard Blaivas classification more confident recommendations might eventually prove possible. For example, where there is significant bladder neck descent (type II) and the VLPP is high, a standard suspension procedure is advised. In type III SUI where there is both descensus of the bladder neck and a low VLPP, then a sling procedure is the treatment of choice. Alternatively, when there is minimal descensus (and a low VLPP) injectables such as collagen or Macroplastique to the bladder neck might suffice.

Given that patients are often only recognised as having ISD after a failed retropubic procedure the importance of the VLPP is self-evident. It is even more important if one considers that those who have had three or more failed operations have only a success rate of 33% with further anti-incontinence procedures. The first operation is always (or should be always) the best opportunity for cure and if the VLPP can secure the appropriate patient selection for particular interventions then this can only further improve outcomes.

Whilst the clinical use of VLPP has gained widest acceptance in the role of female incontinence assessment it has found similar use in the investigation of post-prostatectomy incontinence and myelodysplasia (15). Here one can frequently demonstrate open dysfunctional internal sphincters that leak and low abdominal pressures. VLPP estimation can in these cases equally define and quantify the defect in the urethral sphincter function and so modify treatment protocols accordingly.

VALSALVA LEAK POINT PRESSURE IN THE CLASSIFICATION OF STRESS URINARY INCONTINENCE

There exist 2 important components in the pathophysiology of SUI. Urethral hypermobility and sphincteric weakness. Urethral hypermobility (perhaps best assessed with a Q-tip test) is a difficult concept to define in that there exists at least three different kinds of hypermobility (as defined by fast-scan magnetic resonance imaging) none of which have a clear-cut relationship with the degree of sphincteric weakness. Sphincteric weakness by con-

trast exists as a spectrum of dysfunction. Given that in the patient with SUI he or she must by definition have a weak urinary sphincter then VLPP measurement represents the most accurate means of formally assessing this. Blaivas (16) now recommends that the term ISD is put on hold (since all patients with sphincteric incontinence have a weak sphincter) and that stress incontinence simply be classified by two parameters: VLPP and the degree of hypermobility. Stress urinary incontinence therefore should be regarded as having 2 categories, sphincteric incontinence (urinary incontinence that occurs in the absence of detrusor contraction) and stress hyperreflexia (urinary incontinence during stress that is accompanied by an involuntary detrusor contraction). In sphincteric incontinence only 2 parameters need be considered: a description of the urethral hypermobility and a measure of the VLPP.

For those previously unfamiliar with the concept of VLPP, it should be apparent that its importance in the assessment of SUI can only increase further. From its humble beginnings as a useful adjunct in the selection of surgical interventions it is set to become a fundamental tenet in the understanding and classification of the incontinent patient. The concept of ISD by contrast now appears somewhat dated and far from individuals being labelled as having a sphincteric weakness, all patients will be assumed to have a degree of incompetence the extent of which is graded by the VLPP. Ultimately however the true extent of the clinical applicability of VLPP will depend on the ability of investigators to provide reproducible results that allow accurate comparisons to be made between centres. In turn, this requires standardisation of the technical aspects of VLPP determination so that confidence in the significance of recorded values can be assured.

REFERENCES

1. McGuire EJ, Fitzpatrick CC, Wan J: Clinical assessment of urethral sphincter function. *J Urol*, 150: 1452, 1993.
2. McGuire EJ, Woodside JR, Borden TA: Upper urinary tract deterioration in patients with my-

- elodysplasia and detrusor hypertonia. *J Urol*, 129: 823, 1983.
3. Sand PK, Bowen LW, Panganiban R: The low pressure urethra as a factor in failed retropubic urethropexy. *Obstet Gynaecol*, 69: 399-402, 1987.
 4. Koonings PP, Bergman A, Ballard CA: Low urethral pressure and stress urinary incontinence in women: Risk factors for failed retropubic surgical procedure. *Urology*, 36: 245-248, 1990.
 5. Abrams P, Feneley R, Torrens M: The Clinical Contribution of Urodynamics. In: *Urodynamics*. New York, Springer-Verlag, chapter 5, 1983.
 6. Abrams P, Blaivas J, Stanton SL: The standardisation of terminology of lower urinary tract function. International Continence Society Committee. *Scand J Urol Nephrol*, 114: 5S, 1977.
 7. McGuire EJ, Woodside JR, Borden TA: Prognostic value of urodynamic testing in myelodysplastic patients. *J Urol*, 126: 205, 1981.
 8. Swift SE, Ostergard DR: Evaluation of current urodynamic testing methods in the diagnosis of genuine stress incontinence. *Obstet Gynaecol*, 86: 85-91, 1995.
 9. Faerber GJ, Vashi AR: Variations in Valsalva leak point pressure with increasing vesical volume. *J Urol*, 159: 1909-1911, 1998.
 10. Theofrastous JP, Cundiff GW, Harris RL: The effect of vesical volume on Valsalva leak point pressures in women with genuine stress incontinence. *Obstet Gynaecol*, 87: 711-714, 1996.
 11. Miklos JR, Sze EH, Karram MM: A critical appraisal of the methods of measuring leak-point pressures in women with stress incontinence. *Obstet Gynaecol*, 86: 349-352, 1995.
 12. Jenson JK, Nielson FR, Ostergard DR: The role of the patient history in the diagnosis of urinary incontinence. *Obstet Gynaecol*, 83: 904-910, 1994.
 13. Blaivas JG, Olsson CA: Stress incontinence: classification and surgical approach. *J Urol*, 39: 727-731, 1988.
 14. Petrou SP, Kollmorgen TA: Valsalva leak point pressure and bladder volume. *Neurourol Urodynam*, 17: 3-7, 1998.
 15. Flood H, Alevizatos C, Liu JL: Sex differences in the determination of ALPP in patients with intrinsic sphincter deficiency. *J Urol*, 156: 1737-1740, 1996.
 16. Blaivas JG. Editorial. Classifying stress urinary incontinence: *Neurourol Urodynam*, 18: 71-71, 1999.

Received: March 17, 2000
Accepted: April 12, 2000

Correspondence address:

Julian Shah
Institute of Urology and Nephrology
University College London
Bland Sutton Institute
48 Riding House St
London W1P 7PN, England
Fax: ++ (71) 673-7076
E-mail: rmsqjus@ucl.ac.uk