Original Article

Correlation of Urethral Closure Pressure, Leak-Point Pressure and Incontinence Severity Measures

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Abstract: The aim of this study was to determine whether water perfusion maximum urethral closure pressure (MUCP) correlates with Valsalva leak-point pressure (LPP), and which of these best correlates with subjective and objective incontinence severity measures. Fifty-two women with previously diagnosed genuine stress incontinence (n = 46), or mixed incontinence with a minor and controlled urge component (n = 6), were assigned an incontinence status grade based on interview and diary review. These women then completed visually observed standing LPPs at 250 ml bladder capacity, supine water perfusion MUCP determinations, pad tests and quality of life questionnaires. The urodynamic and severity measures were compared with correlation analysis or analysis of variance. A modest correlation exists between LPP and MUCP (r = 0.50–0.62, P < 0.001). Both MUCP and LPP demonstrated significant decreases (P < 0.01) with increasing severity of assigned incontinence grade. A very low and insignificant correlation existed for these urodynamic parameters and pad loss or quality of life measures. MUCP and LPP correlate modestly with each other and both are comparable in predicting incontinence severity. Either can be used as the urodynamic measure to assess intrinsic sphincter deficiency.

Keywords: Incontinence severity; Intrinsic sphincter deficiency; Leak-point pressure; Maximum urethral closure pressure; Stress incontinence

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Introduction

Stress urinary incontinence occurs whenever the urethra cannot increase its resistance to compensate for the sudden increase in abdominal pressure that occurs with coughing, laughing, sneezing, exercise or the Valsalva maneuver. It is generally accepted that the female urethra needs a normal sphincter that is well supported to accomplish this. Particularly in the United States, there have been attempts to subcategorize stress incontinence into anatomic (urethral hypermobility) incontinence or intrinsic sphincter deficiency (ISD) [1]. This subcategorization influences management: hypermobility stress incontinence is treated with anatomic supporting operations (colposuspension, urethropexy, sling procedures), whereas the poorly functioning but better supported urethral sphincter is treated with bulking agents, slings or artificial sphincters. In reality, this subcategorization is an oversimplification because many parous women with urethral hypermobility are continent. Stress incontinent women with hypermobility must therefore have some sphincter incompetence (or intrinsic sphincter deficiency).

Most practitioners would agree with Bump et al. [2] that ISD should be diagnosed by a composite of historic, anatomic, urodynamic and clinical severity criteria. There is, however, considerable debate on what urodynamic measure best quantifies intrinsic sphincter deficiency – maximum urethral closure pressure (MUCP) or leak-point pressure (LPP). The gynecological literature emphasizes the use of the MUCP, because some retrospective studies have shown higher failure rates following Burch colposuspension in patients with preoperative MUCP < 20 cmH₂O [3–5]. Other studies have not confirmed these results [6,7].
McGuire et al. [8] defined the abdominal pressure required to cause leakage by a Valsalva or coughing maneuver as the abdominal leak-point pressure (LPP). He found that when the LPP was less than 60 cmH2O 75% of stress incontinent women had type III videourodynamic findings and 81% had severe (grade 3) incontinence. In these same patients the authors performed manually withdrawn, water perfusion urethral pressure measurements and found ‘no correlation between maximum urethral pressure and the grade or type of incontinence or the abdominal pressure required to induce urethral urinary loss’. The three reports in the literature reporting MUCP and LPP correlation analysis found statistically significant correlation coefficients in the range of 0.31 [9], 0.56 [10] and 0.62 [11]. These studies all used microtip catheters for the MUCP measurements. The advantages and disadvantages of microtip and water perfusion catheter methods have been well summarized by Griffiths [12]. Microtip catheters do not measure real fluid pressure within the coapted urethra, and perfusion methods have a slow response to rising pressure. Comparative studies have suggested the microtip catheters to be superior [13]. Was the lack of correlation in McGuire’s study real or due to the water perfusion methodology? There are no studies in the literature comparing mechanically withdrawn water perfusion MUCP measurements with LPP. The first goal of this study was to determine whether mechanically withdrawn water perfusion MUCP correlates with LPP.

If these two urodynamic parameters assess sphincter function then they should correlate with symptom severity. Several investigators have demonstrated that low leak-point pressures are associated with a more severe assigned grade of incontinence severity [8,14,15]. Bump et al. [2] found that low MUCP and low VLPP correlated inversely with pad use and incontinence episodes. Although there was a trend for both low VLPP and low MUCP patients to have higher pad weights, only low VLPP reached statistical significance [2]. Urodynamic parameters did not correlate with incontinence-specific quality of life (QOL) instruments [16]. The second purpose of this study was to determine whether MUCP or VLPP correlated with subjective, objective and QOL incontinence severity measures.

Materials and Methods

Fifty-two women were recruited to participate in a clinical trial of a new urethral bulking agent. The urethral injection outcome results are not reported in this paper. The local research ethics committee approved the study and all patients completed approved written consent forms. History, examination, stress tests and multichannel cystometrograms revealed that 46 women had genuine stress incontinence (GSI) and 6 had mixed incontinence (GSI and detrusor instability) with a minor and controlled urge component. All women were between 32 and 72 years of age, had had stress urinary incontinence for at least 12 months, and had failed at least 3 months of conservative therapy. Patients were excluded from study if they were under 18 or over 80 years of age, had an active urinary tract infection, had a bladder capacity <250 ml or a postvoid residual >100 ml, had a neurogenic bladder, had grade 3 prolapse of any compartment, had had previous bulking agent therapy, or were taking an α-agonist or antagonist.

All patients had the same standardized evaluation, consisting of:

- **Incontinence grade**: All patients completed a 7-day diary of their voids, leakage episodes and precipitating events. Before urodynamic testing was performed, the diary was reviewed, the patients were interviewed and, based on the diary and interview, an incontinence grade was assigned according to the Stamey classification system [17].
  - Grade 0: continent
  - Grade 1: loss of urine with sudden increases in abdominal pressure (coughing, sneezing, laughing)
  - Grade 2: leaks with lesser degrees of physical stress, such as walking, standing erect from a sitting position or sitting up in bed
  - Grade 3: total incontinence; urine is lost without any relation to physical activity or to position.
- **Cotton swab (Q-tip) excursion angles**: The 40 women had cotton swab (Q-tip) angles [18] measured at rest and with maximum Valsalva effort, including coughing, by the first author using an orthopedic goniometer. The angles measured from the horizontal at rest and with maximal straining were recorded.
- **Valsalva leak-point pressure**: After voiding, a 7 Fr BARD triple lumen catheter was placed in the bladder and any residual removed. A balloon catheter was placed in the rectum. After filling to 250 ml with water in the standing position, each subject placed a foot on a footstool and was asked to bear down or push ‘like pushing a baby out’. The patient was instructed to look at the monitor and to slowly increase bladder pressure. After swabbing the periurethral area dry, the investigator, using a handheld electronic marker, noted the precise instant that fluid was observed at the external urethral meatus. In a small subset of patients, if leakage could not be obtained with maximum Valsalva effort the patient was asked to gradually increase coughing efforts until leakage was observed. The bladder pressure rise over baseline until leakage occurred was measured three times and averaged. We observed the very high reproducibility of these repeated measures that has already been reported [8].
- **Maximum urethral closure pressures**: Following the technique of Brown and Wickham [19], at the same 250 ml bladder volume in the supine position, three consecutive urethral pressure profiles were obtained at a water perfusion rate of 2 ml/min and a mechanical withdrawal rate of 1 mm/s. The MUCP was the