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A MODIFIED CONTINENCE EQUATION CAN QUANTIFY STRESS LEAK POINT PRESSURE IN TERMS OF MAXIMUM URETHRAL CLOSURE PRESSURE AND PRESSURE TRANSMISSION

AIMS OF STUDY: Stress leak point pressure (LPP) is a useful clinical indicator for diagnosis of stress urinary incontinence (SUI) [4]. It has been demonstrated that the linear relationship between urethral pressure increase (P_{ura}) and the rise of intravesical pressure (P_{ves}) during a cough, or so-called "pressure transmission", is noted to be lower in women with SUI than in continent women [2,3]. Resting urethral pressure is also important in maintaining continence during stress maneuvers [1]. These observations imply that female stress continence depends upon both resting and dynamic functions of the lower urinary tract, represented by maximum urethral closure pressure (MUCP) and pressure transmission, respectively. However, substantial controversies exist regarding the nature of female stress continence function, and none of each of these clinically applicable measurements provides much additional information regarding normal physiology. An attempt has been made to correlate the stress leak point pressure (LPP) into the urodynamic variables using the linearity between the intravesical and urethral pressures during cough ($P_{ura} = \alpha * P_{ves} + \beta$) [3]. The goals of this paper are to: (1) present a new continence equation for correlating the resting and dynamic parameters of female continence, and (2) validate the modified continence equation (MCE) using the urodynamic pressure measurement data in a group of stress incontinent subjects.

METHODS: The leak point pressure at the midurethra can be obtained by substituting the resting pressure values and the leakage condition ($P_{ura} = P_{ves}$ = LPP) into the linear equation above. The modified continence equation can be expressed in terms of MUCP, pressure transmission (α), and resting bladder pressure (RBP): LPP = MUCP / (1-α) + RBP. Note that the pressure transmission parameter will be different for different maneuvers. The graphical illustration of the stress LPP is presented in Fig. 1. Actual cough and Valsalva LPP's from the urodynamic measurements of 46 genuine SUI subjects were compared with the estimated LPP's using the MCE. Two different measures of pressure transmission, classic pressure transmission ratio (PTR) and pressuregram slope [3], were used.

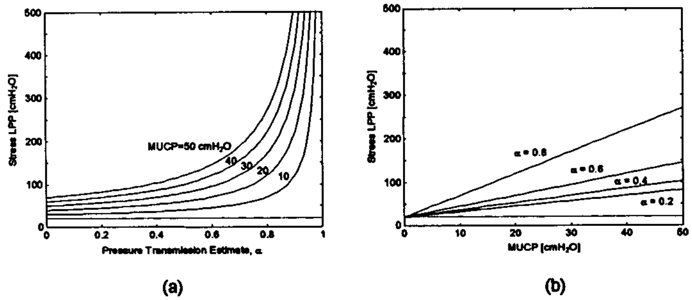

Figure 1. Graphical representation of the modified continence equation: LPP = MUCP / (1-α) + RBP.

RESULTS & CONCLUSIONS: Linear regression analysis with zero intercept between the urodynamically measured and the estimated LPP's using the MCE demonstrates high linearity for cough with regression constants (R^2) of 0.70 and 0.79 for PTR and pressuregram slope based estimates, respectively. Much weaker linearity is found for Valsalva (R^2 = 0.15 and 0.10). Cough LPP's based on both PTR and pressuregram slope overestimates the actual LPP by 9.8 and 7.3%, respectively. Poor predictions are noted for the estimated Valsalva LPP's, underestimating by 45% for PTR and overestimating by 39% for pressuregram slope due to a weak linearity between the urethrovesical pressures. A better estimate of pressure transmission or another form of continence equation is needed for Valsalva. Overall the pressuregram slope based estimation of stress LPP provides better predictions.

Cough LPP is correlated with pressure transmission (ρ = 0.48 ~ 0.55), while Valsalva LPP is associated with MUCP (ρ = 0.63). This indicates that dynamic stress function is more important during cough, while resting tone is critical in maintaining stress continence during Valsalva. A negative correlation is found between the pressure transmission and MUCP (ρ = -0.63 ~ -0.70 for cough and -0.55 ~ -0.63 for Valsalva), which can be also predicted from the MCE: MUCP=(LPP-RBP)*(1-α). This indicates that there are a spectrum of SUI patients who may have deficient MUCP but relatively good pressure transmission (intrinsic sphincter deficiency) and/or vice versa. Therefore, it is suggested that both parameters be considered together for diagnosis.

The MCE demonstrates that stress LPP is proportional to MUCP [5] and resting bladder pressure. On the other hand, it has a rather complicated hyperbolic relationship with pressure transmission. Due to this hyperbolic relationship, stress LPP becomes more sensitive to pressure transmission (Fig. 1) and precise estimation of pressure transmission is critical in estimating stress LPP.

In conclusion, female stress continence is a delicate interplay of resting and dynamic functions, and the MCE can quantify stress LPP into other measurable urodynamic parameters to provide useful insights into the female continence mechanism.

REFERENCES : [1] Bunne & Öbrink, Urol Res 6:127-134, [2] Enhöming, Acta Chir Scand (Suppl.) 276:1-61, [3] Kim et al., J Biomech 30: 19-25, [4] Wan et al., J Urol 150:700-2, [5] Sultana, Obstet Gynecol 86:839-842.