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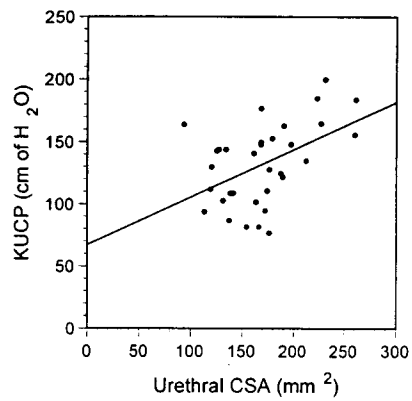
CORRELATION BETWEEN URETHRAL STRUCTURE AND FUNCTION IN CONTINENT NULLIPARAS.

Aims of Study: Young nulliparous continent women can have significant variation in their maximum urethral closure pressures. At present the reason for this variation is unclear. A plausible explanation would be that those individuals with higher pressures have urethras that are larger and contain more muscle. In this study we tested the null hypothesis that no correlation would be found between urethral structure as seen in high resolution MR images and urodynamic function in young nulliparous continent women.

Methods: Thirty-three continent nulliparous women volunteered for this study. None of the subjects demonstrated stress urinary incontinence during a standing provocation test with a full bladder (1). Urethral support was assessed with the Q-tip test. Multichannel cystometrics and a urethral pressure profile were then performed using an 8F Gaeltec dual tip catheter with a bladder volume of 300 ml. Urethral closure pressures at rest and during 3 maximum pelvic muscle contraction were recorded. The best effort was chosen for analysis.

MR imaging (Signa, General Electric Medical Systems, Milwaukee, WI) was used to quantify the urethral muscle bulk of each individual. Transverse, coronal, and sagittal proton density weighted images (TR/TE 4000/15) were made of the pelvic regions using a slice thickness of 4 mm separated by a slice gap of 1 mm. A 160 x 160 mm field of view and an imaging matrix of 256 x 256 were used. Morphologic measures were carried out with the Advantage Windows sdc AW 2.0.18. The urethral cross-sectional area was measured in the axial plane at the level of the proximal urethra. The urethral volume was calculated from the product of its proximal cross-sectional area times its mid-sagittal length. The urethral sphincter muscle volume was calculated using the product of its cross-sectional area at the level of the proximal urethra times its mid-sagitta urethral length.

The data was analyzed with the StatView statistical package (Abascus Concepts, Inc. Berkeley, CA). Correlations were tested with the Pearson correlation coefficient with P values of 0.05 or less being considered statistically significant.



Results: The subjects had a mean age of 27.7 years (SD±4.8;range 20-42) and a mean body mass index of 24.7 Kg/m^2 (±5.3;19.5-50). The maximum urethral closure pressure (MUCP) was positively correlated

with the urethral cross-sectional area (R=.37;p=.03)and the urethral volume (R=.41;p=.02). There was also a positive correlation between the urethral closure pressure during a maximum pelvic muscle contraction (the kegel urethral closure pressure-KUCP) and the urethral cross-sectional area (R=.48;p=.004:Figure 1). The KUCP as correlated positively with the urethral volume (R=.52;p=.002). In addition the KUCP also correlated with the urethral sphincter muscle volume (R=.38;p=.03).

Conclusion: There is a positive correlation between measures of urethral function and structure in young nulliparous women. Comment: The Galenic doctrine of "final cause" states that descriptions of structure should agree with the observed function of a region. The above findings are supportive of this. Urethra dysfunction, quantified by functional measures, should also be viewed in terms of structural abnormalities. MR provides us with the opportunity to image parous women with urethral dysfunction to see if these structure function relationships continue to hold.

References:

1. Obstet Gynecol 1998;91:705-9.

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QUANTIFICATION OF CIRCULAR AND LONGITUDINAL SMOOTH MUSCLE IN THE DORSAL WALL OF THE FEMALE URETHRA

AIMS OF STUDY:

Urethral pressure is important in maintaining urinary continence. Smooth muscle is an important contributor to urethral closure pressure. (Brading). This study was undertaken to analyze the variation in amount and distribution of smooth muscle within the muscular wall of the urethra previously studied and tc clarify the proportion of the smooth muscle region that is occupied by smooth muscle cells.

METHODS:

Midline-sagittal sections of 13 cadaveric urethras were stained with smooth muscle alpha actin antibody stain. The ventral urethral wall from the vesical neck to the caudal margin of the striated sphincter muscle was studied. The area of the region occupied by circular smooth muscle (CSM) and longitudinal smooth muscle (LSM) was determined by summing the areas of contiguous rectangular low power microscopic screens (0.42mm^2) occupied by each region of smooth muscle. The proportion of the region comprised of smooth muscle cells was assessed using actin stained sections. High power (400x) microscopic field images were captured and the proportion of the microscopic field stained by nonvascular smooth muscle was measured using digital imaging techniques. The total quantity of smooth muscle cells within the urethra was calculated by multiplying the regional area by the proportion of the region occupied by smooth muscle cells.

RESULTS:

The mean area of CSM region in the dorsal urethral wall was 29.8mm^2 (range 15.3 – 50.5 mm^2, SD $\pm$ 11.1mm^2) and the mean area of LSM region was 36.4 mm^2 (10 - 56 mm^2, $\pm$ 14.2 mm^2)(see left chart below). Smooth muscle cells occupied 20.9 % (15.3 – 23.6, $\pm$ 2.5) of the CSM region and 17.8 % (12.3 – 20.6, $\pm$ 2.6) of the LSM region. This means that there were 6mm^2 (2.9 – 11.3, $\pm$ 2.7) of smooth muscle cells in the CSM region and 6.7mm^2 (0.7 – 13.2, $\pm$ 3.7) in the LSM region.

Study of the variation in distribution of smooth muscle along the urethral wall shows that there is 16%