270

Pontbriand-Drolet S[1], Tang A[2], Madill S[3], Bergeron J[1], Dumoulin C[1]
1. *Centre de recherche de l'Institut Universitaire de Gériatrie de Montréal, Canada,* ***2.*** *Radiology, Hôpital Saint-Luc, University of Montreal, Canada,* ***3.*** *School of Physical Therapy, University of Saskatchewan, Canada*

AN MRI STUDY: DO PELVIC FLOOR MORPHOLOGICAL AND FUNCTIONAL DEFICIT DIFFER IN WOMEN WITH STRESS COMPARED TO MIXED URINARY INCONTINENCE?

Hypothesis / aims of study

A large number of women aged 60 and over experience stress (SUI) or mixed urinary incontinence (MUI) and negative quality-of-life consequences; yet, the pathophysiology of these disorders is not completely understood. We hypothesized that deficiencies in the morphology of the pelvic floor muscles (PFM), bladder neck and urethral sphincter, in addition to the pelvic floor contractile dysfunction, are partially responsible for SUI and MUI symptoms. Thus, the study's aim was to compare continent, SUI and MUI women's, a) pelvic floor, bladder neck and urethral sphincter morphology using magnetic resonance imaging (MRI) under 3 conditions (rest, PFM maximum voluntary contraction [PFM MVC] and straining) and b) pelvic floor contractile function using digital palpation with the PERFECT scheme.

Study design, materials and methods

Women 60 years and older were recruited and included in the study if they were independently ambulatory and were either continent or reported at least weekly symptoms of SUI or MUI in the 3 months prior to the evaluation (based on Urogenital Distress Inventory questionnaire). Women were excluded if they reported contraindications to MRI scanning or other conditions or medications that were likely to interfere with the study. An experienced pelvic floor physiotherapist taught the women how to perform PFM contractions correctly. PFM contractile function was then assessed through a digital evaluation using Laycock's PERFECT scheme. Dynamic MR imaging in the sagittal plane was conducted with a Siemens Magnetom Trio 3.0T, using an iPAT torso/pelvis coil centered on the pubic symphysis. Six consecutive image acquisitions were made in the mid-sagittal plane with T2-weighted single-shot fast spin-echo (SSFSE) pulse sequences to provide a cine view (field of view 24x24cm, matrix 256x256, 6mm thick, TR=3000ms, TE 110ms, bandwidth 320Hz/pixel, NEX 1, 6 images recorded every 3s for a total scan duration of 18s to generate a cine-loop). Sagittal dynamic acquisitions were acquired at rest, during a PFM MVC and during straining. The straining effort was controlled by having the women blow into a standardized tube.
The PFM morphological measurements at rest were taken from the mid-sagittal slice presenting the clearest image. For the PFM MVC and the straining images, the measurements were taken from the mid-sagittal slices that demonstrated the greatest bladder-neck elevation and depression, respectively. The following eight measurements were taken in each of the three conditions: 1) the pubococcygeal line (PCL) [from the inferior edge of the pubic symphysis to the anterior aspect of the sacrococcygeal joint line], 2) the anorectal (AR) angle, 3) the H-line, 4) the M-line, 5) the PCL/H-Line angle, 6) the height of the urethrovesical (UV) and 7) the height of the uterocervical (UC) junction, and 8) the UV junction approximation (UV jct Approx).
The bladder neck funnelling and posterior urethrovesical (PUV) angle were measured using Schaer et al. (1999) and Hodroff et al. (2002) techniques (1,2), respectively, on the sagittal image that demonstrated the greatest funnelling. Urethral sphincter morphology (i.e., thickness, area, volume) was assessed using the technique described in Morgan et al. (2009)(3). Finally, the PERFECT Scheme (where P: Force, E: Endurance, R: Repetitions, F: Fast Contractions, E: Elevation, C: Co-contractions, T: Timing) was used to assess PFM contractile function. All evaluators were blinded to the subjects' UI type. A one-way analysis of variances (ANOVA) or a Kruskal-Wallis test (when data were not normally distributed) with a Bonferroni correction were conducted to compare measurements between the three groups (continent, SUI and MUI). Chi-square tests were used for dichotomous variables. On the basis of a Hoyte et al. (2001) study on middle-aged and older women, we estimated that the study would require at least 17 women per group to detect a 5mm difference in the urethrovesical junction height (α= 0.05, power=0.80, SD= 4.8 ms).

Results

Sixty-six women, mean age of 67.70 (5.24), participated in the study: 22 per group (Continent, SUI and MUI). There were no differences among the groups in age (p=0.43), weight (p=0.31), body mass index (p=0.37), vaginal deliveries (p=0.23), or hysterectomies (p=0.45). To control for the potential effect of pelvic size on study parameters, subjects were matched across the groups based on their pelvic inlet length. There were significant differences (Table I) between groups in terms of PFM and bladder neck morphology and in PFM contractile function, but no significant differences in urethral sphincter morphology.

Interpretation of results

With respect to PFM morphological parameters, MUI women seem to have a lower PFM resting position and a lower pelvic organ support at rest, based on the differences in M-Line, PCL/ H-Line angle and UV junction height. However, SUI women seemed to have a PFM morphology similar to that of continent women.
The SUI group seemed, nevertheless, to present more bladder neck funnelling occurrence than the other two groups. There were no differences in funnelling width or length between the groups. The PUV angle was larger in SUI women, compared to the other groups, supporting the greater occurrence of funnelling in SUI women. The urethral sphincter morphology did not seem to be a deficit causing SUI or MUI symptoms as there were no differences in thickness, area and volume between the groups.

Functionally, both UI groups had poorer pelvic floor strength on maximal contraction then continent women. Additionally, the MUI group demonstrated poor PFM elevation on contraction, probably related to the lower position of their PFMs at rest; conversely, the SUI women seemed to have a timing problem with PFM contractions.

Concluding message

Morphological and functional deficits in SUI and MUI women appear to be very different. Notwithstanding, these deficits all support the rationale for PFM exercise treatment in older women with SUI and MUI. However, the findings suggest the need for different rehabilitation treatments, adapted to the specific deficits of each UI type.

Table I: Significant differences in PFM, bladder neck or urethral sphincter morphology and PFM function between Continent, SUI and MUI women.

Measurements	Conditions	Groups	x (SD)	p-value	Bonferroni/ P value
M Line	Rest	C SUI MUI	19.42 (7.76) 18.32 (8.51) 26.15	**0.010**	C/SUI: 1.000 C/MUI: 0.046 SUI/MUI:
PCL/ H-Line angle	Rest	C SUI MUI	20.50 (7.36) 18.49 (8.27) 25.32 (9.42)	**0.026**	C/SUI: 1.000 C/MUI: 0.184 SUI/MUI:
Urethrovesical junction Height	Rest	C SUI MUI	14.22 (3.94) 13.87 (5.56) 9.96 (5.78)	**0.013**	C/SUI:1.000 C/MUI: 0.024 SUI/MUI:
Funnelling Occurrence	Rest	C SUI MUI	0.45 (0.51) 0.80 (0.40) 0.45 (0.51)	**0.026**	C/SUI:0.036 C/MUI: 1.000 SUI/MUI:
PUV angle	Rest	C SUI MUI	138.68 169.31(134.56	**0.008**	C/SUI:0.034 C/MUI: 1.000 SUI/MUI:
P *(Strength)*	PFM MVC	C SUI MUI	3.64 (0.76) 2.61 (0.79) 2.86 (0.87)	**0.000**	C/SUI:0.000 C/MUI: 0.007 SUI/MUI:
E *(Elevation)*		C SUI MUI	1.00 (0.00) 0.81(0.40) 0.62 (0.50)	**0.007**	C/SUI:0.115 C/MUI: 0.006 SUI/MUI:
T *(Timing)*		C SUI MUI	0.81 (0.40) 0.24 (0.44) 0.79 (0.42)	**0.000**	C/SUI:0.001 C/MUI: 1.000 SUI/MUI:

Significant level was set at $p<0.05$.

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