

URETHRAL INNERVATION BETTER IN CONTINENT WOMEN THAN STRESS INCONTINENT WOMEN

Hypothesis / aims of study

Stress urinary incontinence (SUI) is thought to be secondary to loss of urethral function. Neuropathic changes on quantitative electromyography (EMG) have been shown in the urethral sphincter of women with persistent SUI after surgery. However, urethral EMG parameters of continent women have not been reported. Our aim was to compare EMG parameters in continent and stress incontinent women.

Study design, materials and methods

We recruited 2 groups of women using responses for the first 6 questions on the stress subscale of the Medical, Epidemiologic, and Social Aspects of Aging (MESA) urinary incontinence questionnaire. Continent women responded “never” to all six questions.

Stress incontinent (SUI) women had at least one answer of “sometimes” or “always”.

We collected urethral EMG data with a disposable 30 gauge, 1-inch concentric needle electrode inserted into the striated urethral sphincter muscle using 3-4 different insertion sites: 12 o'clock (5 mm above the external urethral meatus), 3 o'clock, and 9 o'clock. Needle electrode was positioned using auditory and oscilloscope guidance. We assess this data using three methods. The Medtronic Keypoint electromyography instrument (Medtronic Corporation, Minneapolis, MN) was equipped with automated software to perform multiple motor unit action potential analysis (Multi-MUP) and interference pattern analysis (IP) at baseline. In addition, the Nicolet Viking IVp electromyography instrument (Nicolet Instrument Corporation, Madison, Wisconsin) was used to process EMG signals during filling cystometry. We used standard filter settings (10Hz to 10Kz) and an amplifier gain of 50 μ V per division.

At baseline with the bladder empty, the Multi-MUP Analysis software on the Medtronic Keypoint.NET electrodiagnostic instrument automatically obtained the following MUP parameters listed in Table 1. IP Analysis was also performed at baseline with an empty bladder. At each insertion site, we instructed participants to gradually “squeeze as if they were trying to hold in urine” to recruit more MUP and create an IP. The IP analysis was done at resting muscle activity and as the patient increased urethral sphincter muscle activity with a voluntary squeeze. At each site, a 500 millisecond epoch of EMG activity was automatically obtained and analyzed. At the final insertional site, maximum voluntary activity IP software on the Nicolet Viking IVp electromyography instrument was used to analyze sphincter activity during cystometry. Maximum voluntary activity software measures the mean rectified voltage (MRV) or the mean amplitude calculated over the entire tracing after the waveform is rectified. A recording of MUP activation is made with women at rest with an empty bladder and during filling cystometry to 300 ml bladder volume.

SPSS Version 16 (Chicago, IL) was used for data management and analysis. We used independent Student's t-test to compare means of independent groups, and Chi-square test of association to compare nominal data. Pearson's correlations were used to assess the relationship between MUP parameter and age.

Results

67 women (30 continent and 37 SUI) participated in the study. Continent women were younger (39 \pm 14 vs 48 \pm 9, P=.002) and less likely to be vaginally parous (59% vs 94%, P=.001) than SUI women. 41% of continent compared to 70% of SUI women were Caucasian (P=.004). Only one Multi-MUP parameter differed between the groups. Polyphasia was more common in continence women [37% continent vs. 27% SUI, P=.03]. (Table 1). In IP analysis, continent women had more turns, larger turns/amplitude ratio, increased activity, and increased number of short segments. Similarly, continent women had a larger change in MUP MRV during bladder filling than SUI women. Age inversely correlated with all MUP parameters; the strongest correlation was between age and turn/amplitude (ρ =-.61, P<.0005).

Table 1: EMG Parameters in Continent and SUI Women

	Continent Mean \pm SD	SUI Mean \pm SD	p-value
<u>MULTI-MUP Parameters</u>			
<i>Amplitude (μV)</i>	381 \pm 176	324 \pm 79	.09
<i>Duration (msec)</i>	9.9 \pm 3.5	8.4 \pm 3.1	.08
<i>Phases (N)</i>	5.1 \pm 1.6	4.0 \pm 1.2	.02
<i>Turns (N)</i>	5.6 \pm 2.4	4.5 \pm 2.3	.14
<u>Interference Pattern Parameters</u>			
<i>Turns (N)</i>	201 \pm 110	131 \pm 88	.006
<i>Amplitude (μV)</i>	628 \pm 369	571 \pm 313	.50
<i>Turns/Amplitude</i>	.72 \pm .36	.48 \pm .28	.003
<i>Activity (%)</i> (% time with sharp activity)	8.3 \pm 5.8	5.1 \pm 4.1	.01
<i>Number Short Segments (N)</i> (sharp activity with short rise times)	112 \pm 78	70 \pm 59	.01
<i>Envelope (μV)</i>	548 \pm 228	466 \pm 227	.15
<u>Mean Rectified Voltage During Cystometry</u>			
<i>Baseline (0 ml)</i>	17.2 \pm 14.8	15.7 \pm 9.7	.61
<i>300 ml</i>	23.6 \pm 14.2	18.2 \pm 11.3	.13
<i>Change from 300 m to Baseline</i>	8.8 \pm 9.3	3.5 \pm 8.6	.01

Demographic characteristics that differed between groups (age, race-ethnicity, continence status, vaginal parity) were placed in multivariate linear regression models to determine which were associated with various MUP parameters. Using backwards linear regression, age was the only parameter significantly associated with IP-Turns ($P<.0005$), Turns/Amplitude analysis ($P<.0005$), % Activity ($P<.0005$), and NSS ($P<.0005$). In contrast, using backward linear regression, continence status was the only variable associated with change in MRV during bladder filling ($P=.001$).

Interpretation of results

We found significant differences in multiple MUP parameters in the striated urethral sphincter between continent and SUI women, suggesting that continent women have better innervation of the urethral sphincter. SUI women had lower levels of MUP recruitment as measured by decreasing number of *turns*, *turns/amplitude* ratio, *% activity*, and *number of short segments* during the IP analysis. These IP findings are consistent with those found in neuromuscular disorders. In Multi-MUP analysis, continent women showed similar trends in MUP parameters. They tended toward larger amplitude, longer duration, polyphasic MUP, which are changes consistent with more successful reinnervation. Although these findings are frequently interpreted as “abnormal”, they may be appropriately interpreted as evidence of successful reinnervation. Since the majority of continent women in our study were parous, it is reasonable to believe that these women sustained a mild neural injury and had superior subsequent reinnervation with better urethral sphincter function. In addition, continent women showed a greater increase in mean rectified voltage (amplitude) with bladder filling suggesting women with SUI have decreased activation of MUP with filling.

Stress incontinent women were more likely to be vaginally parous; however, most MUP parameters did not differ by vaginal parity. The majority of both SUI and continent women were vaginally parous. While parity may result in some reinnervation changes associated with neuropathy, parity does not explain differences in our groups. Aging is also independently associated with MUP parameters consistent with neuromuscular decline.

Concluding message

Continent women have urethral EMG changes consistent with better reinnervation, supporting that SUI is secondary to neuromuscular damage to the striated urethral sphincter. Since the majority of women in our study were parous, these data suggest that continent women sustained a mild neural injury and had superior subsequent reinnervation resulting in better urethral sphincter function.

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<i>Was this study approved by an ethics committee?</i>	Yes
<i>Specify Name of Ethics Committee</i>	Institutional Review Board at Loyola Medical Center
<i>Was the Declaration of Helsinki followed?</i>	Yes
<i>Was informed consent obtained from the patients?</i>	Yes