

Electromyographic Study of the Anal Sphincter in Women

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ABSTRACT

The objectives of this study were to identify the electromyographic (EMG) changes in the anal sphincters, and to determine whether there are myogenic or neurogenic damages to the muscles in stress incontinence in women (SI). Possible damage was expected while the number of EMG studies has reported evidence of denervation as a result of certain aethiologic factors. The intention was to determine risk factors for development of fecal incontinence. 110 women with SI and 91 women with spinal lesion (SL) were examined. The anal sphincters were examined in both groups by means of standardized EMG technique with concentric needle electrode. The results demonstrated predominately neurogenic lesion of the anal sphincters in SL women and predominately normal findings in SI women. The contribution of genitourinary or pelvic surgeries to the fecal incontinence in SI group has been established by means of discriminatory analysis.

Key words: fecal incontinence, urinary stress incontinence, EMG analysis

Introduction

The anal sphincter plays a direct role in fecal incontinence, and the loss of anal sphincter control leads to the unwanted or untimely release of feces or gas. The incidence rate in the general population is 1–5%, 30% of the individuals are older than 65 years, and 63% of them are women¹. Childbirth is widely accepted as the most common predisposing factor to fecal and urinary incontinence in women. It may result in internal or external anal

sphincter disruption, or damage to the pudendal nerve through overstretching or prolonged compression and ischemia^{2–4}. The majority of electromyographic (EMG) studies have reported evidence of partial denervation as a result of transvaginal childbirth, genitourinary or pelvic surgery^{4–7}. Adiposity, heavy lifting at work, age and oestrogen deficiency due to menopause are possible aethiologic factors. Urinary stress incontinence (SI) also

occurs as a result of weakness of the pelvic floor or the urethral sphincter.

The objectives of this study were to identify the EMG changes in the anal sphincters and to find correlations between some possible aetiological factors. Although EMG helps quantitate denervation and locate the sphincters defect for years, the standardization of the anal sphincter EMG is rather recent⁸.

Subjects and Methods

To identify the EMG changes in the anal sphincters two groups of women were studied. The first group comprised 110 women with history of stress incontinence (SI), examined primarily by urologists or gynaecologists. The diagnosis was based on clinical examination and graded to patient description⁹. Type 2 SI was found in 97 patients, and only 13 had type 3 SI. Mean age was 54.17 years (range 40–84). None of the women studied had a history of anorectal incontinence. Neurological examination of the trunk and lower limbs excluded abnormalities, and none of the patients suffered from any neurological diseases affecting the perineal muscles or peripheral nerves.

The second group comprised 91 women with history of urinary incontinence after a spinal cord or spinal nerve lesion (SL), only 12 of them with history of fecal incontinence. Mean age was 51.92 years (range 40–72). Neurological examination of the trunk and lower limbs revealed abnormalities, and none of the patients suffered from incontinence before the spinal lesion.

This study was carried out in open conditions over 3 years, and was approved by the Hospital Ethical Committee. The subjects agreed to participate in this study and gave their informed consent. A detailed history was obtained regarding occupation, the duration of incontinence in years, the number of deliveries and abor-

tions, the number of previous genitourinary or pelvic surgeries, age at menopause in years, years since menopause (natural or due to surgery), and the body mass index (BMI). The level of SL was observed in second group.

The EMG activity of the anal sphincters (on the left and the right sides of each muscle) was recorded using a concentric needle electrode (No 17915, Vickers Medical, Medelec, Voking, UK) connected to the Mystro (Vickers Medical, Medelec, Voking, UK) electromyographic system. The patients were in the supine position and a ground electrode was attached to the patient's right ankle. The EMG activity, including the tonic activity, the maximal voluntary activity and the forced activity achieved by coughing were examined. The innervation pattern (IP) and the amplitudes of motor unit potentials (MUP) in μV were recorded.

The statistical analyses were carried out by means of χ^2 -test for testing the relations of the nominal variables. The structural difference of SI and SL women was analyzed by means of multivariate discriminant analysis in four-dimensional discriminative space of the following variables: age, BMI, physical load at work, duration of incontinence in years, the number of deliveries, the number of abortions, the number of previous genitourinary or pelvic surgeries, age at menopause in years, the innervation pattern of the anal sphincter, the amplitude of MUP, the tonic activity of the anal sphincter, the forced activity of the anal sphincter.

In the statistical analysis parametric and nonparametric statistical software packages were used: STATISTICA for Windows, Release 5.5 H ('99 Edition) and SPSS for Windows, Release 7.5.

Results and Discussion

There was no statistically significant difference between SI and SL group con-

cerning occupation. 30.8% of all patients had sedantery occupation, 38.3% had standing occupation, 15.9% were constantly bending at work, 13.4% were heavy load lifters at work. Only 3% of the patients were constantly walking at work.

A statistically significant difference was found concerning menopause. In the SL group only 35.4% were menopausal and in the SI group 64%. Average years since menopause were 4.12 (SD 7.16) in the SL group, 6.05 (SD 7.83) in the SI group.

The number of deliveries and abortions was similar in both groups. 36.3% of the patients were primiparous with 1 child, 32.2% had 2 deliveries, 14.4% had 3

deliveries, and only 3% of the patients had 4 or more deliveries. 13.9% of the patients were nulliparous. The average number of childbirths was 1.55 in the SL group, 1.57 in the SI group. The average number of artificial abortions was 0.35 in the SI group, 0.36 in the SL group. 74.9% had 1 abortion, 6.9% had 2 abortions, and 1.5% had more than 2 abortions.

In the SL group there was no history of gynaecological surgery in 95.6% patients, and only 4.4% had 1 operation (Hysterectomy). 20.9% of the patients in the Sigroup had 1 operation, 1.8% had 2 or 3 gynaecological operations.

Significant differences in the IP of the anal sphincters at maximal voluntary

TABLE 1
CONTINGENT TABLE OF THE INNERVATION PATTERN OF THE ANAL SPHINCTER IN STRESS INCONTINENCE WOMEN AND WOMEN WITH SPINAL LESION AND INCONTINENCE; χ^2 -TEST RESULTS

Innervation pattern	Groups			Total
		Urinary stress incontinence	Spinal nerve lesion	
Single	n ^a	1	4	5
	hp ^b	20.0%	80.0%	100.0%
	vp ^c	0.9%	4.4%	2.5%
Reduced intermediate pattern	n	1	12	13
	hp	7.7%	92.3%	100.0%
	vp	0.9%	13.2%	6.5%
Intermediate pattern	n	17	42	59
	hp	28.8%	71.2%	100.0%
	vp	15.5%	46.2%	29.4%
Good intermediate pattern	n	30	17	47
	hp	63.8%	36.2%	100.0%
	vp	27.3%	18.7%	23.4%
Interference pattern	n	61	16	77
	hp	79.2%	20.8%	100.0%
	vp	55.5%	17.6%	38.3%
Total	n	110	91	201
	hp	54.7%	45.3%	100.0%
χ^2 -test		$\chi^2 = 50.25$	df = 4	p<0.001

^a count, ^b horizontal percent, ^c vertical percent

TABLE 2
EIGENVALUES

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	0.552	100.0	100.0	0.596

TABLE 3
WILKS' LAMBDA (Λ)

Test of functions	Wilks' Λ	χ^2	df	p
1	0.645	84.779	12	<0.001

contraction were detected when comparing the SI patients with the SL group. Reduction in the IP and single potentials pattern were found mostly in the SL group (Table 1). The tonic activity of the anal sphincters was moderate and in expected percentage in both groups. In SI patients a good tonic activity was found in 81%, whereas 36.3% of the SL patients had good tonic activity. The forced activity of the anal sphincter revealed similar findings: good forced activity had 93.6% of the SI patients, 46.2% of the SL patients. Mean MUP amplitude was 604.55 μ V (SD 363.03) in the SI group, 602.20 μ V (SD 376.82) in the SL group.

To synthesize univariate results, differences were subjected to the multivariate discrimination analysis of variance in both the SI and SL group defined by age, history, BMI and EMG findings. By means of discriminant analysis the significant difference between SI and SL group was determined in afore mentioned one-dimensional discriminative space (Table 2 and 3). Both groups could be differentiated mostly by the forced activity, the tonic activity, and the IP of the anal sphincters (Table 4). The difference was also found in the number of transvaginal operations.

The prediction of the examinees by the groups on the basis of discriminant analysis is shown by the classification results (Table 5). The separation of the groups is

TABLE 4
POOLED WITHIN-GROUP CORRELATIONS
BETWEEN DISCRIMINATING VARIABLES AND
STANDARDIZED CANONICAL DISCRIMINANT
FUNCTIONS (STRUCTURE MATRIX)

Variables ^a	Function ^b
	1
Forced activity	0.809
Innervation pattern	0.740
Tonic activity	0.727
Gynaecological surgeries	0.371
Duration of incontinence	0.348
Menopause	0.173
Age	0.167
Load at work	-0.106
BMI	-0.100
Number of deliveries	0.016
Number of abortions	-0.008
Amplitudes of motor units	0.004

^a Variables ordered by absolute size of correlation within function

^b Bold font style denote largest absolute correlation between variable and any discriminant function

clear on the discriminative function. These facts point the differences between the groups and are important for the assessment of possible aetiological factors to fecal incontinence.

The method used in this study could be criticized on the grounds that conven-

TABLE 5
CLASSIFICATION RESULTS^a

Original		Predicted Group Membership		
		Urinary stress incontinence	Spinal nerve lesion	Total
Urinary stress incontinence	Count	99	11	110
Spinal nerve lesion		37	54	91
Urinary stress incontinence	%	90.0	10.0	100.0
Spinal nerve lesion		40.7	59.3	100.0

^a 76.1% of original grouped cases correctly classified

tional EMG used to investigate the anal sphincters rather than the quantitative methods or the nerve conduction velocities^{10–13}. Several methods are available: anal plug, concentric needle electrodes, single-fiber electrodes, and monopolar wire electrodes. By using the concentric needle electrodes it is possible to distinguish myogenic from neurogenic damage to the muscles.

The objective of this study was also to determine the type of lesion involved. Few laboratories in Croatia are investigating the pelvic floor muscles, and this was the first investigation on such a relatively large number of patients.

A clear difference between SI and SL patients was found in the present study. In SL patients the IP of the anal sphincters revealed the neurogenic lesion more often. The majority of SI patients revealed the normal IP of the anal sphincter, which comprised consequently normal distribution of MUPs, and the better tonic and forced activities. Evidence of nerve damage in SI patients was significantly lower than in SL patients. These findings differ from the results reported before¹⁴.

The EMG activity of the anal sphincter is very discriminating due to capabil-

ity of contraction of the muscle, and its anatomy. The anal sphincter consists of three parts: subcutaneous, superficial and deep. The EMG activity can be detected almost subcutaneously and the standardization of needle examination was proposed by Podnar et al.⁸

Abnormal findings after EMG evaluation are expected in majority of patients with fecal incontinence, but only few of the patients in this study had history of fecal incontinence.

EMG of the anal sphincters remains the objective method which helps to distinguish between neurogenic and myogenic lesion.

The present EMG study demonstrates clear difference between SI and SL patients. In SL patients the anal sphincter was characterized by neurogenic lesion, while in SI patients the findings were mostly normal. These results suggest that the anal sphincter in SI women may be preserved when there is no history of fecal incontinence. In SL women with history of fecal incontinence the neurogenic damage to the anal sphincter may be responsible.

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ELEKTROMIOGRAFSKA STUDIJA ANALNOG SFINKTERA U ŽENA

SAŽETAK

Ciljevi ovog ispitivanja bili su identificirati elektromiografske (EMG) promjene u analnom sfinkteru i odrediti postoje li miogena ili neurogena oštećenja mišića u žena sa stres inkontinencijom (SI). Moguće su promjene očekivane jer su u većem broju ispitivanja nađeni dokazi o denervaciji kao posljedici određenih etioloških čimbenika. Namjera je bila odrediti čimbenike rizika za razvoj fekalne inkontinencije. Ispitano je 110 žena sa SI i 91 žena sa ozljedom leđne moždine (SL). Analni su sfinkteri ispitivani u obje skupine uz pomoć standardizirane EMG tehnike s koncentričnom iglenom elektrodom. Rezultati su pokazali pretežno neurogeno oštećenje analnog sfinktera u žena sa SL a pretežno uredan nalaz u žena sa SI. Utvrđen je doprinos genitourinarnih ili operacija u zdjelici za nastajanje fekalne inkontinencije u skupini sa SI, uz pomoć diskriminacijske analize.