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CLINICAL AND ELECTROMYOGRAPHIC ASSESSMENT OF LEVATOR ANI IN WOMEN WITH AND WITHOUT PELVIC FLOOR DYSFUNCTION.

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ABSTRACT **Objective:** Clinical and electromyographic assessment of levator ani in women with and without pelvic floor dysfunction. **Materials And Methods:** This was a prospective study in department of obstetrics and gynaecology and department of Neurology at Vardhman Mahavir Medical college and Safdarjung Hospital, New Delhi. This study had two groups. Group A had 25 women who had complaints of pelvic floor dysfunction (PFD) and group B had 25 subjects without complaints of pelvic floor dysfunction. Both the groups had undergone clinical examination and assessment of strength of levator ani by clinical examination and with Electromyography, their findings were compared. **Results:** Findings of EMG examination showed that our women with pelvic floor dysfunction had myopathy and neuropathy both as underlying cause. Digital examination method was able to discriminate between symptomatic and asymptomatic group. Correlation between digital examination and EMG for pelvic floor muscle was found to be significant.

KEYWORDS : Electromyography, Pelvic Floor Dysfunction, Motor Unit Action Potential, POPQ

INTRODUCTION

Many attempts have been made to explain the pathophysiology of pelvic floor muscles & pelvic organ dysfunction, the common denominator of which seems to be the weakness of the muscles of the pelvic floor and sphincteric mechanisms. Child bearing causes injury to nerve and certain amount of tissue injury of uterus, cervix, vagina & perineum which gets aggravated as parity increases. The pelvic floor muscles are integral to anal and urinary continence mechanisms and should be assessed routinely when performing a pelvic examination[1]. Mechanical strength of the pelvic tissues is essential for normal pelvic floor function. The vaginal wall supports urethral and bladder neck and prevents its descent by acting as the main support tissue. According to Bump & Norton (1998), it is not possible to identify apparently healthy women if she would develop pelvic floor dysfunction after vaginal delivery[2]

Pelvic floor dysfunction is a result of denervation injury to pelvic floor especially puborectalis, pubococcygeus and anal sphincter[3]. Substantial recovery from nerve damage occurs within 2 months of delivery but its found least complete in multipara. Reinnervation is a normal consequence of ageing which however is increased by childbirth as has been found by doing single fibre electromyography[4].

There are various methods available to assess the status of Levator ani muscle in patients with pelvic floor dysfunction: Clinical assessment, Electromyography (EMG), pressure perineometer, Ultrasound. But no test has proved itself to be highly accurate in outline the damage to levator ani muscle. EMG by measuring bioelectric potentials generated during depolarisation of skeletal muscle, is the only method which can accurately measure the extent of denervation injury. Glazen et al 1999 suggested that surface EMG can be useful tool in detecting pelvic floor dysfunction in those early and at risk of development and to have prophylactic intervention[5].

MATERIALS AND METHODS

This Prospective and randomised study was done in the Department of Obstetrics & Gynaecology and Neurology of Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi between February 2002 to April 2003. Patients were divided into study group (Group A) suffering from Pelvic floor dysfunction and another control group (Group B) of normal individuals suffering from unrelated gynaecological problems. Each group had 25 patients who were non pregnant non lactating during the study.

The study involved approval from hospital ethical committee and informed consent of all 50 participating patients. Patients with pelvic floor dysfunction presented with
-bladder dysfunction like stress incontinence and difficulty in voiding & retention
-Bowel dysfunction like fecal incontinence and constipation
-Uterine descent/ prolapse
-sexual dysfunction like dyspareunia.

Those with previous pelvic surgery, chronic medical condition, Congenital and acquired neurological diseases were excluded.

All women in group A & B were evaluated with relevant specific history and examination. A history of Parity, number of vaginal and caesarean deliveries, history of prolonged labour, instrumental delivery , episiotomy, weight of largest baby, menopausal status, history of perineal exercises were taken.

All group A patients with prolapse underwent stage of prolapse evaluation as recommended by POPQ protocol of staging system by International Continence Society. Clinical pelvic muscle assessment for levator ani tone was done as described by Digital muscle assessment scale[6].The scores were noted for all 50 patients which range from 0 to 5/5. After this all patients underwent concentric needle electromyographic examination of levator ani[7].

The electromyographic signal was filtered (range 5KHz-10KHz) and amplified and then sampled at 5 KHz rate with a 10bit analog to digital converter. Epochs of upto 20 seconds contraction effect were recorded with frequency response range of 2 KHz- 22 KHz. Amplification was set at 100 HV /cm and a sweep speed of 1mm/ms units.
1.Resting phase motor unit action potentials (MUAPs).
2.Contraction phase (volitional) MUAPs
3.Interference pattern during contraction phase.

MUAPs[8] were analysed in terms of
(a) Amplitude (peak to peak or from baseline to negative peak) in mv.
(b) Duration (from onset to termination or return to baseline) in msec.

(c) Area (amplitude x time constant) in m U/ms.
(d) Amplitude-Area ratio
(e) Number of turns (phase reversals which do not touch baseline).

Using multibasis OTE biomedics equipped with digitalise computer software using bandwidth of 0.3 m V to 5 Mv frequency of 1Hz to 10 kHz and time constant of 0.053ms. Concentric needle electrode had recording area of 0.07 Ms, diameter of 0.45 mm.

After voiding urine, patients were placed in lithotomy position and explained about relaxation and graded voluntary contraction of pelvic floor muscle. A ground electrode was placed on right place on right thigh.

A per vaginal examination was done and ischial spines were palpated as a reference point and concentric needle put perpendicular to direction of fibres when subjects were relaxing their musculature.

A resting (relaxation) phase EMG recording and contraction phase (after 20 sec of voluntary contraction) recording was taken from pubococcygeus part of levator ani.

RESULTS:

Th risk factors for pelvic floor dysfunction were studied.

- Age: The age of women belonging to Group A ranged between 30-60 yrs. with mean age of 46.84+ 7.46 yrs. and the age in Group B was 28- 56 yrs. with mean age of 44.4+7.36 yrs. The age distribution between two groups was not significant (p value 0.188).
- Parity: In Group A, there were 8 women with parity 5(28%), 5 women with parity3 (12%), 2 women with parity 2(8%) and no nullipara.
- In Group B, there were 6 women with parity 4(24%), 5 with parity 3(12%), 4 with parity 2(8%) and no nullipara. The p value for parity between two groups was not found significant (p value 0.66).
- History of prolonged labour: Group A had 8 and Group B had 6 women with history of prolonged labour. This was not found significant between two groups (p value 0.68).
- History of instrumental delivery: Group A had 5 women and group B had 2 women with history of instrumental delivery. This was not found significant.
- Weight of largest baby delivered: Group A had 11 and 14 women with baby weight 2.5-3 kg and > 3 kg respectively. Group B had 2,12 and 11 women with baby weight < 2 kg, 2.5-3 kg and > 3 kg respectively. The p value 0.49 not significant.
- Home delivery: Group A had 10 women with all home deliveries and 15 women who delivered their children combination of home and hospital deliveries. Group B had 3 women with all home deliveries and 22 women who delivered their children combination of home and hospital deliveries. Th data was found to be significant with p value 0.024. There were 13 women with home deliveries and 37 women with either hospital deliveries or combination of home and hospital deliveries when both groups taken together.
- Menopausal status: Group A had 12 premenopausal women and 12 postmenopausal women not taking HRT, 1 postmenopausal woman taking HRT. Group B had 17 premenopausal women and 7 postmenopausal women not taking HRT, 1 postmenopausal woman taking HRT. The data was not significant with p value 0.136.

The symptoms of the patients in group A were analysed (Table1). All the patients in Group A had complaints of prolapse. Urinary dysfunction and pelvic discomfort were seen in 28% while sexual dysfunction was seen in 24% of females. On assessment by digital examination, maximum mean strength was seen in asymptomatic patients which formed group B and was 3.92 with standard deviation of 0.49(Table3). For Group A patients, all stages of prolapse the mean strength was 2.30. There was significant difference between muscle strength of women with and without prolapse. The mean value of digital muscle strength fell between 2/5 and 3/5 for group A and fell on either side of 4/5 for group B. The muscle strength by digital examination was found to be significant between two groups with p value <0.001.

Table 1. Distribution Of Symptoms Of Pelvic Floor Dysfunction In Group A

Symptoms	No. of Women	Incidence (%)
Urinary dysfunction	7	28
Bowel dysfunction	0	0
Sexual dysfunction	6	24
Pelvic discomfort	7	28
Something coming out of vagina	25	100

Table 2. POPQ Staging Of Prolapse In Women With Group A

Stage	No. of women	Incidence
I	0	0%
II	7	28%
III	7	28%
IV	11	44%

Table 3. Distribution Of Muscle Strength In Women Of Two Groups

Digital Examination	Group A	Group B	Total
1/5	0	0	0
2/5	17	0	17
3/5	8	4	12
4/5	0	19	19
5/5	0	2	2
Total	25	25	50

Electromyographic parameters were studied in both groups (Table 4).

There was significant difference in amplitude of MUAP in women with or without prolapse. The mean amplitude of MUAP in group A was 0.0804±0.08 and in group B was 0.2011±0.018. The amplitude of MUAP was found to be significant parameter (p value <0.001) to differentiate group A from group B. Low amplitude was found in group A as compared to group B(asymptomatic) which suggests myopathy[9].

The duration of MUAP found to be a significant parameter (p value <0.001) to differentiate group A from Group B. Maximum no. of patients in group A had duration of 11 – 13.9 Ms which is much more than the duration observed (5-7.9) in control group. Increase duration is seen in neuropathy.

The area of MUAP was found to be a significant parameter (p value <0.001) to differentiate group A from group B. Maximum mean area of MUAP was seen in women group B (asymptomatic group) and it was of 1.02 with S.D. of 0.08. the area was found to be significantly low in symptomatic group suggesting myopathic change.

The no. of turns of MUAP was not found to be significant (p value 0.39).

Interference pattern was found to be incomplete or reduced in all subjects (group A) and complete in all subjects (Group A). This observation was found to be significant with p value <.001. The interference pattern is reduced in cases of myopathy[10].

Risk Factor Of PFD: There were 13 women with home deliveries and 37 women with either hospital deliveries or

combination of home and hospital deliveries when both groups taken together. The mean of muscle strength on digital examination in women with history of home deliveries were 2.54+0.88 as compared to 3.32+0.88 in women without home delivery. The mean amplitude of MUAP in two groups with or without home deliveries were 0.0904±0.05 mv and 0.155±0.06 mv respectively. The p value was found to be significant. The mean duration of MUAP in these groups was 10.76+3.83 and 7.95+2.77. The p value was 0.007(significant). The area of MUAP was found to be a significant parameter with and 10.75+3.77 and 7.95+2.77 in these groups. The mean area was also found significant with values 0.51+0.27 and 0.79+0.31. This means that the findings of digital examination EMG parameters were deranged in women with home deliveries whether they were symptomatic or not.

Table 4. Values Of Electromyographic Parameters In Two Study Groups:

		Group A (N=25)	Group B (N=25)
Amplitude(mv)	Range	0.045 – 0.146	0.160-0.236
	Mean	0.0804±0.02	0.20±0.018
Duration(ms)	Range	6-19.8	5.1-8
	Mean	11.12±2.83	6.25±1.31
Area(mv/ms)	Range	0.95-1.2	0.234± 0.74
	Mean	0.422±0.143	1.024± 0.08
Amp-Area ratio	Range	5.06-5.6	5.06-5.6
	Mean	5.26± 0.2	5.096± 0.177
No. of turns	Range	1-5	1-3
	Mean	2±1.29	2.28±0.98
Interference pattern	Normally dense	0	25
	Incompletely dense	25	0

Table 5. Correlation Of Findings Of Digital Examination And Electromyography In Both Groups

Digital assessment	Group A N=25				Group B N=25			
	Amplitude	Duration	Area	Amp-area ratio	Amplitude	Duration	Area	Amp-area ratio
0/5	0	0	0	0	0	0	0	0
1/5	0	0	0	0	0	0	0	0
2/5	0.068	11.2	0.35	0.194	0	0	0	0
3/5	0.107	11	0.56	0.191	0.171	6	0.95	0.18
4/5	0	0	0	0	0.214	5.64	1	0.214
5/5	0	0	0	0	0.230	5.2	1.2	0.191

Correlation of EMG findings and digital examination for assessment of muscle strength was done by testing group A & group B independently by paired the test (Table 5). The mean difference in group A was 2.32±0.48 for digital examination & 0.08±0.03 for amplitude of electromyography. The mean difference in group B was 3.92±0.49 for digital examination & 0.20±0.02 for amplitude of electromyography. When these differences were subjected to test for level of significance, they yielded p value of <0.001(significant) for both the groups. When agreement analysis was done using intra class correlation, difference of averages(R) and (B) it was found that both the methods were not agreeing to each other. This means that one cannot say that both these methods measure the same phenomenon occurring in diseased muscle though they significantly correlate with each other for measuring disease states of levator ani.

DISCUSSION

Pelvic floor dysfunction is a widely prevalent disease in our country but because of lack of much work being done in this regard, the exact incidence of this disease is not known. Also, the incidence and prevalence of urogenital prolapse is unknown because it is largely asymptomatic and most women after childbirth have some degree of pelvic floor laxity. All the women, underwent pelvic floor muscle strength measurement and evaluation by careful digital examination and needle electromyography of levator ani.

Digital examination technique used in this study was suggested initially by Brink et al in 1989 in their pioneering study which is also used by physiotherapists[6]. This is the easiest and cost-effective tool for assessing pelvic floor muscles but the digital score shows only weak correlation with symptoms. So, these have limited predictive value for clinical status variables & represent only a first line screening procedure[7]. The other methods of assessment are use of pressure perineometer and Ultrasound and EMG. There was retrospective analysis of Clinical assessment of pelvic organ prolapse with bowel and bladder dysfunction using clinical methods and by ultrasonography. The study used POP-Q to classify prolapse and found good reproducibility.[8]

Kegel in 1948 initiated the measurement of pelvic muscle function perineometer which was limited in accuracy because of difference in vaginal size affected pressure readings[9]. He popularized the observation that many women sustaining urinary continence can be improved by improving the strength of the muscles. A study done by Chevalier et al (2014) on stratification of the strength of pelvic floor muscles in a normal distribution of a large sample of women with SUI was done and the relationship between strength of pelvic floor muscle and perineometer was found[10]

Perineal ultrasonography has been proposed for the evaluation of pelvic floor muscle strength for biofeedback purposes. But the disadvantage is that it doesn't offer the possibility of quantifying the result of pelvic floor contraction. A study done to find out the correlation between the measurements of bladder neck elevation during pelvic floor muscle contraction and Pelvic floor muscle strength measured using Manual muscle testing and perineometry[11]. It showed that ultrasound can be used in the assessment of Pelvic floor muscle function; however, the correlation was only moderate and, therefore, indicates that the different measurement tools assess different aspects of pelvic floor muscle function. A study done to evaluate the evidence for pathologies underlying stress urinary incontinence (SUI) in women. It was found that pathology of SUI is multifactorial, with strong evidence pointing to bladder neck and urethral incompetence with also evidence of impaired urethral support and levator ani function[12].

EMG is a simple electrophysiological method of evaluating the bioelectrical potentials that are generated during depolarization of skeletal muscle & provides a means to evaluate the neuromuscular integrity of the pelvic floor muscle and can accurately measure the extent of denervation injury. Needle electromyography was done on levator ani by inserting needle transvaginally to measure activity at rest, maximal muscle contraction and a interference pattern at maximum force of contraction[13]. Automated computer software in built in EMG machine allowed measurement of amplitude, duration, area & amplitude area ratio of MUAP. Also type of interference pattern observed from maximal muscle contraction was read & reported[14]. A study done by Berman showed that the results EMG done for finding out pelvic floor dysfunction were good[15].

Findings of digital examination revealed that the maximum mean strength was seen in asymptomatic patients which formed group B and was 3.92 with standard deviation of 0.49(Table3). For Group A patients, all stages of prolapse the mean strength was 2.30. The muscle strength by digital examination was found to be significant between two groups with p value <0.001. This means that this method is able to

discriminate between symptomatic and asymptomatic women. The findings are similar to study done in Turkey on 131 women in which 70% were multipara, the median muscle strength was 2/5[16].This test was found to be simple, with definite capability of distinguishing diseased from non diseased group. This method of examination requires explaining the patients about tedious procedures of coordinated pelvic floor muscle contraction. This study showed that by taking muscle strength 3/5 as a cutoff and dividing line between diseased and non diseased women, the digital assessment appeared to have sensitivity of 100% and specificity of 84%.

Analyses of distribution of EMG parameters between women with different stages of prolapse shows that mean amplitude to be significantly lower than that of control group. Similarly mean duration and mean area was statistically significant between two groups and showed deranged levels in diseased group. The control group showed mean duration of MUAP to be lower than standard observations done in various studies so far while mean duration of MUAP in study group fell in between the values quoted in literature. Assessment of interference pattern gave EMG a sensitivity & specificity 100% and findings were consistent with neurogenic damage to pelvic floor. Findings of EMG examination showed that our women with pelvic floor dysfunction had myopathy and neuropathy both as underlying cause. A study done by Weidner et al (2000) on EMG of Levator ani and anal sphincter in women with pelvic floor dysfunction revealed neuropathic damage with early recruitment of high-threshold motor units suggestive of reinnervation in pelvic organ prolapse[17]. Correlation between digital examination and EMG for pelvic floor muscle is significant.

CONCLUSION:

From the present study we conclude that women with pelvic floor dysfunction have significantly decreased pelvic floor muscles strength. Electrodiagnostic studies can characterize the integrity of the nerve, muscle, and neuromuscular junction, helps in localizing the nerve injury and quantify the severity of the problem. For assessment of muscle strength, the sensitivity and specificity of EMG is better than digital examination. Compared to the results of EMG of Levator ani in nulliparous women, even asymptomatic group showed deranged amplitude and duration of MUAP. Though most of the women in this age group have muscle strength of 4/5 or 5/5 on digital examination. Thus, EMG uncovers a subclinical pelvic floor dysfunction in them by showing a deranged amplitude and duration of MUAP. Electromyographic assessment of muscle function consists of recording and interpreting the intrinsic electric activity generated by the conduction mechanisms of skeletal muscle & peripheral nerves. The exact interpretation of the recorded electrical activity of the skeletal muscle and peripheral nerves and allows the determination of the state of innervation, the extent of nerve injury or the nature of extrinsic muscle disturbance and helps in the planning of medical therapy, surgical intervention and rehabilitation. We, therefore conclude that in all women with presence of risk factors of pelvic floor dysfunction, EMG can be a screening test to find out the functional status of pelvic floor muscle and predict the possibility of pelvic floor dysfunction. Correlation between both the methods is significant and these methods are used for pelvic floor muscle assessment.

Conflict Of Interest: There is no conflict of interest.

Ethical Clearance And Consent:

ethical clearance was taken from institutional ethical committee. Informed consent was taken from all subjects.

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