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Perineal floor efficiency in sexually potent and impotent men

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Given the knowledge that the ischiocavernous and bulbocavernous muscles are involved in the erection of the penis, we studied the voluntary contractile activity of the perineal floor muscles in sexually potent and impotent men to investigate whether or not a different muscular efficiency can be found in these subjects. The activity of perineal floor muscles was studied in 76 sexually potent men and in 97 impotent men matched by age. A further group of 217 older impotent men was also studied to verify the impact of age on the efficiency of perineal floor contraction. The average myoelectrical activity of 24 maximized contractions of the perineum was measured in μV by anal plug electromyography. Perineal floor muscle contraction was significantly higher ($P = 0.0007$) in potent than in impotent men matched by age. In addition, in older impotent men the less perineal floor efficiency was also negatively correlated to age ($r = -0.21$, $P = 0.002$). Our results clearly demonstrated that a reduction of contractile activity of perineal muscles may be related to erectile dysfunction in younger men and an additional influence of age on perineal floor efficiency can be present in older impotent men.

Keywords: ischiocavernosus muscle; electromyography; impotence

Introduction

The role of perineal floor muscles in penile erection is still under debate. Indeed, some electromyographic studies[1] appear to exclude any determinant role of both the ischiocavernous muscle (ICM) and bulbocavernous muscle (BMC) in the erection of the penis in younger men, supporting the idea that the vascular phase[2,3] and the characteristics of the human tunica albuginea[4] are able to guarantee enough intracavernous pressure for penetration. On the other hand, there is a considerable body of evidence in the literature that demonstrates an active role of the ICM in the initiation and maintenance of erection in humans[5–8] and in large mammals.[9,10] In monkeys,[10] the vascular phase alone, even together with the characteristics of the albuginea, were not capable to induce enough intracavernous pressure for vaginal penetration and, therefore the contractions of ICM and BCM seemed to be determinant. In addition, two recent studies[11,12] correlated the activity of the ICM with penile venous drainage.

To investigate whether or not there is a 'skeletal-muscle factor' in impotence in men, we compared the activity of the perineal floor musculature of a sexually potent young male population with that of impotent young men. In addition, we studied the perineal floor efficiency also in a large population of impotent older males to verify the impact of age on the activity of perineal floor musculature.

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Materials and methods

Subjects

Among the male population who were referred to our Andrologic Unit of Milan, there were sexually potent young men ($n = 76$) who we studied, after they have given their informed consent to perineal floor diagnostic sessions. They were between 18 and 35 y of age (mean 29.3 ± 3.6 y). A further group of impotent men ($n = 97$) matched by age (mean 28.1 ± 4.1 y, range 18–35 y) underwent perineal floor examination in the same period of time, after they gave informed consent. Two other groups of impotent older men were selected according to age ($n = 127$, mean age 43.7 ± 4.2 y, range 36–50 y, and $n = 90$, mean age 58.3 ± 5.5 y, range 51–75 y) who underwent to the same procedure. Impotent men underwent endocrine and metabolic evaluation, penile arteries duplex scanner, a pool of intracavernous injections with different doses of vasoactive drugs (PgE1 2.5–30 mcg, papaverine 30 mg + phentolamine 3 mg, PgE1 10 mcg + papaverine 20 mg + phentolamine 2 mg), this study of bulbocavernous evoked response and dorsal nerve somatosensory evoked-potentials, psychosexual counselling and, in selected cases, two nocturnal penile rigidity recordings by Rigiscan® and cavernosometry.

According to above mentioned tests, an arteriogenic factor was established when peak systolic velocity of both cavernous arteries during phase-2 of erection was less than 25 cm/s[13] and acceleration time was more than 110 ms.[14] A corporeal veno-occlusive disease was diagnosed in patient non-responders to high doses of vasoactive drugs, in those with a flow to maintain erection more than 12 ml/min at pharmacocavernosometry, according to 90th percentile in our control group. Patients were classified as neurogenic when both bulbocavernous evoked response and/or dorsal nerve somatosensory evoked-potentials were mono-bilaterally absent.[15] A psychogenic factor was defined according to DSM IV[16] and patients fulfilled the Diagnostic Criteria for male erectile disorders. Patients with inhomogeneous echopattern of the cavernous bodies and tunica albuginea (iperechoic spots, calcific areas, plaques) were considered as affected by cavernosal fibrosis. An endocrine factor was defined in those patients with marked low testosterone and/or dydrotestosterone plasma levels and when prolactin was significantly high. A pharmacological factor was defined in those patients who were treated with drugs well-known to inhibit erection.[17]

Experimental procedure

To evaluate the muscular activity of the perineal floor, we employed an apparatus for biofeedback consisting of a transrectal electromyographic probe which is non-invasive and easy enough to be clinically used on large populations. This apparatus is mainly employed in urology to evaluate and remedy incontinence due to urethral sphincter insufficiency.[18]

The apparatus has a central computerized unit connected to an anal plug electrode and to two surface electrodes that record the myoelectric activity of the perineum and of the antagonist muscles (abductors, glutei and abdominals). A third surface electrode (grounded) is placed on the anterosuperior iliac spine of the patient.

The contraction of the pelvic muscles and any recruitment of the antagonist muscles that may occur are visualized, in real time, by means of a monitor, as two distinct X–Y curves, in which the X axis represents the duration (s) and the Y axis the amplitude of muscular contraction in μV. Then, the patient can watch on the screen his own muscles working and may focus exclusively on the contraction of the pelvic floor. The subject lies down on his right side on a confortable couch in the best position to have a clear view of the monitor. The small anal plug is inserted, with the help of a small quantity of gel. Following explanations of the technique, an imitation of coital thrusts to increase the rigidity of the penis, the subject can watch the monitor for short sessions of trial contractions and the physician can put right the probe in the anal canal. Only then is the patient ready to start the diagnostic session that consists of a series of 24 maximal contractions of the perineum of 3 s each, at intervals of 6 s. The number and duration of contractions used in our protocol can be pre-programmed on the apparatus. The phases of contraction and relaxation are rhythmically signaled on the apparatus through two different sound signals. At the end of the exercise, two bar graphs are printed out and express in μV the average of myoelectric activity of the perineum and of the antagonist muscles during the 24 contractions.

The myoelectric activity of perineum (MAP) is the principal parameter for evaluation of musculature's performance.

This investigation makes it possible to diagnose:

(1) the perception of the patient of his own body plan and therefore being able to contract only the perineal floor, without recruiting antagonist muscle groups;
(2) the average of perineal floor muscle performance. The average of 24 muscular contractions reflects better than a single electromyogram what happens physiologically during sexual activity. Indeed, given the protracted request for muscular contraction, especially the recruitment of type 1 fibers (slow twitch, tonic), more suitable for sustaining long and repeated contraction than types 2 fibers (fast twitch, phasic), the action is more intense, giving easily exhaustion.

Statistical analysis

In order to analysed data we performed a Student *t*-test for unpaired data and analysis of variance with multiple comparison calculated according Bonferroni *t*-test. Spearman Rank Order correlation was applied to analyse an eventual correlation between MAP values and etiologic factors involved in erectile dysfunction.

Results

Table 1 displays the distribution of etiopathologic factors in the three subgroups of impotent patients.

MAP values ranged from 6–42 μV in sexually potent young men and the distribution curve was independent of age ($r = -0.024$, $P = 0.819$) (Figure

Table 1 Distribution of etiologic factors in the three subgroups of impotent patients

	18–35 y (n = 97)	*36–50 y (n = 127)*	*51–75 y (n = 90)*
Psychogenic	88 (90.7%)	87 (68.5%)	34 (37.7%)
CVOD	24 (24.7%)	25 (19.7%)	20 (22.2%)
Arteriogenic	8 (8.2%)	49 (38.5%)	56 (62.2%)
Neurogenic	11 (11.3%)	27 (21.2%)	29 (32.2%)
Fibrosis	4 (4.1%)	13 (10.2%)	16 (17.7%)
Pharmacologic	5 (5.1%)	12 (9.4%)	19 (21.1%)
Endocrine	2 (2.0%)	3 (2.3%)	3 (3.3%)
Diabetes	0 (0.0%)	8 (6.2%)	8 (8.9%)

1). In addition, MAP values were significantly higher in sexually potent young men (20.3 μV ± 6.2) in comparison to impotent men matched by age (16.8 μV ± 7.2) ($P = 0.0007$). Similarly to potent young men, no significant correlation was found between perineal floor activity and age ($r = -0.033$, $P = 0.898$) in impotent young men (Figure 1). On the other hand, in impotent men older than 50 y MAP values were significantly lower in comparison to young impotent men (up to 35 and 50 y, respectively) (Table 2) and a negative correlation ($r = -0.23$, $P = 0.002$) was found between MAP values and the age of subjects (Figure 2). No significant differences were found in the activity of the antagonist muscles between potent young men and impotent men of any age (data not shown).

In the control group we calculated the 10th percentile (7.9%) as 11 μV which included six patients. According to this threshold we observed the below frequencies and percentages in the impotent subgroups (Table 3). There was no significant

Table 2 MAP values in three subgroups of impotent subject ANOVA showed that three subgroups are statistically ($P < 0.01$) different. Multiple comparisons, considering as critical levels 0.0017 for $P < 0.05$ and 0.003 for $P < 0.01$, showed statistical differences between first and third subgroup ($P < 0.01$) and between second and third subgroup ($P < 0.05$) while first subgroup is not significant as compared to the second one.

Age	*Number*	*Map μV Mean*	*Map μV SD*	*Anova P*	
18–35 y	97	16.8	7.2	0.0026	$P < 0.01$
36–50 y	127	15.9	6.3		
51–75 y	90	13.5	6.0		
Multiple comparison (Bonferroni)					*P*
18–35 y *vs* 36–50 y			0.3363		NS
18–35 y *vs* 51–75 y			0.0009		$P < 0.01$
36–50 y *vs* 51–75 y			0.0091		$P < 0.05$

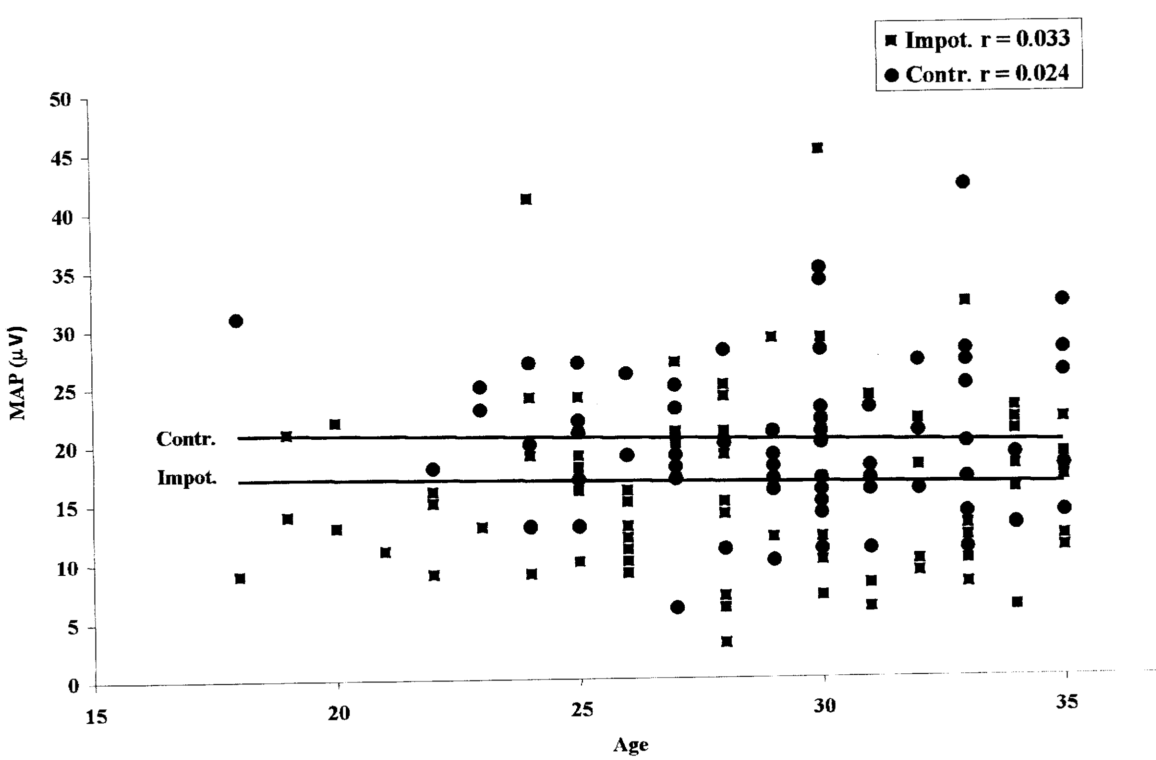

Figure 1 Distribution curve for MAP values in control group and in age-matched impotent group. MAP values are not significantly correlated with age.

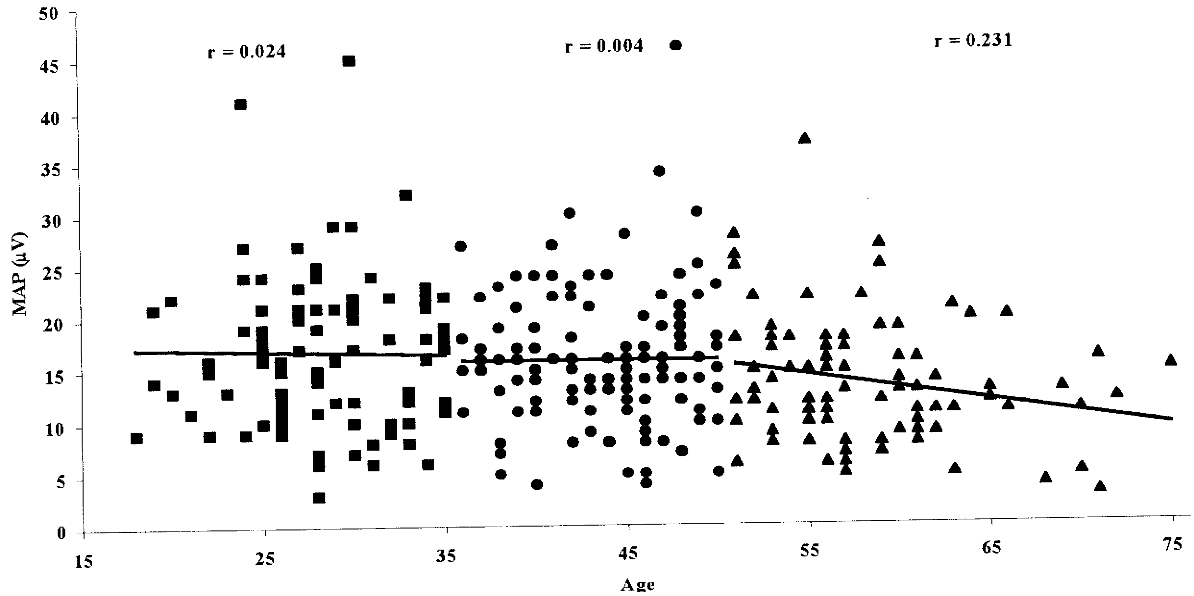

Figure 2 Shows correlation values between the above classes of age in impotent males and MAP values expressed as µV. For first and second subgroup correlation is not statistically remarkable, while for elderly patients (third subgroup) there is a significant ($P < 0.05$) correlation. As a matter of fact in the last subgroup there is negative trend which causes a decrease in MAP as age increases.

Table 3 According to the 10th percentile of MAP (11 µV) in control group, Table 2 shows below frequencies and percentages in the impotent subgroups

	Number	*≤ 11 µV*	*%*
Healthy	76	6	7.9
Impotent 18–35 y	97	26	26.8
Impotent 36–50 y	127	29	22.8
Impotent 51–75 y	90	37	41.1

Table 4 Correlation between MAP values and etiopathogenetic factors in 18–35 y old impotent men

	N	*R*	*P-level*
MAP and Arterial factor	97	0.160878	0.115442
MAP and Venogenic factor	97	0.004476	0.965291
MAP and Psychogenic factor	97	0.056566	0.582096
MAP and Pharmacologic factor	97	0.045034	0.661382
MAP and Fibrosis	97	0.087173	0.395858
MAP and Endocrine factor	97	0.020762	0.840032
MAP and Neurologic factor	97	0.034311	0.738651

Spearman Rank order correlation.

Table 5 Correlation between MAP values and etiopathogenetic factors in 36–50 y old impotent men

	R	*P-level*
MAP and Arterial factor	0.024450	0.784964
MAP and Venogenic factor	0.028721	0.748560
MAP and Psychogenic factor	0.065791	0.462407
MAP and Pharmacologic factor	0.119049	0.182500
MAP and Fibrosis	0.104734	0.241259
MAP and Endocrine factor	0.003543	0.968464
MAP and Neurologic factor	0.020091	0.822607
MAP and Diabetes	0.095238	0.286837

Spearman Rank order correlation.

Table 6 Correlation between MAP values and etiopathogenetic factors in 51–75 y old impotent men

	R	*P-level*
MAP and Arterial factor	0.122402	0.250430
MAP and Venogenic factor	0.130892	0.218813
MAP and Psychogenic factor	0.181833	0.086302
MAP and Pharmacologic factor	0.025596	0.810742
MAP and Fibrosis	0.066683	0.532324
MAP and Endocrine factor	0.154324	0.146420
MAP and Neurologic factor	0.044993	0.673693
MAP and Diabetes	0.082810	0.437773

correlation between MAP values and etiologic factors found in the three subgroups of patients (Tables 4, 5 and 6).

Discussion

Our results demonstrate that perineal muscles voluntary activity is more efficient in sexually potent men in comparison to impotent men matched by age which supports the idea that pelvic floor efficiency may be related to erectile dysfunction.

We employed a technique which, unlike the more invasive ICM needle electrode electromyography, did not provide any direct neurological information about the ICM, but gave us kinesiologic clues on the contraction state of all the 'cloacal muscles'. While some investigators[19] found differences in the myoelectrical activity of the muscles that make up the perineal floor (BMC and the external anal sphincter), another study[20] claimed that electromyography of any area of the pelvic musculature (in that case the anal sphincter) would generally reflect the overall electrical activity of the pelvic floor, including the ICM, and further recent studies in men[21] and rats[22] seemed to support such an idea. It is well known that in humans[21] ICM and BCM have the same distribution of type 1 and type 2 fibers (and its subtypes 2A, 2B, 2C), similarly to other striated sphincters, such as anal and bladder external sphincter. On the other hand, neuronal mapping of five pelvic muscles using retrograde tracer in rats[22] demonstrated the existence of an abundant dendritic network between the motoneurons of the various medullary nuclei, which are able to synchronize their contractile activity.

In our study we did not aim to correlate pelvic floor activity to vascular, neurological, endocrine etiopathological agents, but we wanted to state the importance of pelvic floor efficiency for penile erection in young men. In addition, the evidence that the impact of age on the activity of perineal floor musculature starts to be important after 50 y of age in impotent men fits with the knowledge that aging may affect voluntary contractile capacity because there is a tendency to more sedentary life style and to systemic pathologies, such as diabetes, hepatopathy, atheriosclerosis, and neuropathies, which may cause important decreases in muscle mass.

Conclusions

Our results provided further evidence that pelvic floor efficiency has to be taken into account in erectile dysfunction, which has long been observed by other investigators,[23–25] that the reinforcement of the striated muscles of the penis achieved through physiotherapy, directly or indirectly, may improve penile erection.

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