PELVIC MUSCLE TRAINING UNDER BIOFEEDBACK CONTROL IN PATIENTS WITH URINARY INCONTINENCE FOLLOWING RADICAL PROSTATECTOMY

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ABSTRACT — Pelvic floor muscle training is an effective method of post prostatectomy continence recovery. Muscle training is based on the concept of plasticity of the nervous and muscular system and their capacity to acquire new abilities and reinforce the new motor skill. Using EMG biofeedback as an additional source of information about muscle performance contributes to enhanced efficacy of training. Two channels of the total EMG enable regulation of the antagonist muscles activity and development of new motor skills, in this case isolated PFM contraction. The recovery of urinary continence is a function of the ability to consciously control the pelvic floor muscles. The rate of development and reinforcement of the isolated PFM contraction may serve as a prognostic indicator of the efficacy of training and the speed of the recovery process.

INTRODUCTION

Urinary incontinence (UI) is one of the most common complications of radical prostatectomy, a surgical intervention performed to treat prostate cancer. The underlying causes of UI after prostatectomy are incompetent closure mechanism of the vesicourethral anastomosis and hyperactivity of the detrusor muscle.

It is generally held that in the early post-operative period shortly after removal of the urethral catheter it is possible for patients to experience episodes of stress incontinence. If this should happen, neither the doctor nor the patient need to be overly concerned about it. Prior to surgery the patients are briefed on the possibility that recovery of adequate voiding after radical prostatectomy may be a long-term process.

In the majority of observations, urinary continence tends to improve over time following surgical intervention. A number of researchers reported improved voiding control during the first year after radical prostatectomy. Urine leakage within a year after radical prostatectomy persists in less that 5% of patients. Men aged up to 50 years show a better recovery rate of continence function than their counterparts over 70 years old (Kundu S.D., 2004). There is a body of opinion, which holds that recovery of urinary continence function continues up to 24 months. The outcome of surgery should be assessed no earlier than nine months after its completion (Veliev E.I., 2011).

The discrepancy in data on UI could be related to different criteria used to characterize urinary incontinence (Wei J.T., 2000). Within three months after radical prostatectomy only 54% of patients do not wear absorbent products (Walsh P.C., 2000). This index tends to increase to 80% by eight months, reaching 93% after the elapse of 12 months and subsequently stays at this level.

It is worth noting that this pattern of wear is rather rigid and uncompromising because included in the patient group wearing pads are even those patients who use no more than one incontinence pad a day (Pushkar D.Yu., 2007).

It goes without saying that the underlying mechanism of urinary continence in all patients who underwent a similar operation will run a different recovery course (Pushkar D.Yu., 2007).In this context of the utmost interest is the question of the importance and intensity of age-related atrophy of the urinary bladder sphincter and neurophysiological changes in its function given post-surgery impaired innervation. When observing a group of 2415 patients over a period of 17 months to 8.5 years the percentage of patients who had a post surgical urinary incontinence level of one tablespoonful per day or more was 6.65. Among males aged up to 60 years this indicator was 4%, and in those over 75 years old —10% (Karakiewicz P. I., 2004).

Obviously, it is not only surgical techniques but also individual rehabilitation potential of the body which is conditioned to a large extent by the patient's age have a very significant effect on outcomes of radical prostatectomy (Pushkar D.Yu., 2007).

Non-surgical therapy of UI after radical prostatectomy includes changes in lifestyle, pelvic floor muscle training and electrical stimulation. Pelvic muscle training is aimed at increasing the pelvic muscle strength and tone as well as developing the perineal reflex –the ability of the patient to contract muscles in response to an abrupt increase in intra-abdominal pressure. Providing the patient with feedback on pelvic muscles functioning during training sessions (biofeedback) helps to control muscle activity and muscle strength while enhancing the efficacy of exercises.

MATERIALS AND METHODS

Pelvic muscle training under biofeedback control was employed in 87 patients who have undergone radical prostatectomy. The age of patients in the study group was 63 years (55–72)[1]. Clinical investigation included response to ICIQ-SF questionnaire in order to facilitate objectifying of patient complaints. During history taking situations where urinary incontinence may occur were reviewed. Clinical urinalysis was performed in all patients and the amount of residual urine was estimated. The ICIQ-SF score in the group totaled 17(10–21).The median time of urine incontinence after prostatectomy at the onset of training was 2 months (1–22). Urinary leakage before reaching the bathroom was reported by 29 patients (33.3%), when coughing or sneezing — 63 (72.4%) , while sleeping —15 (17.2%), during physical exertion — 73 (83.9%), after a trip to the bathroom — 15 (17.2%). Loss of urine without any identifiable cause was reported by 43 patients (49.4%).

Inflammatory changes in urinalysis were found in 4 patients (4.6%). None of the patients had post-void residual urine. The main problem associated with pelvic floor muscle training is that 40 to 60% of patients are unable to selectively isolate and contract the muscles of the pelvic floor, especially given that these muscles are anatomically obscure (Ivanovsky Yu.V., 2003). Rather than activating their levator ani muscle , the patients would normally contract antagonist muscles –the rectus abdominis muscle, the gluteal, thigh muscles, thereby contributing to increased intra-abdominal pressure. Clearly such exercises apart from being ineffective may aso lead to ongoing urinary incontinence.

The goal of isolated pelvic floor muscle training can be accomplished only through the use of biofeedback techniques because in this case visual feedback information is relayed directly to the patient which enables them to monitor the accuracy of exercise performance.

The efficacy of pelvic floor muscle training with use of biofeedback resides in its ability to help the patients develop the feeling of being in control over the pelvic floor. This has the effect of reducing their fear, anxiety, a sense of isolation and hopelessness (Tries J., 1990).

The training of pelvic floor muscles and monitoring patients' performance were carried out under biofeedback control with a dual-channel EMG. The first channel monitored the electrical activity of pelvic floor muscles displaying it as total EMG while the second channel measured abdominal muscle activity. In a healthy individual abdominal and pelvic floor muscles will contract simultaneously when sneezing, coughing, changing body posture and during voluntary exertion. However, the exertions of abdominal and pelvic floor muscles produce a different effect — when pelvic floor muscles contract the closing function is executed and reinforced whilst during abdominal muscle contraction there is an increase in intra-abdominal pressure.

Therefore the goal of training under a dual-channel EMG control was to acquire the habit of isolated contractions with minimal involvement of anterior abdominal wall muscles. During the training process the patients were learning to consciously control groups of muscles and regulate the intensity of their contraction. In this way they acquired a new behaviour and learnt a new motor skill. A similar technique was introduced by Caufriez M. (1997) into gynecologica practice and gained a wide acceptance in Europe. 42

[1] Hereinafter the median, 5th and 95th percentiles are shown.

patients (48.3%) have developed the skill of isolated contractions of the perineal muscles with minimal involvement of anterior abdominal wall muscles in the course of 2 or 4 training sessions. 45 other patients (51.7%) had to rely on dual-channel EMG biofeedback support to enable them to perform this type of exercises. They performed exercises once a week.

The primary efficacy endpoint of treatment was reduced frequency of UI episodes, longer intervals between voidings and an increase in excreted urine volume. The use of one small absorbent pad per day to protect against accidental leaks was considered a measure of recovery.

RESULTS

The patient group with sustainable skill of isolated contractions of perineal muscles could exercise on their own gradually augmenting the frequency and duration of training sessions. The efficacy and effort tolerance were monitored once a month by evaluating the dynamics of total EMG of perineal and abdominal muscles.

While exercising the patients learnt to correctly identify the pelvic floor muscles and consciously perform the exercises. Abdominal muscle training has contributed to behaviour change and regulation of work loads during exercise which helped minimize the loss of urine. The results of exercises are given in Table 1.

Table 1. Results of pelvic floor muscle training with biofeedback control (n=87)

Result	Number, %
Recovery	28 (32.2%)
Improvement	19 (21.8%)
Unchanged	36 (41.4%)
Sling placement	2 (2.3%)
Artificial urinary sphincter implantation	2 (2.3%)
Total	87 (100%)

Dynamics of urinary continence recovery after radical prostatectomy with use of pelvic floor muscle exercises under biofeedback control is shown in diagram 1.

The median time to recover urinary continence after training pelvic floor muscles with biofeedback was 5.1 months.

A major focus of patient training being development of the ability for isolated contractions, the impact of this skill on training outcomes was duly assessed (diagram 2).

Of the 45 patients with post prostatectomy incontinence who trained with biofeedback control to perform corrective exercises, 18 patients have regained continence or improved their voiding function. 27 patients showed no signs of improvement secondary to pelvic muscle training and had an artificial urinary sphincter implanted. The median time of improved health status in this group was 9.5 months.

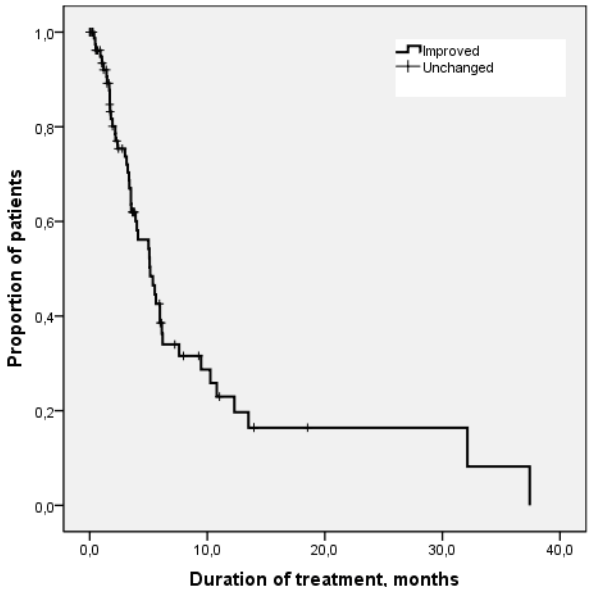

Diagram 1. Recovery of urinary continence after RP

Of the 42 patients who acquired the skill of isolated floor muscle contraction, 29 patients reported some degree of improvement and recovery, while 13 patients experienced no change in their condition (an artificial urinary sphincter and a sling implanted). The median time of improvement in this patient group was 4 months. Differences in improved health dynamics between these groups were statistically significant (p=0.003).

Comparison of outcomes of pelvic floor muscle training in patients who acquired the skill of isolated

Table 2. Ability to identify pelvic floor muscles and results of treatment of urinary incontinence (n=87)

Result of pelvic muscle training with biofeedback control	Ability to identify pelvic muscles		Total
	no	available	
Recovery	7 (8.0%)	21 (24.1%)	28 (32.2%)
Improvement	11 (12.6%)	8 (9.2%)	19 (21.8%)
Unchanged	26 (29.9%)	10 (11.5%)	36 (41.4%)
Sling		2 (2.3%)	2 (2.3%)
Artificial urinary sphincter	1 (1.1%)	1 (1.1%)	2 (2.2%)
Total	45 (51.7%)	42 (48.3%)	87 (100%)

PFM contraction and those who failed to learn the skill are shown in table 2.

There were significantly fewer patients who showed no changes in their condition and a significantly greater number of those who made a full recovery (p=0.002) in the patient group that acquired the skill of biofeedback-assisted isolated pelvic muscle contraction. Clinical symptoms and signs of disease were seen to resolve within 5.1 months[2].

In patients with sustainable skill of isolated PFM contraction the median time to recover urinary continence was 4 months. In the absence of lasting skill to perform isolated contractions median time to continence recovery was 9.4 months (p= 0.001)[3].

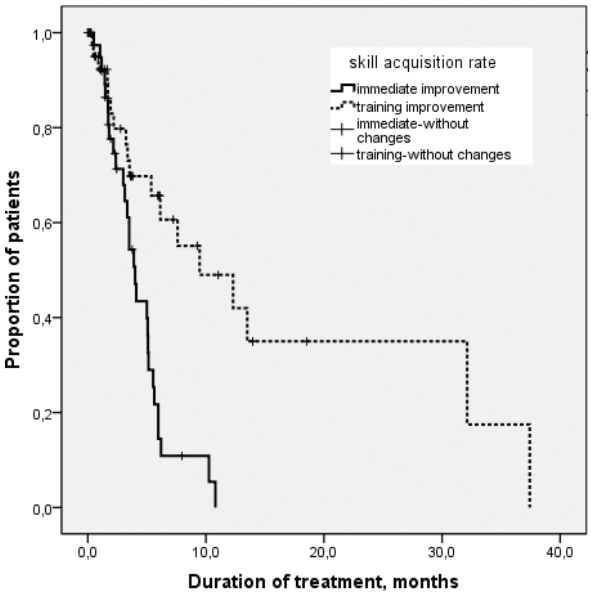

Diagram 2. *Recovery of urinary continence after RP*

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[2] Hereinafter the median is shown.
[3] The long-rank test is applied.