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Physiotherapeutic evaluation of pelvic floor muscle function in patients after radical prostatectomy using ultrasound imaging: retrospective study

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Abstract

Introduction: Urological physiotherapy is an effective treatment for post-radical prostatectomy (RP) lower urinary tract disorders, which significantly impairs patients' quality of life. Our study aimed to evaluate, with ultrasound examination, pelvic floor muscle function in patients who have undergone RP. Furthermore, we analyzed factors impacting the effectiveness of urological physiotherapy.

Material and methods: We retrospectively analyzed medical records of patients who underwent physiotherapy protocols, before RP consisted of the standard examination of pelvic floor function was performed utilizing ultrasound imaging and physiotherapy treatment. In total 42 patients were included.

Results: Before physiotherapy protocols 36 (86%) patients had an incorrect muscle reaction. After physiotherapeutic treatment, incorrect reactions were observed in less than 10% of patients. The median time between first consultation and radical prostatectomy was 9.3 months. The time between physiotherapy and radical prostatectomy has a statistically significant influence on the effects of physiotherapy ($p < 0.01$). In addition, the time-span between radical prostatectomy and first physiotherapy consultation did not influence the functional state of the pelvic floor muscles ($p = 0.47$). The results show that the early commencement of exercises increases the effectiveness of the physiotherapy.

Conclusions: Ultrasound imaging is a useful tool for assessing the pelvic floor muscles activity as well as for control the correctness of exercises performed. Utilization of ultrasound imaging during physiotherapy process should be performed to assess functional diagnosis of pelvic floor muscles.

Keywords: Prostate cancer, Rehabilitation, Ultrasound imaging, Prostatectomy, Exercise therapy

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Introduction

Epidemiological data from the Global Cancer Observatory (GCO) indicate that prostate cancer is the second most common cancer among men worldwide accounting for 14.1% of all cancer cases in 2020. Moreover, it is the fifth cause of cancer-related deaths worldwide, accounting for 6.8% [1-3]. The increased incidence of prostate cancer is also associated with a family history of the disease [2-4]. A number of potential environmental factors that may be related to prostate cancer risk have been described in the literature, among them are those related to the course and treatment of metabolic syndromes, dietary factors, factors related to the administration of hormonal medications and the level of physical activity [4].

The main therapeutic approaches include deferred treatment, radical prostatectomy, radical radiotherapy, experimental local therapy, and hormonal treatment [4-8]. Radical prostatectomy, which involves complete removal of the prostate gland and seminal vesicles, is dedicated to patients with cancer confined to the organ at low and intermediate risk of biochemical recurrence [9,10]. The procedure is performed using a variety of methods - open, laparoscopic, and using robotic assistance [11]. Currently, there is no evidence of superiority of any of the surgical methods in terms of mortality, tumor recurrence or postoperative complications, although laparoscopic and robotic methods may lead to shorter hospital stays and fewer serious postoperative complications [11,12].

Micturition disorders are the most common postoperative complication of surgical treatment for prostate cancer (PCa), with a prevalence up to 43% [13-15]. The prevention and treatment of urinary incontinence in men suffering from PCa presents a challenge for health care providers. Lower urinary tract symptoms caused by radical prostatectomy have a significant impact on quality of life because they adversely affect the comfort of living and undermine the individual's self-esteem. Such factors may result in withdrawal from social, professional, and sexual activity [16,17]. However, existing treatment options can significantly reduce the severity of urinary symptoms and sometimes even alleviate them completely. Individualized treatment programs which take into account the type and severity of urinary dysfunction must be established to bring about effective therapy for micturition disorders. In particular, accurate functional examination of the lower urinary tract and pelvic floor muscles is indispensable in identifying the type and severity of the disorder. Implementation of early and appropriate management physiotherapy after radical prostatectomy is an indispensable component of the of a multimodal treatment model for patients with prostate cancer. The goals of physiotherapy are centred around

the elimination of early and late complications after the surgical procedure [4,18]. In professional centres dealing with urological physiotherapy, the management physiotherapy begins even before the radical prostatectomy. This allows to reduce the frequency and intensity of post-surgical complications, i.e. urinary incontinence or erectile dysfunction, and for earlier recovery from surgery. The start of physiotherapy sessions should be performed in early postoperative period after the radical prostatectomy procedure due to the significantly decreasing chances of prevent the development of neurovascular dysfunction [4,18]. The optimal management program with patients after radical prostatectomy includes continence training (pelvic floor muscles training), biofeedback therapy and physical therapy treatments [18,19]. Therefore, the diagnostic and treatment process must be undertaken by teams of professionals in the fields of urology, physiotherapy, and nursing [20,21].

The pelvic floor muscles training allows to increase their volume, which is beneficial in the processes of reinnervation of this muscle group, enhances the formation of a network of new blood vessels and allows to improve proprioception. In addition, higher neuromuscular control of the pelvic floor muscles improves stabilization of the lumbar spine. Continence training itself, aimed at activating the muscles that allow you to hold urine, involves selectively activating them through isolated contractions. It is important that the training of the pelvic floor muscles takes place under the supervision of a physiotherapist who specializes in urological physiotherapy. The main task of the therapist during continence training is to teach the patient how to activate the relevant muscles. Another important task of the physiotherapist is to control that contractions of the pelvic floor muscles are not accompanied by contractions of other muscles, such as those of the abdominal muscles, gluteal, thighs or lumbar muscles. The patient should also be informed that these exercises are among those that are difficult and require a lot of patience, and their effects do not appear immediately [19,22]. An extremely beneficial tool to assist in this process is ultrasonography. The use of ultrasound is a relatively new, but effective and validated method of assessing the position of pelvic floor structures in both men and women. It allows assessment of their function and capacity during static and dynamic activity in real-time [23-25]. In addition, ultrasonography is used during therapy aimed at re-educating the function of pelvic floor muscles providing a tool to assess the correctness of exercises performed [10].

Our main goal was to report ultrasound imaging-based assessment of pelvic floor muscle functional outcomes in patients who have undergone RP. In addition, the impact of urological physiotherapy and factors influencing its effectiveness were analyzed.

Materials and methods

The patients' data came from three private practices runned by academic physiotherapists. All patients underwent laparoscopic radical prostatectomy. Exclusion criteria comprised biochemical recurrence after RP, inflammation of the urinary tract at the time of the examination, neurological disorders, arterial hypertension, diabetes, and history of lumbar spine surgery. The study was approved by bioethics committee (KNW/0022/KB/153/19) we retrospectively analyzed the medical records from June 2019 to May 2021. Standard examination of pelvic floor function was performed utilizing ultrasound imaging using a Mindray Z5 Portable Ultrasound System with convex array transducer operating at a frequency of 3.5 to 5 MHz. During the examination, the patient was placed on a couch in a supine position with the knees slightly flexed, feet in a neutral position, and upper limbs parallel to the torso. This position was intended to relax the muscles of the anteromedial area of the abdomen. Following the application of ultrasound gel, the convex array transducer was set transversely to the median line of the abdomen just above the pubic symphysis and pointed in a posteroinferior direction towards the bladder. The point of application of ultrasound transducer is shown in Figure 1.



Fig. 1. Point of application of ultrasound transducer

The patients who underwent the examination were prepared to contract and release their pelvic floor muscles. During the examination, multiple trials of contraction and release of pelvic floor muscles were performed while the position of the ultrasound array transducer was changed to obtain the highest possible quality of ultrasound image. This method of examination made it possible to assess the position of the pelvic floor during contraction. Elevation of the pelvic floor muscles during volitional contraction was assessed as a correct reaction and therefore as proper

functioning of the muscles (Figure 2a). The lack of reaction or depression to the contraction was assessed as incorrect functioning (Figure 2b and 2c, respectively).

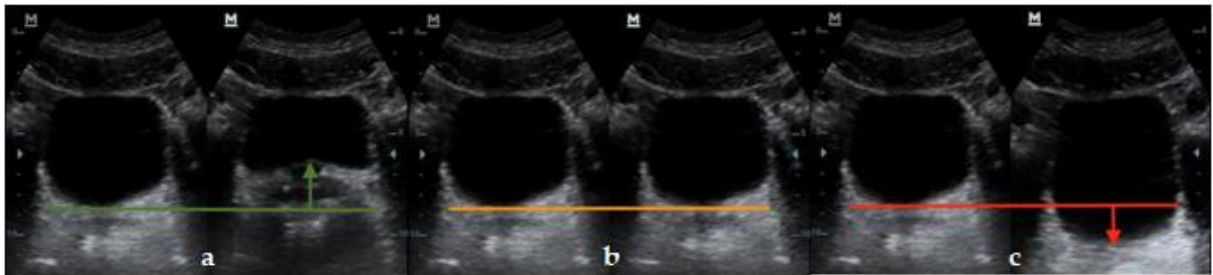


Fig. 2. The position of the pelvic floor during contraction: (a) Elevation of the pelvic floor muscles during volitional contraction; (b) Lack of reaction of the pelvic floor muscles during volitional contraction; (c) Depression of the pelvic floor muscles during volitional contraction

Statistical analysis

All medical data were analyzed using the IBM SPSS Statistics 20. For the comparison of the two group samples, the Student's t-test for two independent groups was applied. For data with heterogenous variance, a non-parametric U Mann-Whitney test, was used. P value less than 0.05 was considered statistically significant.

Results

The study cohort included 42 patients. The mean age of patients was 63 years (SD 5.4). The average age of patients whose medical records were analyzed entered demographic data presenting the structure of the incidence of prostate cancer in Poland and worldwide [4,26]. The time between radical prostatectomy and first physiotherapeutic consultation was 9.6 months (SD 25.0) on average. Most of the study group (N = 37; 89.9%) first consulted a physiotherapist after surgical treatment. Detailed information concerning time between radical prostatectomy and physiotherapy consultation is presented in Table 1.

Tab. 1. Time between radical prostatectomy and first physiotherapeutic consultation

Time between radical prostatectomy and first physiotherapeutic consultation	Population	
	N	%
Before surgery	5	11.9
3 months	19	45.2
3 – 6 months	9	21.4
6 – 12 months	4	9.5
> 12 months	5	11.9

After individualized physiotherapeutic treatment lasting up to 5 weeks of 2 sessions per week and with the use of sonofeedback and electromyography (EMG) biofeedback devices, incorrect reactions were observed in less than 10% of patients (N = 4). Detailed information about the reaction of the pelvic floor muscles before and after physiotherapy programme is showed in Table 2.

Tab. 2. Reaction of the pelvic floor muscles before and after physiotherapy

Reaction of the pelvic floor muscles	Before physiotherapy		After physiotherapy	
	N	%	N	%
Elevation	6	14.3	38	90.5
Lack of reaction	14	33.3	4	9.5
Depression	22	52.4	0	0

Length of time has impact on the effectiveness of physiotherapy ($p < 0.01$). Patients who reported improvements in urinary continence were largely from the group which had consulted a physiotherapist either before or within 6 months of surgery (N = 31; 79%). In contrast, those patients who did not report any improvement after physiotherapy began physiotherapy at least 6 months after radical prostatectomy. In addition, the impact of time elapsed between radical prostatectomy and first physiotherapy consultation on the functional state of the pelvic floor muscles before starting physiotherapy was analysed. The time period had no significant influence on the functional state of pelvic floor muscles at the commencement of physiotherapy treatment ($p = 0.47$).

Discussion

The present study is one of first study describing activity of the pelvic floor muscles in ultrasound imaging among prostate cancer patient planning to undergo radical prostatectomy. The advantages of present study include its multicenter character and utilization of the ultrasound imaging as a tool for assessing the pelvic floor muscles activity in real time.

In accordance with the guidelines issued by the European Association of Urology (EAU), early commencement of physiotherapeutic treatment gives the highest chance of therapeutic success in the form of diminution of urinary symptoms and return to social life, working life, and sexual activity [14,16]. We, believe that the first physiotherapeutic consultation should be scheduled before surgery to assess the function of the pelvic floor muscles, to discuss essential physiotherapeutic recommendations and, if necessary, to begin the program of physiotherapy.

A study conducted by Patel et al., which included 284 patients, supports the above recommendations regarding the importance of early commencement of physiotherapy after radical prostatectomy. The study indicated that a 4-week preoperative physio-therapeutic treatment program based on pelvic floor muscle exercises led by a physio-therapist significantly improves urinary continence after radical prostatectomy. At 6 weeks, 25% and 17% of studied population had no incontinence in the intervention and control groups, respectively ($p=0.003$) [27]. Furthermore, based on a meta-analysis, which included 11 studies and 739 patients the authors concluded that starting physiotherapy before radical prostatectomy improves continence capacity in the early post-operative period of up to 3 months after surgery. However, they also indicate that only two studies show positive effects of physiotherapy before surgery on the severity of urinary symptoms 6 months after radical prostatectomy. They draw attention to the fact that assessment of the long-term effects of preoperative physiotherapy is an area in need of further studies [28].

The results of the present study show that the overwhelming majority of patients – 88% ($N = 37$) of the total number – consulted a physiotherapist for the first time only after radical prostatectomy. It is alarming to find that mere 5 patients (12%) consulted a physiotherapist before surgery. This may reflect not only a lack of awareness among men suffering from PCa, but also a lack of information about options for conservative treatment of the most common postoperative complications, i.e. urinary incontinence and erectile dysfunction [29].

The average length of time between radical prostatectomy and first physiotherapy consultation in the present study was over 9 months. However, analysis of the available literature indicates that there are at least two differing views on the question of when physiotherapeutic treatment after surgery should commence. On the one hand, some researchers consider that the

sixth week after surgery is a safe starting point for the physiotherapeutic process [30,31]. On the other hand, Nielsen et al. examines the impact of pelvic floor muscle training on the quality of life of 85 men after radical prostatectomy and concludes that physiotherapy should begin immediately after catheter removal [32]. A similar view is presented by Lin et al., who investigates the impact of early commencement of pelvic floor exercises on the return of sexual functions after radical prostatectomy [33]. More widely however, de Santana e Santos et al. point to the lack of unified protocols or guidelines which unambiguously indicate the proper and safe time to begin physiotherapeutic programs after radical prostatectomy [34].

With reference to the guidelines of the European Association of Urology, which state that recovery from poor urinary tract function is most likely to be brought about in the first year after radical prostatectomy, it can be stated that all subjects of the present study did commence physiotherapy within the period recommended by the EAU. However, not all patients completed a full treatment program within one year of surgery. The abovementioned twelve-month period as described by the EAU should be used by patients as a time for active physiotherapeutic treatment focused on improvement in urinary continence and erectile function. However, it appears that many patients have to wait 12 months for a spontaneous improvement of urinary continence which does not transpire and only then decide to seek professional help in the form of urological physiotherapy. Considering our findings waiting for a spontaneous improvement should not be a first choice, which indicates that early professional urological physiotherapy has a positive effect on the function of the pelvic floor muscles while the mere passing of time after radical prostatectomy has no influence.

The limitations of present study include a relatively small sample size. Secondly, radical prostatectomies were performed by many surgeon, and we lack data on histopathological results. Finally, process of physiotherapy program performed by different therapists could have impact on its effectiveness, however it should be mentioned that all physiotherapists have the same education and they are working according to our common internal protocol.

Conclusions

Early commencement of physiotherapeutic treatment increases the chances of obtaining satisfactory results in the form of improved continence. Ultrasound imaging can be one of elements of functional diagnosis of pelvic floor muscles in clinical practice in patients after radical prostatectomy because it allows assessment of muscle performance in real time. Physiotherapeutic treatment comprising a program of individualized pelvic floor muscle exercises under the control

of an ultrasound imaging system and EMG biofeedback is an effective instrument for learning correct pelvic floor muscles contractions after radical prostatectomy.

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Conflicts of interest

The authors declare no conflict of interest.

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