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

Abstract:

**Introduction:** Urological physiotherapy is an effective treatment for lower urinary tract disorders incurred by radical prostatectomy (RP), which significantly impair quality of life. The present study evaluates pelvic floor muscle function in patients who have undergone RP using ultrasound; it also analyses the factors impacting the effectiveness of urological physiotherapy.

**Material and methods:** The medical records of 42 patients who underwent physiotherapy before RP were subjected to retrospective analysis. All received a standard examination of pelvic floor function utilizing ultrasound imaging and physiotherapy.

**Results:** Thirty-six (86%) patients demonstrated an incorrect muscle reaction before physiotherapy, but fewer than 10% after physiotherapy. The median time between first consultation and radical prostatectomy was 9.3 months; this length of this period had a significant influence on the effects of physiotherapy (p < 0.01), but not on the functional state of the pelvic floor muscles (p = 0.47). Early commencement of exercises appears to increase the effectiveness of the physiotherapy.

**Conclusions:** Ultrasound imaging is a useful tool for assessing pelvic floor muscle activity and for monitoring the correctness of the performed exercises. Ultrasound imaging should be used during physiotherapy to provide a functional diagnosis of the pelvic floor muscles.

**Keywords:** exercise therapy, prostatectomy, prostate cancer, ultrasound imaging
Introduction

According to epidemiological data from the Global Cancer Observatory (GCO), 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 highest cause of cancer-related deaths worldwide, accounting for 6.8% of all fatalities [1-3]. While a greater risk of prostate cancer is known to be associated with a family history of the disease [2-4], a number of potential environmental factors have also been described, including those related to the course and treatment of metabolic syndromes, as well as dietary factors, hormonal medications and 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 reserved for patients with cancer confined to the organ, and who are at low and intermediate risk of biochemical recurrence [9,10]. The procedure is performed using open and laparoscopic methods, and using robotic assistance [11]. Currently, there is no evidence that any particular surgical methods offers any advantage 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].

The most common postoperative complication of surgical treatment for prostate cancer (PCa) are micturition disorders, 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 quality of life and undermine self-esteem. Such factors may result in withdrawal from social, professional, and sexual activity [16,17].

Existing treatment options can significantly reduce the severity of urinary symptoms and sometimes even alleviate them completely. However, to achieve effective therapy for micturition disorders, it is necessary to establish individualized treatment programs which take into account the type and severity of urinary dysfunction. 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, as is the implementation of early and appropriate management physiotherapy after radical prostatectomy; both play key parts in the multimodal treatment 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, physiotherapy aimed at management begins even before the radical prostatectomy, as this has been found to reduce the frequency and intensity of post-surgical complications, i.e. urinary incontinence or erectile dysfunction, and allow earlier recovery from surgery. The physiotherapy sessions should begin in the early postoperative period following the radical prostatectomy procedure as this will significantly decrease the chances of neurovascular dysfunction [4,18]. The optimal management program with patients after radical prostatectomy includes continence training (pelvic floor muscle training), biofeedback therapy and physical therapy treatments [18,19]. Therefore, the diagnostic and treatment process should be carried out by teams of professionals in the fields of Urology, Physiotherapy, and Nursing [20,21].

The pelvic floor muscle training can increase the volume of the target muscles; this is beneficial for reinnervation of the muscle group, it enhances the formation of a network of new blood vessels and improves proprioception. In addition, greater neuromuscular control of the pelvic floor muscles improves stabilization of the lumbar spine. Continence training, i.e. exercises aimed at activating the muscles that allow urine to be retained, involves their selective activation 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. The physiotherapist should also ensure that the 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 difficult: they 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. Although the use of ultrasound is relatively new, it is an effective and validated method of assessing the position of pelvic floor structures in both men and women. It allows assessment of muscle function and capacity during static and dynamic activity in real-time [23-25]. In addition, during therapy aimed at re-educating the function of pelvic floor muscles, ultrasonography is used to assess the correctness of the exercises performed [10].

The aim of the study was to examine ultrasound imaging-based assessment of pelvic floor muscle functional outcomes in patients who have undergone RP. In addition, the study also analyses the impact of urological physiotherapy and factors influencing its effectiveness.

Materials and methods

The study retrospectively analysed the medical records of patients who had undergone laparoscopic radi-
Men underwent radical prostatectomy from June 2019 to May 2021 in three private practices run by academic physiotherapists. The 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 the local bioethics committee (KNW/0022/KB/153/19).

Standard examination of pelvic floor function was performed by ultrasound imaging: a Mindray Z5 Portable Ultrasound System was used 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 the ultrasound transducer is shown in Figure 1.

Fig. 1. Point of application of ultrasound transducer

The patients who underwent the examination were asked to contract and release their pelvic floor muscles before the examination. During the examination, the patient performed multiple trial attempts at contracting and releasing the pelvic floor muscles while the ultrasound array transducer was moved to obtain the highest possible quality image. This approach made it possible to assess the position of the pelvic floor during contraction. Correct muscle function was indicated by elevation of the pelvic floor muscles during volitional contraction (Figure 2a); conversely, a lack of reaction to the contraction, or depression, was assessed as incorrect function (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 IBM SPSS Statistics 20 software. Pairs of sample groups were compared using Student’s t-test for two independent groups. For data with heterogenous variance, the non-parametric Mann-Whitney U-test was used. A 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 entered demographic data was similar to that noted in other studies based on men with prostate cancer in Poland and worldwide [4,26]. The mean time between radical prostatectomy and first physiotherapeutic consultation was 9.6 months (SD 25.0). Most of the study group (N = 37; 89.9%) had not consulted a physiotherapist until after surgical treatment. Detailed information concerning time between radical prostatectomy and physiotherapy consultation is presented in Table 1.

The treatment programme consisted of two sessions a week of sonofeedback and electromyography (EMG) biofeedback, for up to five weeks. Detailed information about the reaction of the pelvic floor muscles before and after the physiotherapy programme is given in Table 2.

<table>
<thead>
<tr>
<th>Time between radical prostatectomy and first physiotherapeutic consultation</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before surgery</td>
<td>5</td>
</tr>
<tr>
<td>3 months</td>
<td>19</td>
</tr>
<tr>
<td>3 – 6 months</td>
<td>9</td>
</tr>
<tr>
<td>6 – 12 months</td>
<td>4</td>
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<tr>
<td>&gt; 12 months</td>
<td>5</td>
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</tbody>
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<table>
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<tr>
<th>Reaction of the pelvic floor muscles</th>
<th>Before physiotherapy</th>
<th>After physiotherapy</th>
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<tbody>
<tr>
<td>Elevation</td>
<td>6</td>
<td>14.3</td>
</tr>
<tr>
<td>Lack of reaction</td>
<td>14</td>
<td>33.3</td>
</tr>
<tr>
<td>Depression</td>
<td>22</td>
<td>52.4</td>
</tr>
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The length of time between the procedure and the beginning of the physiotherapy programme was found to influence the effectiveness of physiotherapy (p < 0.01). Patients who had consulted a physiotherapist either before surgery or within six months postoperatively were more likely to report improvements in urinary continence (N = 31; 79%) while those who did so more than six months after radical prostatectomy were more likely to not report any improvement. In addition, the length of this time period had no significant influence on the functional state of pelvic floor muscles at the start of physiotherapy (p = 0.47).

Discussion

The present multicenter study is one of the first to describe pelvic floor muscle activity in prostate cancer patients planning to undergo radical prostatectomy. In addition, it offers the advantage that it assesses pelvic floor muscle activity in real time using ultrasound imaging. The European Association of Urology (EAU) recommends early commencement of physiotherapeutic treatment following radical prostatectomy, as this affords the highest chance of therapeutic success, manifested as fewer urinary symptoms, and a faster return to social life, working life and sexual activity [14,16]. In the opinion of the authors, it is advantageous for the patient to schedule the first physiotherapeutic consultation before surgery to assess pelvic floor muscle function, to discuss essential physiotherapeutic recommendations and, if necessary, to begin a physiotherapy program.

These recommendations are supported by a study of 284 patients conducted by Patel et al., which found that a four-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 six weeks, no incontinence was reported by 25% of the intervention group and by 17% of the control group (p = 0.003) [27]. Also, a meta-analysis of 11 studies, encompassing 739 patients, found...
that starting physiotherapy before radical prostatectomy improves continence capacity in the early post-operative period, i.e. up to three months after surgery; however, only two studies indicated pre-operative physiotherapy to have positive effects of on the severity of urinary symptoms six months after radical prostatectomy. The authors emphasise that further studies are needed to determine the long-term effects of preoperative physiotherapy [28].

The results of the present study show that the overwhelming majority of patients, i.e. 88% (N = 37) of the total number, first consulted a physiotherapist only after radical prostatectomy: only five (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 mean length of time between radical prostatectomy and first physiotherapy consultation in the present study was over nine months. Interestingly, the literature presents at least two differing views on 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 physiotherapy [30,31]. On the other, a study of the impact of pelvic floor muscle training on the quality of life of 85 men after radical prostatectomy recommends that physiotherapy should begin immediately after catheter removal [32]. A similar view is presented by Lin et al., who investigated the impact of early commencement of pelvic floor exercises on the return of sexual function after radical prostatectomy [33]. More broadly speaking, however, de Santana e Santos et al. highlight the lack of unified protocols or guidelines that unambiguously indicate an appropriate time to commence postoperative physiotherapy [34].

According to European Association of Urology guidelines, recovery from poor urinary tract function is most likely to occur in the first year after radical prostatectomy. Although all participants in the present study did commence physiotherapy within the period recommended by the EAU, not all of them completed the full treatment program within one year of surgery. This twelve-month postoperative period should be used as a time for active physiotherapeutic treatment focused on improving urinary continence and erectile function. However, it appears that many patients wait 12 months for spontaneous improvement of urinary continence, and only then seek professional help, in the form of urological physiotherapy, when the improvement does not transpire. Our findings demonstrate that the mere passage of time after radical prostatectomy has no significant influence on pelvic floor muscle function, and that the patient would be well advised to seek assistance, i.e. urological physiotherapy, as soon as possible after the procedure.

Despite its novel findings, the study has some limitations. The analysis was based on a relatively small sample size, the radical prostatectomies were performed by more than one surgeon, and it was not possible to obtain any histopathological data. Also, the substance of the physiotherapy programs could have varied between therapists, and this would have impacted on its effectiveness; nevertheless, all physiotherapists had received the same training and were working according to a common internal protocol.

Conclusions

Early commencement of physiotherapeutic treatment increases the chances of obtaining satisfactory results in the form of improved continence. Ultrasound imaging allows real-time assessment of muscle performance, and as such, can be a valuable tool in the functional diagnosis of pelvic floor muscles in patients after radical prostatectomy. Physiotherapeutic treatment based on individualized pelvic floor muscle exercises, monitored by ultrasound imaging, and EMG biofeedback is an effective approach for training correct pelvic floor muscle contraction after radical prostatectomy.

Funding

This research received no external funding.

Conflicts of interest

The authors declare no conflict of interest.

References