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Perioperative Rehabilitation After Radical Prostatectomy: A Narrative Review

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Abstract

Background. Prostate cancer is one of the most frequently diagnosed malignancies in men worldwide. Radical prostatectomy is the standard treatment for localized disease, providing excellent oncological control. However, postoperative complications, including urinary incontinence, erectile dysfunction, impaired physical function, and psychological distress, significantly reduce quality of life. Evidence indicates that perioperative rehabilitation improves functional recovery and facilitates return to daily activities.

Aim. To summarize evidence on perioperative rehabilitation after radical prostatectomy, focusing on pelvic floor muscle training, physical exercise, erectile dysfunction management, nutritional optimization, psychological support, and multimodal prehabilitation, and their effects on functional outcomes and quality of life.

Materials and Methods. A narrative literature review was conducted using PubMed, Scopus, Web of Science, and Google Scholar. Original studies, systematic reviews, meta-analyses, and international guidelines on perioperative rehabilitation were included.

Results. Preoperative pelvic floor muscle training accelerates urinary continence recovery. Multimodal prehabilitation, including exercise, nutritional counseling, and psychological support, improves physical fitness and may reduce postoperative complications. Early mobilization, structured rehabilitation, and individualized erectile dysfunction management enhance functional recovery and support sexual function. Multidisciplinary care and patient education further improve postoperative outcomes.

Conclusions. Perioperative rehabilitation should be integral to radical prostatectomy care. Early implementation of evidence-based strategies improves functional recovery and quality of life, while further high-quality randomized controlled trials are needed to establish standardized protocols.

Keywords: prostate cancer, radical prostatectomy, prehabilitation, rehabilitation, pelvic floor muscle training, urinary incontinence, erectile dysfunction, quality of life.

Introduction

Prostate cancer (PCa) is the second most frequently diagnosed malignancy and one of the leading causes of cancer-related death among men worldwide. According to the latest global cancer statistics, over 1.4 million new cases are diagnosed annually, and the burden of the disease is anticipated to increase further because of population ageing, improved life expectancy, and wider implementation of prostate-specific antigen (PSA)-based screening and modern imaging techniques [1,2]. Earlier diagnosis has contributed to a growing proportion of patients presenting with localized disease, making curative treatment possible for an increasing number of men.

Radical prostatectomy (RP) remains one of the standard therapeutic choices for patients with localized and selected cases of locally advanced prostate cancer. Advances in surgical techniques, particularly robot-assisted radical prostatectomy, have substantially improved perioperative safety and oncological outcomes while reducing blood loss, postoperative pain and length of hospital stay [2–4]. Nevertheless, despite excellent cancer control, surgery may significantly affect postoperative functional status and health-related quality of life. Urinary incontinence and erectile dysfunction remain the most common long-term complications following RP, while reduced physical capacity, fatigue, anxiety, depressive symptoms and delayed return to normal daily activities may additionally impair recovery [3–6].

In recent years, more emphasis has been placed on optimizing perioperative care rather than focusing solely on oncological outcomes. The concept of prehabilitation, defined as interventions implemented before surgery to enhance patients' physiological and psychological reserve, has emerged as an important component of modern surgical management. Together with structured postoperative rehabilitation, prehabilitation goal is to improve functional recovery, reduce postoperative complications, minimize hospital stay, and facilitate an earlier return to everyday activities [7–9]. This patient-centred approach is consistent with Enhanced Recovery After Surgery (ERAS) protocols, which emphasize evidence-based multimodal perioperative care to accelerate recovery and enhance overall treatment outcomes [10].

Among available rehabilitation strategies, pelvic floor muscle training (PFMT) has received the strongest scientific support. Numerous randomized controlled trials and systematic reviews have demonstrated that appropriately supervised PFMT initiated before or immediately after surgery accelerates the recovery of urinary continence and may reduce the severity and duration of post-prostatectomy urinary incontinence [11,12]. Current evidence also suggests that

combining PFMT with biofeedback, individualized physiotherapy, or structured exercise programmes may further enhance functional outcomes in selected patient populations [11].

Beyond pelvic floor rehabilitation, comprehensive perioperative care increasingly incorporates general physical exercise, nutritional optimization, psychological support, and lifestyle modification. Exercise programmes involving aerobic and resistance training have been associated with improvements in cardiorespiratory fitness, muscle strength, fatigue, and overall physical functioning, whereas nutritional counselling may help preserve lean body mass and support postoperative healing [7–10]. Psychological interventions addressing anxiety, stress, and patients' expectations before surgery may additionally contribute to improved quality of life and treatment satisfaction [9]. Consequently, multidisciplinary rehabilitation involving urologists, physiotherapists, dietitians, psychologists, and specialized nursing staff is becoming an integral component of modern prostate cancer care.

Although the evidence supporting perioperative rehabilitation continues to expand, considerable heterogeneity remains regarding the optimal timing, duration, and composition of rehabilitation programmes. Furthermore, individual studies differ in rehabilitation protocols, outcome measures, and patient populations, making direct comparisons challenging and highlighting the need for continued synthesis of the available literature [7–11].

The aim of this narrative review is to summarize current evidence regarding perioperative rehabilitation in patients undergoing radical prostatectomy, with particular emphasis on pelvic floor muscle training, physical exercise, nutritional interventions, psychological support and multimodal prehabilitation. In addition, the review discusses the impact of these interventions on postoperative functional recovery, urinary continence, quality of life, and return to everyday functioning.

Research materials and methods

A narrative review of the literature was conducted to summarize current evidence on multidisciplinary rehabilitation following radical prostatectomy. A comprehensive search of the PubMed, Scopus, Web of Science, and Google Scholar databases was performed for articles published in English between January 2014 and July 2026.

The search strategy combined Medical Subject Headings (MeSH) and free-text terms, including: *prostate cancer*, *radical prostatectomy*, *rehabilitation*, *prehabilitation*, *pelvic floor muscle training*, *urinary incontinence*, *erectile dysfunction*, *exercise therapy*, *nutrition*, *psychological support*, and *quality of life*. Boolean operators ("AND", "OR") were used to refine the search.

Original studies, randomized controlled trials, systematic and narrative reviews, meta-analyses, and international clinical guidelines addressing perioperative rehabilitation in adult patients undergoing radical prostatectomy were considered eligible. Publications focusing exclusively on surgical techniques, oncological outcomes without rehabilitation, pediatric populations, case reports, conference abstracts, editorials, and non-English articles were excluded.

The retrieved literature was screened based on titles and abstracts, followed by full-text assessment for relevance. Studies were selected according to their methodological quality, clinical relevance, and contribution to the understanding of multidisciplinary perioperative rehabilitation. Particular attention was given to evidence regarding pelvic floor muscle training, physical exercise, nutritional interventions, psychological support, sexual rehabilitation, multimodal prehabilitation programs, postoperative functional recovery, and health-related quality of life.

As this study is a narrative review, no formal risk-of-bias assessment or quantitative meta-analysis was performed.

During the preparation of this work, the authors used AI in order to improve language readability, ensure an appropriate academic tone, structure the text logically, and format the bibliography. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the final content of the publication.

Prehabilitation before radical prostatectomy

Prehabilitation is defined as a multimodal intervention implemented before surgery to improve a patient's postoperative recovery. In men undergoing radical prostatectomy (RP), prehabilitation most commonly includes pelvic floor muscle training (PFMT), structured aerobic and resistance exercise, nutritional optimization, psychological support, and lifestyle

modification. The primary objectives are to reduce postoperative complications, accelerate the recovery of urinary continence and physical function, and improve health-related quality of life [8].

Among all components of prehabilitation, pelvic floor muscle training has the strongest evidence supporting its effectiveness. A recent systematic review and meta-analysis by Zhou et al. (2023), including randomized controlled trials evaluating preoperative PFMT, demonstrated that initiating pelvic floor muscle exercises before surgery significantly improved early postoperative urinary continence. Patients who received supervised PFMT before RP achieved higher continence rates during the first postoperative months compared with standard care. The greatest benefit was observed when exercises were started several weeks before surgery and combined with postoperative continuation. Although long-term continence rates became similar between groups after approximately one year, preoperative PFMT shortened the duration of postoperative incontinence and facilitated earlier functional recovery [12].

The mechanisms responsible for these benefits include improved neuromuscular control of the pelvic floor, increased muscle strength and endurance, and enhanced proprioception before surgical trauma. Patients familiar with correct contraction techniques before surgery are also more likely to adhere to rehabilitation protocols after catheter removal, contributing to improved early continence outcomes.

Mungovan et al. (2021) emphasized that preoperative exercise interventions should extend beyond isolated PFMT. Their review proposed a comprehensive prehabilitation model combining pelvic floor exercises with aerobic and resistance training. Improved cardiorespiratory fitness and skeletal muscle function may increase physiological reserve, decrease perioperative deconditioning, and facilitate earlier return to normal daily activities. The authors also highlighted the importance of supervised exercise programmes, as incorrect performance of PFMT is common when patients receive only written instructions [8].

The concept of multimodal prehabilitation was evaluated in two randomized controlled trials conducted by Santa Mina and colleagues. The pilot multicentre study published in 2014 investigated the feasibility of a structured programme combining aerobic exercise, resistance training, pelvic floor muscle exercises, nutritional counselling, and psychological preparation before RP. The intervention demonstrated excellent patient adherence and confirmed that such

programmes can be safely implemented in routine clinical practice without delaying surgery [13]

Subsequently, the larger multicentre randomized controlled trial published in 2018 further assessed the clinical effectiveness of multimodal prehabilitation. Although improvements in postoperative physical function did not reach statistical significance for all outcomes, patients participating in the intervention demonstrated better maintenance of functional capacity, higher physical activity levels, and favourable trends toward improved recovery. Importantly, the study confirmed that comprehensive prehabilitation is feasible across multiple institutions and may contribute to enhanced postoperative rehabilitation when integrated into perioperative care pathways [14].

The integration of prehabilitation with Enhanced Recovery After Surgery (ERAS) protocols has also demonstrated promising results. In a cohort study by Ploussard et al. (2020), patients undergoing robot-assisted radical prostatectomy managed with combined ERAS and prehabilitation pathways experienced shorter hospital stays, fewer postoperative complications, faster recovery, and lower overall healthcare costs compared with conventional perioperative management. These findings support the concept that optimization before surgery complements ERAS principles by improving patient readiness before the surgical insult rather than focusing exclusively on postoperative recovery [15].

Current evidence therefore supports prehabilitation as an important component of modern perioperative care for men undergoing radical prostatectomy. While pelvic floor muscle training remains the intervention with the strongest evidence for improving early urinary continence, the greatest clinical benefits appear to arise from multimodal programmes integrating exercise training, nutritional optimization, psychological support, and ERAS pathways. Nevertheless, further large randomized controlled trials are needed to determine the optimal duration, intensity, and composition of prehabilitation programmes and to establish standardized clinical protocols [8,12-16]. (Table 1)

Table 1. Key studies evaluating prehabilitation before radical prostatectomy (ordered from newest to oldest).

Author (Year)	Design/ population	Intervention	Key findings	Clinical significance
Zhou et al. (2023) [12]	Systematic review and meta-analysis, 12 RCTs, 1365 patients	PFMT ± biofeedback	Improved continence at **3 months** (OR 0.61; 95% CI 0.37–0.98; *p*=0.04); no benefit at 1, 6 or 12 months	**Strongest evidence supporting preoperative PFMT** for earlier continence recovery
Mungovan et al. (2021) [8]	Narrative review	PFMT + aerobic and resistance exercise	Multimodal exercise programmes improved pelvic floor function, physical fitness, and postoperative recovery compared with PFMT alone.	**Exercise should complement PFMT**, not replace it
Ploussard et al. (2020) [15]	Prospective cohort, 507 patients	ERAS + multimodal prehabilitation	Shorter hospital stay, fewer complications and lower healthcare costs	Supports **integration of prehabilitation into ERAS pathways**
Santa Mina et al. (2018) [14]	Multicentre RCT, 111 patients	Home-based multimodal prehabilitation	Better physical function and postoperative activity despite non-significant primary endpoint	Demonstrates the **clinical feasibility** of multimodal prehabilitation

Santa Mina et al. (2014) [13]	Multicentre pilot RCT 100 patients	Multimodal prehabilitation	The programme demonstrated high adherence (>80%), was safe, and did not delay surgery.	Demonstrates the **clinical feasibility** of multimodal prehabilitation

RCT - randomized controlled trial; PFMT - pelvic floor muscle training; ERAS - enhanced recovery after surgery

Pelvic floor muscle training

Pelvic floor muscle training (PFMT) is considered the cornerstone of conservative rehabilitation for urinary incontinence after radical prostatectomy. The procedure compromises several anatomical and functional mechanisms responsible for continence, including the external urethral sphincter, supporting pelvic tissues, and neural pathways. Consequently, postoperative rehabilitation aims to restore pelvic floor muscle strength, endurance, coordination, and timely activation during increases in intra-abdominal pressure, thereby accelerating the recovery of urinary continence [17].

Although PFMT is widely recommended in clinical practice, published protocols differ considerably with regard to exercise intensity, duration, supervision, use of biofeedback, and the timing of intervention. Current evidence suggests that these differences may explain the variability in reported outcomes rather than indicating a lack of treatment efficacy [18].

One of the strongest randomized controlled trials evaluating PFMT was conducted by Milios et al. [19]. Ninety-seven men scheduled for radical prostatectomy were randomized to either conventional PFMT (30 contractions/day) or an intensive programme initiated five weeks before surgery and continued for 12 weeks postoperatively (120 contractions/day, combining rapid and sustained contractions in standing). Patients receiving intensive training achieved significantly faster continence recovery. Ultrasound assessment also demonstrated superior pelvic floor muscle function in the intervention group, suggesting that higher training volume and functional exercise progression improve postoperative recovery.

Similar findings were reported by Sayılan and Özbaş [20] in a randomized study including 60 patients after robot-assisted radical prostatectomy. Participants who completed a supervised

six-month PFMT programme achieved significantly lower International Consultation on Incontinence Questionnaire–Short Form (ICIQ-SF) scores than controls at both three months (9.03 ± 3.55 vs. 14.27 ± 3.25; $p < 0.01$) and six months (6.17 ± 2.85 vs. 14.63 ± 3.02; $p < 0.01$). Clinically meaningful differences were also observed in pad use. Six months after surgery, 50% of patients performing PFMT required no pads compared with only 3.3% of the control group, whereas nearly half of the controls continued to require one or more pads daily [20].

Not all studies have demonstrated additional benefits from more complex rehabilitation strategies. Laurienzo et al. [21] compared home-based PFMT, PFMT combined with anal electrical stimulation, and standard postoperative care in 123 men following radical prostatectomy. Although continence, pelvic floor muscle strength, and quality-of-life scores improved over time in all groups, no significant differences were found between interventions. These findings suggest that electrical stimulation does not provide clinically relevant advantages over properly performed PFMT alone.

PFMT may also be successfully incorporated into broader home-based rehabilitation programmes. In a prospective study, Pan et al. [22] evaluated a modified programme combining pelvic floor exercises with resistance-band training after robot-assisted radical prostatectomy. Significant improvements were observed in urinary incontinence severity, quality of life, and psychological well-being during the three-month follow-up. Although the absence of a control group limits interpretation, the study supports the feasibility of structured home rehabilitation.

Evidence synthesized in a systematic review by Strączyńska et al. [23] confirms that PFMT generally reduces urinary leakage and improves postoperative quality of life. However, the authors also highlighted considerable heterogeneity among published protocols regarding exercise timing, supervision, duration, and outcome assessment, making direct comparison between studies difficult. Similarly, Ma et al. [24] proposed a standardized PFMT programme developed through expert consensus, emphasizing the need for reproducible rehabilitation protocols in future clinical trials.

Overall, current evidence indicates that PFMT is an effective component of multidisciplinary rehabilitation after radical prostatectomy, particularly when initiated before surgery, supervised by trained physiotherapists, and continued for several months after catheter removal. High-intensity, functionally oriented programmes appear to accelerate continence recovery more

effectively than conventional exercise recommendations, whereas routine use of adjunctive electrical stimulation is not supported by current evidence [19-21].

Physical exercise and functional recovery

Radical prostatectomy may result in a temporary reduction in muscle strength, lean body mass, aerobic capacity and performance of everyday activities. Therefore, rehabilitation should not be limited to pelvic floor muscle training but should also include exercises targeting general strength, endurance, mobility and functional capacity. A systematic review of eight clinical trials found that comprehensive functional physiotherapy produced significant improvements in physical capacity, physical and emotional functioning, health-related quality of life and urinary continence [25]. Similarly, a systematic review by Razdan et al. indicated that combining pelvic floor exercises with aerobic, resistance or Pilates-based training may improve continence and functional outcomes, although considerable heterogeneity between exercise protocols limits firm conclusions [26].

The timing of exercise may influence the postoperative recovery trajectory. In a randomized trial involving 38 men, a six-week supervised programme performed three times weekly before prostatectomy increased leg-press strength by 17.2 kg and chest-press strength by 2.9 kg. It also improved the 400-m walk time by 14.9 seconds and the chair-rise test by 1.3 seconds. Although postoperative rehabilitation restored strength and function, no significant between-group differences were observed at 12 weeks, suggesting that prehabilitation primarily increases functional reserve and attenuates the early postoperative decline [27].

Postoperative resistance training can also produce clinically relevant benefits. Ashton et al. randomized 40 men after robot-assisted radical prostatectomy to usual care or a six-month home-based resistance programme consisting of three weekly sessions using elastic bands. At six months, resistance training significantly improved aerobic capacity ($p < 0.01$), upper-limb strength ($p < 0.01$), lower-limb strength ($p = 0.01$), body weight ($p = 0.04$), body fat ($p = 0.02$) and prostate cancer-specific quality of life ($p < 0.01$) [28]. These findings support the progressive introduction of whole-body resistance exercise once postoperative restrictions have been lifted.

Habitual physical activity may additionally predict recovery. Among 509 men undergoing nerve-sparing radical prostatectomy, only 46% achieved the recommended level of at least 150 minutes of moderate or 75 minutes of vigorous activity per week. Patients meeting these recommendations reported better postoperative quality of life ($p = 0.02$) and were 19% less likely to be incontinent six weeks after surgery ($p = 0.028$) [29]. However, observational findings cannot establish whether exercise itself or better baseline health explains these outcomes.

Exercise programmes should therefore be individualized according to preoperative fitness, age, comorbidities, surgical approach and severity of urinary leakage [30-33]. Early recovery should focus on mobilization, walking, breathing exercises and gradually increasing daily activity. After surgical healing, aerobic and progressive resistance training may be introduced, ideally under physiotherapeutic or exercise-specialist supervision. Overall, the available evidence suggests that combined aerobic, resistance and functional exercise improves physical recovery and quality of life, while its independent effect on urinary continence remains less consistent.

Erectile dysfunction

Erectile dysfunction (ED) is one of the most clinically relevant long-term complications of radical prostatectomy (RP), substantially affecting patients' quality of life, intimate relationships, and psychological well-being. Despite advances in nerve-sparing and robot-assisted surgery, postoperative erectile function outcomes have not improved significantly over recent years. In a cohort of 2,364 patients, the year of surgery was not independently associated with erectile function recovery at either 12 or 24 months, while the probability of achieving adequate erectile function after RP has been estimated at approximately 35% after 2 years [34,35].

Post-prostatectomy ED is predominantly caused by intraoperative traction, thermal injury, ischemia, or partial disruption of the cavernous nerves. Even after technically successful bilateral nerve-sparing surgery, temporary neuropraxia reduces nitric oxide release and spontaneous erections. The resulting prolonged penile hypoxia promotes apoptosis of cavernosal smooth muscle cells, collagen deposition, fibrosis, and veno-occlusive dysfunction [35-38]. Recovery may therefore continue for several years and depends primarily on age,

preoperative erectile function, comorbidities, cancer characteristics, and the extent and quality of neurovascular bundle preservation [36-39].

Penile rehabilitation aims to preserve cavernosal oxygenation and tissue integrity during neural recovery. Phosphodiesterase type 5 inhibitors (PDE5Is) remain the most frequently used first-line treatment after nerve-sparing RP [36,38-41]. A systematic review including 39 randomized trials showed that both regular and on-demand PDE5I therapy improved treatment-assisted erectile function compared with placebo. At 6 months, the likelihood of achieving an IIEF-EF (International Index of Erectile Function, Erectile Function domain) score of at least 22 was higher with regular treatment (OR 1.87) and on-demand treatment (OR 2.17). However, no clear superiority of either dosing strategy was demonstrated [41]. Earlier initiation may be beneficial: starting sildenafil immediately after catheter removal resulted in better erectile recovery than commencing treatment 3 months after surgery [42]. Nevertheless, evidence that PDE5Is reliably restore unassisted spontaneous erections remains inconsistent [38-41].

Patients who do not respond adequately to oral medication may be offered vacuum erection devices, topical/intraurethral alprostadil or intracavernosal injections [43]. Vacuum therapy can increase penile oxygenation, facilitate earlier sexual activity, and limit postoperative penile shortening. In pooled analyses, vacuum devices improved IIEF-5 scores by a mean of 6.70 points at 6–9 months compared with control treatment, although substantial heterogeneity was present [40,41]. Intracavernosal injections provide erections independently of neural recovery and may therefore be particularly useful after non-nerve-sparing surgery. Combination treatment, such as PDE5Is with vacuum therapy or injections, may produce better functional outcomes than monotherapy, although adherence is frequently limited by discomfort, invasiveness, cost, and unrealistic expectations [36,38,40,41].

For patients with severe erectile dysfunction who fail to respond to conservative treatment, penile prosthesis implantation remains the most effective definitive therapeutic option [35]. Compared with pharmacological therapies, prostheses allow spontaneous sexual activity independent of residual neurovascular function and therefore represent an important treatment option after non-nerve-sparing radical prostatectomy or unsuccessful penile rehabilitation. However, implantation is irreversible and requires careful patient selection and preoperative counselling regarding potential complications, including infection, mechanical failure, and the need for future revision surgery [35]. Consequently, current treatment algorithms reserve penile

prosthesis implantation as third-line therapy after unsuccessful oral medication and intracavernosal injection therapy [35].

Pelvic floor muscle training may constitute a non-invasive adjunct to conventional penile rehabilitation. The pelvic floor muscles contribute to penile rigidity by increasing intracavernosal pressure and reducing venous outflow. In a randomized trial of 97 men, intensive training initiated 5 weeks before RP and continued postoperatively reduced early sexual-function-related distress, but did not produce conclusive improvement in erectile function within 12 weeks [19]. Another randomized study found no significant effect of pelvic floor exercises or electrical stimulation on erectile function recovery [21]. Consequently, pelvic floor rehabilitation may support continence, confidence, and earlier resumption of sexual activity, but it should not replace established ED treatments [19,21].

Low-intensity extracorporeal shockwave therapy (Li-ESWT) has been proposed as a regenerative treatment through stimulation of angiogenesis and improvement of endothelial function [44,45]. In a randomized trial, 92 men received tadalafil 5 mg daily, with or without eight weekly Li-ESWT sessions. The final median IIEF-5 score was statistically higher with combination therapy than with tadalafil alone (12 vs 10; p=0.006), but the predefined clinically meaningful four-point difference was not achieved. Moreover, the proportion of men reaching an IIEF-5 score of at least 17 did not differ significantly between groups (22.2% vs 17.1%; p=0.57) [44]. Li-ESWT should therefore currently be considered investigational in post-RP rehabilitation.

Management should also include preoperative counselling, realistic discussion of the prolonged recovery process, assessment of cardiovascular and psychological risk factors, and active involvement of the patient's partner. Sexual recovery extends beyond erectile rigidity and should address decreased libido, orgasmic changes, climacturia, penile shortening, altered body image, and relationship difficulties [37,46]. An individualized, multimodal programme combining early counselling, PDE5Is, mechanical or injectable therapy when required, pelvic floor rehabilitation, and psychosexual support appears to be the most appropriate strategy, although no single rehabilitation protocol has conclusively demonstrated superiority [37-41,46]. (Figure 1)

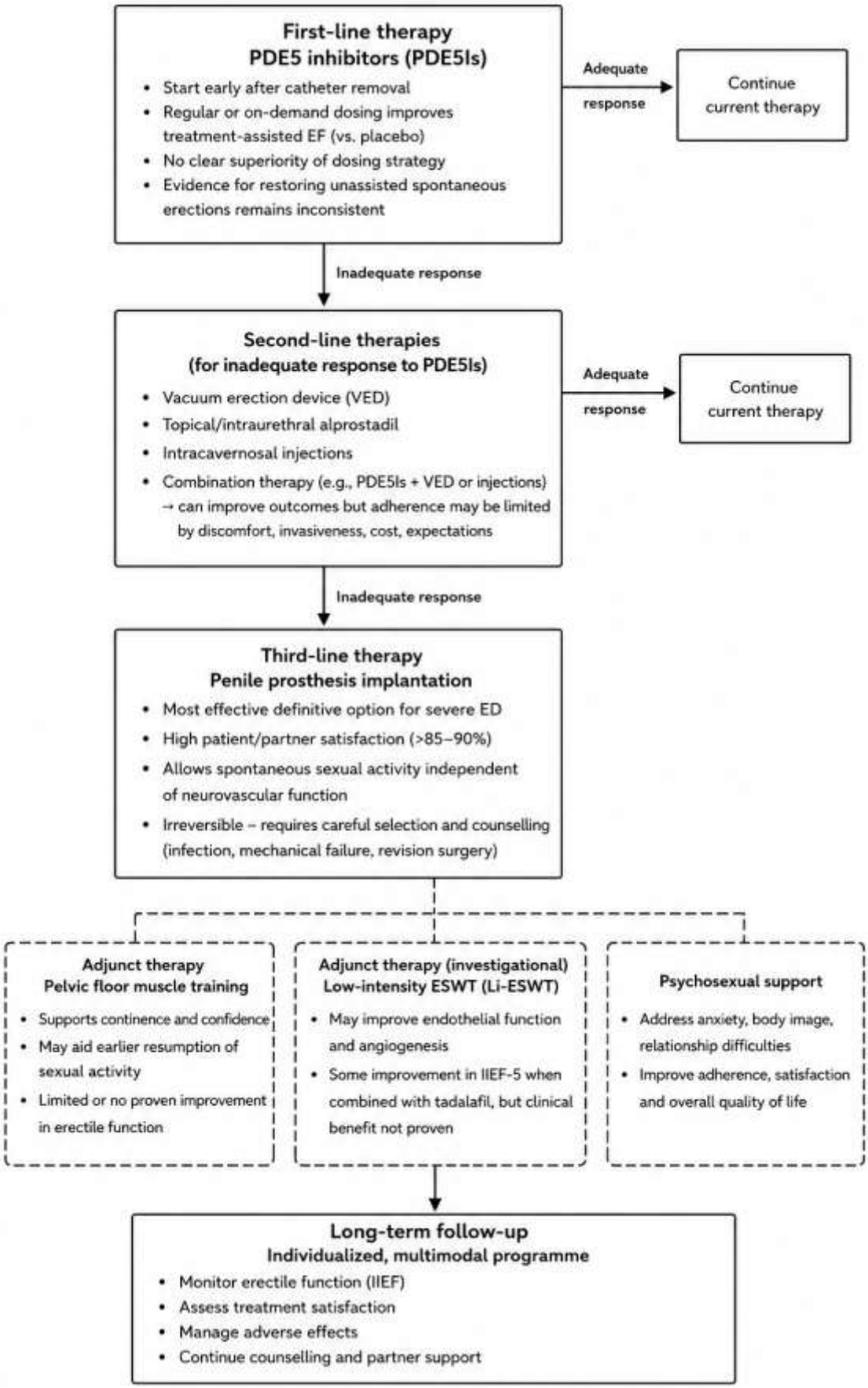

First-line therapy
PDE5 inhibitors (PDE5Is)
• Start early after catheter removal
• Regular or on-demand dosing improves treatment-assisted EF (vs. placebo)
• No clear superiority of dosing strategy
• Evidence for restoring unassisted spontaneous erections remains inconsistent
Adequate response
Continue current therapy
Inadequate response
Second-line therapies
(for inadequate response to PDE5Is)
• Vacuum erection device (VED)
• Topical/intraurethral alprostadil
• Intracavernosal injections
• Combination therapy (e.g., PDE5Is + VED or injections) → can improve outcomes but adherence may be limited by discomfort, invasiveness, cost, expectations
Adequate response
Continue current therapy
Inadequate response
Third-line therapy
Penile prosthesis implantation
• Most effective definitive option for severe ED
• High patient/partner satisfaction (>85–90%)
• Allows spontaneous sexual activity independent of neurovascular function
• Irreversible – requires careful selection and counselling (infection, mechanical failure, revision surgery)
Adjunct therapy
Pelvic floor muscle training
• Supports continence and confidence
• May aid earlier resumption of sexual activity
• Limited or no proven improvement in erectile function
Adjunct therapy (investigational)
Low-intensity ESWT (Li-ESWT)
• May improve endothelial function and angiogenesis
• Some improvement in IIEF-5 when combined with tadalafil, but clinical benefit not proven
Psychosexual support
• Address anxiety, body image, relationship difficulties
• Improve adherence, satisfaction and overall quality of life
Long-term follow-up
Individualized, multimodal programme
• Monitor erectile function (IIEF)
• Assess treatment satisfaction
• Manage adverse effects
• Continue counselling and partner support

Fig. 1. Treatment pathway for erectile dysfunction following radical prostatectomy.

PDE5I - phosphodiesterase type 5 inhibitor; EF - erectile function; ED - erectile dysfunction; Li-ESWT - Low-intensity extracorporeal shockwave therapy; IIEF - International Index of Erectile Function

Nutritional interventions

Nutritional management may constitute an important supportive component of multidisciplinary rehabilitation after radical prostatectomy (RP). Its principal goals include correction of malnutrition, preservation of lean body mass, support of wound healing, reduction of postoperative complications and promotion of long-term metabolic and cardiovascular health. However, evidence concerning the direct effects of diet on urinary continence, erectile recovery or prostate cancer recurrence remains heterogeneous [47-49].

A systematic review by Baguley et al. showed that nutrition and exercise interventions in men with prostate cancer may reduce cancer-related fatigue and improve selected quality-of-life outcomes. The most favourable effects were generally observed in multimodal programmes combining dietary counselling with structured physical activity, although differences in study design, intervention duration and outcome assessment limited the strength of the conclusions [47]. The acceptability of such interventions appears high. Men treated with RP or radiotherapy reported willingness to increase fruit and vegetable intake, reduce dietary fat and participate in structured lifestyle programmes, particularly when individual counselling and support from healthcare professionals were provided [48].

The importance of perioperative nutritional support is reinforced by a recent retrospective study of patients undergoing RP. Du and Zhang reported that structured nutritional management was associated with improved postoperative nutritional indicators, faster recovery of gastrointestinal function, shorter hospitalisation and fewer postoperative complications compared with routine care [50]. Although retrospective data cannot establish causality, these findings support preoperative nutritional screening and early postoperative dietary intervention, especially in older, frail or nutritionally deficient patients.

Dietary patterns may also influence prostate cancer biology and long-term outcomes. Recent evidence supports a predominantly plant-based dietary pattern rich in vegetables, fruit, legumes, whole grains, nuts and unsaturated fats, with limited intake of processed foods, refined carbohydrates, saturated fats and processed or heavily cooked red meat [49,51,52]. Mandair et al. identified 85 publications with the strongest available evidence and concluded that excessive intake of red meat, saturated fat and milk should be limited. Consumption of less than 500 g of red meat per week was associated with a potentially protective effect, whereas high milk intake in adolescence was associated with a 3.2-fold higher risk of advanced prostate cancer. Nevertheless, these associations mainly concern cancer risk, and evidence that dairy exclusion improves outcomes in men with an established diagnosis remains insufficient [51].

Potentially protective dietary components include tomatoes and tomato products, cruciferous vegetables, soy products, green tea and other sources of polyphenols [49,51,52]. However, the available studies remain inconsistent. Lycopene, soy protein, omega-3 fatty acids and green tea extracts have shown biological or clinical potential in selected studies, but routine supplementation cannot currently be recommended. Selenium, vitamin E, high-dose multivitamins and β-carotene should be used cautiously because supplementation has not consistently reduced prostate cancer risk and may be harmful in some populations [49,51,52].

Sulforaphane, an isothiocyanate found in cruciferous vegetables, has been investigated in men with biochemical recurrence after RP. In a randomized placebo-controlled trial, 78 men received oral sulforaphane or placebo for six months. Sulforaphane reduced the slope of PSA increase by approximately 38.5%, while PSA doubling time was 28.9 months compared with 15.5 months in the placebo group, representing an 86% prolongation [53]. Although these results suggest a possible biological effect, the intervention did not establish a definitive reduction in clinical progression or mortality, and sulforaphane should not replace standard oncological surveillance or salvage treatment.

The feasibility of implementing dietary intervention after RP was demonstrated in the PrEvENT trial. Eighty-one participants were allocated to nutritional interventions including lycopene supplementation, a plant-based dietary programme or a control group, alongside a factorial physical activity intervention. Recruitment, randomisation and adherence were considered sufficiently feasible to support further investigation, although the study was not powered to demonstrate differences in cancer recurrence or survival [54].

Nutrition may also indirectly support sexual rehabilitation. Obesity, diabetes, dyslipidaemia, hypertension and endothelial dysfunction are recognised contributors to erectile dysfunction. Consequently, weight control, regular physical activity and a diet supporting cardiovascular health may improve the overall conditions required for erectile recovery after RP. Nevertheless, the available review of post-RP erectile dysfunction describes dietary supplements mainly as experimental strategies supported by preclinical rather than definitive human evidence [36].

Overall, current evidence supports routine nutritional screening and individualised dietary counselling as part of prehabilitation and rehabilitation after radical prostatectomy. A balanced, predominantly plant-based diet, adequate protein and energy intake, maintenance of healthy body weight and combination of nutritional intervention with physical activity appear reasonable. Specific supplements should not be routinely recommended because evidence for their effect on functional recovery or oncological outcomes remains limited [36, 47-54].

Psychological rehabilitation

Psychological rehabilitation should be considered an integral component of recovery after radical prostatectomy, as postoperative urinary incontinence, sexual dysfunction, uncertainty regarding oncological outcomes and changes in intimate relationships may substantially affect emotional and social well-being. Psychological difficulties are not limited to formally diagnosed depression or anxiety. Patients may also experience shame, loss of masculine identity, reduced self-esteem, fear of recurrence, social withdrawal and reluctance to discuss treatment-related complications.

Evidence supporting structured psychoeducational care was provided by a pilot randomized controlled trial of 35 men with severe urinary incontinence after radical prostatectomy. In addition to routine nursing, the intervention group received individualized psychological assessment, relaxation training, weekly telephone contact, monthly two-hour group sessions, peer support and involvement of family members. After 3 months, anxiety scores were lower in the intervention group than in the conventional-care group (Self-Rating Anxiety Scale: 32.8 ± 0.7 vs 43.3 ± 0.6; $p < 0.001$), as were depression scores (Self-Rating Depression Scale: 46.4 ± 1.3 vs 53.5 ± 0.7; $p < 0.001$). Incontinence-related quality of life was also substantially higher after psychoeducation (84.2 ± 3.7 vs 68.4 ± 1.0; $p < 0.001$) [55]. Although the study population

was small and limited to patients with severe incontinence, the findings indicate that repeated, structured psychological support may provide greater benefits than routine postoperative information alone.

Psychological distress may be present both before and after surgery. In a prospective multicentre study, Köhler et al. assessed emotional distress and adjustment to disease in men undergoing radical prostatectomy. The results indicated considerable interindividual variation: while distress decreased in some patients following definitive treatment, a clinically relevant subgroup continued to experience anxiety, depressive symptoms or maladaptive coping after surgery [56]. Consequently, psychological assessment should not be restricted to the time of diagnosis. Screening should be repeated during early recovery and after the appearance of complications such as persistent incontinence, erectile dysfunction or an unexpected postoperative PSA result.

Longitudinal evidence also highlights the importance of the patient's private social network. In a follow-up study conducted at 3, 12 and 24 months after prostate cancer surgery, support from partners, family members and friends was more strongly associated with psychological well-being than the use of professional psychosocial services. Nevertheless, patients with poorer well-being were more likely to require additional professional support, indicating that informal and specialist care should be viewed as complementary rather than competing resources [57]. Psychological rehabilitation should therefore include evaluation of loneliness, relationship strain and caregiver burden, as well as direct referral to psycho-oncology services when distress persists.

The social consequences of prostatectomy may continue long after physical recovery. A qualitative meta-synthesis incorporating 31 studies identified recurring themes concerning relationships, family functioning, social participation and communication after surgery. Urinary leakage and sexual dysfunction altered relationship dynamics, reduced spontaneity and intimacy, and frequently required partners to assume both supportive and caregiving roles. Some men withdrew from social activities because of fear of leakage, odour or embarrassment, while others avoided discussing their difficulties to preserve a sense of masculinity and independence [58]. These observations justify involving partners in counselling, while respecting the patient's preferences and relationship circumstances. Rehabilitation should address not only symptom management but also communication, intimacy, role changes and return to occupational and social activities.

Sexual dysfunction represents a particularly important source of psychological distress. A recent scoping review screened 53 studies concerning sexual health after radical prostatectomy. The review demonstrated persistent physical, psychological, social and informational needs among patients and their partners. Sexual problems were frequently under-discussed and inadequately managed, and access to individualized psychosexual interventions remained limited. Feelings of isolation, frustration, altered body image and relationship tension were common [59]. Therefore, erectile rehabilitation should be combined with psychosexual counselling, realistic education regarding the course of recovery and partner-inclusive interventions. Discussion should extend beyond erectile rigidity and include intimacy, sexual satisfaction, adaptation to changed sexual function and alternative forms of sexual activity.

The need for comprehensive support is reinforced by qualitative interviews with 19 men treated radically for prostate cancer, including eight after prostatectomy. Men described an initial "diagnostic blow," uncertainty regarding cancer control and functional outcomes, emotional repercussions for partners and families, and the need to reorganize social and everyday activities. Anxiety and low mood were often most pronounced around diagnosis and treatment decision-making, while insufficient information intensified feelings of uncertainty. The authors also highlighted the importance of peer networks, clear professional communication and support directed towards partners and families [60].

In clinical practice, psychological rehabilitation after radical prostatectomy should begin before surgery with education regarding possible functional outcomes and assessment of baseline distress. Postoperative care should include repeated screening for anxiety, depression, fear of recurrence, relationship difficulties and psychosexual distress. Interventions may consist of psychoeducation, supportive counselling, cognitive-behavioural techniques, relaxation training, peer-support groups, telephone or digital follow-up and couple-based therapy. Patients with persistent or severe symptoms, suicidal ideation, major functional impairment or inability to adapt to postoperative complications require referral to a psychologist, psycho-oncologist or psychiatrist. Current evidence particularly supports an individualized, multidisciplinary approach integrating psychological care with continence, sexual and physical rehabilitation.

Future directions in prehabilitation and rehabilitation

Future research should focus on replacing isolated interventions with personalized, multimodal pathways combining pelvic floor muscle training, general exercise, erectile dysfunction management, nutritional optimization, psychological support and education. Current studies remain heterogeneous in terms of intervention intensity, timing, supervision and outcome definitions, which limits direct comparison. Therefore, adequately powered multicentre randomized trials using standardized measures of urinary continence, erectile function, physical capacity, psychological well-being and health-related quality of life are required [61,62].

An important direction is the integration of prehabilitation with continuous postoperative rehabilitation rather than treating these as separate phases. Programs should be adapted to baseline frailty, sarcopenia, comorbidities, nutritional status, functional capacity and the individual risk of urinary or sexual dysfunction. Patient involvement is also essential, as qualitative evidence suggests that interventions are more acceptable when they are flexible and tailored to personal needs rather than based on a uniform protocol [62,63].

Digital health technologies, including mobile applications, wearable activity monitors, video consultations and telerehabilitation platforms, may improve accessibility, adherence and long-term monitoring, particularly in patients living far from specialist centres [64,65]. Early studies after robot-assisted radical prostatectomy indicate that digitally delivered rehabilitation is feasible and may increase program uptake without compromising safety [66]. However, future trials should assess not only clinical effectiveness but also cost-effectiveness, digital exclusion, data security and sustained adherence. Ultimately, the goal should be the development of an integrated, multidisciplinary and scalable care pathway extending from diagnosis through surgery to long-term survivorship.

Conclusions

Current evidence indicates that multidisciplinary perioperative rehabilitation should be regarded as an integral component of the treatment pathway for men undergoing radical prostatectomy rather than as an optional adjunct. The greatest benefits are achieved when rehabilitation begins before surgery (prehabilitation) and continues in a structured manner

throughout the postoperative period. The strongest evidence supports preoperative and postoperative pelvic floor muscle training for accelerating recovery of urinary continence, while regular physical exercise improves functional capacity, reduces fatigue, and facilitates return to daily activities. Nutritional optimization and psychological support further contribute to improved recovery, treatment adherence, and health-related quality of life. Rehabilitation of erectile function, including early penile rehabilitation strategies, may enhance the likelihood of functional recovery in appropriately selected patients, although optimal treatment protocols remain to be established.

Despite the growing body of evidence, considerable heterogeneity exists among published studies with respect to intervention protocols, duration, outcome measures, and patient selection. Future well-designed randomized controlled trials are needed to establish standardized perioperative rehabilitation pathways and identify the most effective combinations of interventions. Overall, current data support the implementation of individualized, multidisciplinary rehabilitation programs as a standard component of care for patients undergoing radical prostatectomy, with the potential to improve both short- and long-term functional outcomes and quality of life [2,11-14,35,43,66].

Disclosure

Author Contributions

Conceptualization: GS, PZ, AM

Formal analysis: GS, PZ, MŁ

Investigation: AGS, HL

Methodology: MS, AT, AZ

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Visualization: AT, MS

Writing - rough preparation: GS, HL, AZY, MŁ

Writing - review & editing: AZ, PZ, AT

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