

Authors:

Julie K. Silver, MD
Jennifer Baima, MD

Cancer

Affiliations:

From the Department of Physical Medicine and Rehabilitation, Harvard Medical School, Boston, Massachusetts.

Correspondence:

All correspondence and requests for reprints should be addressed to Julie K. Silver, MD, Department of Physical Medicine and Rehabilitation, Harvard Medical School, Countway Library, 2nd Floor, 10 Shattuck St, Boston, MA 02115.

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REVIEW & ANALYSIS

Cancer Prehabilitation

An Opportunity to Decrease Treatment-Related Morbidity, Increase Cancer Treatment Options, and Improve Physical and Psychological Health Outcomes

ABSTRACT

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Cancer prehabilitation, a process on the continuum of care that occurs between the time of cancer diagnosis and the beginning of acute treatment, includes physical and psychological assessments that establish a baseline functional level, identifies impairments, and provides targeted interventions that improve a patient's health to reduce the incidence and the severity of current and future impairments. There is a growing body of scientific evidence that supports preparing newly diagnosed cancer patients for and optimizing their health before starting acute treatments. This is the first review of cancer prehabilitation, and the purpose was to describe early studies in the noncancer population and then the historical focus in cancer patients on aerobic conditioning and building strength and stamina through an appropriate exercise regimen. More recent research shows that opportunities exist to use other unimodal or multimodal prehabilitation interventions to decrease morbidity, improve physical and psychological health outcomes, increase the number of potential treatment options, decrease hospital readmissions, and reduce both direct and indirect healthcare costs attributed to cancer. Future research may demonstrate increased compliance with acute cancer treatment protocols and, therefore, improved survival outcomes. New studies suggest that a multimodal approach that incorporates both physical and psychological prehabilitation interventions may be more effective than a unimodal approach that addresses just one or the other. In an impairment-driven cancer rehabilitation model, identifying current and anticipating future impairments are the critical first steps in improving healthcare outcomes and decreasing costs. More research is urgently needed to evaluate the most effective prehabilitation interventions, and combinations thereof, for survivors of all types of cancer.

Key Words: Prehabilitation, Rehabilitation, Cancer, Function, Survivors, Disability, Survivorship

Increasing the quantity and quality of life in cancer patients is challenging. There is significant literature documenting cancer-related and cancer treatment-related impairments, disability, and evidence-based rehabilitation interventions.¹⁻⁶ In fact, the prospective surveillance model has recently been suggested as an improved model for rehabilitation care in the breast cancer population.⁷⁻¹⁰ In an impairment-driven cancer rehabilitation model, identifying current and anticipating future impairments are the critical first steps in improving healthcare outcomes and decreasing costs. This is the first review on cancer prehabilitation, and the purpose was to describe the available research in this important area of oncology care. A review of the current literature was conducted in March 2013 on prehabilitation in general and then, more specifically, as it applies to an oncology population with PubMed and then repeated with Scopus (Table 1). Identical search terms were used and similar results were found, with Scopus yielding two additional studies that were incorporated into this review. Using *prehabilitation* as a search term did not identify most of the articles used in this review because many pretreatment interventions were not identified in the literature as prehabilitation. General prehabilitation studies were selected to highlight specific issues as these apply to noncancer patient populations, whereas a comprehensive literature review was performed to describe the current evidence for cancer prehabilitation. This review is designed to describe the current literature and acknowledges that the research to date, although promising in concept and early small studies, reveals an urgent need for larger randomized controlled trials of both unimodal and multimodal interventions in the oncology population.

Prehabilitation typically occurs at the beginning of the rehabilitation care continuum and is used in anticipation of an upcoming stressor, such as surgery. Cancer prehabilitation may be defined as a process on the continuum of care that occurs between the time of cancer diagnosis and the beginning of acute treatment, includes physical and psychological assessments that establish a baseline functional level, identifies impairments, and provides targeted interventions that improve a patient's health to reduce the incidence and the severity of current and future impairments. Prehabilitation is the beginning of the rehabilitation care continuum during which there may be an opportunity to obtain a baseline status, identify pretreatment impairments, improve physical and emotional health before treatment, reduce treatment-related morbidity and/or mortality, decrease length of hospital stay and/or readmissions, increase available treatment options for patients who would not otherwise be candidates, and quickly facilitate return of patients to the highest level of function possible. The primary goal of prehabilitation is to prevent or reduce the severity of anticipated treatment-related impairments that may cause significant disability.

Prehabilitation from a Historical Perspective

Although prehabilitation is not a new concept and its use is not specific to individuals diagnosed with cancer, evidence-based prehabilitation interventions appropriate for use within this specific population are emerging. Historically, prehabilitation using unimodal or multimodal approaches has been used in diverse noncancer patient populations and demonstrated improved patient outcomes by means of a variety of methods. Before considering how prehabilitation can improve care in newly diagnosed cancer patients, it is important to briefly consider the historical evidence supporting the use of prehabilitation in other diverse patient populations.

One of the earliest articles on prehabilitation was published in the *British Medical Journal* in 1946 and was focused on improving the health of men, such that substandard military recruits could be fashioned into standard recruits.¹¹ Before prehabilitation, many recruits were simply rejected for poor general development caused by malnutrition, inadequate education, insanitation, poverty, and lack of opportunity. The prehabilitation program offered several interventions including nutritious food, lodging, hygiene, recreation, controlled physical training, and general education. Of the approximately

TABLE 1 Prehabilitation literature search results

Search Term	No. Articles Identified in PubMed ^a
Cancer prehab	2
Cancer prehabilitation	6
Prehabilitation	57
Fast track cancer rehabilitation	64
Prophylactic cancer rehabilitation	68
Pretreatment cancer rehabilitation	84
Perioperative cancer rehabilitation	186
Preoperative cancer exercise	257
Preoperative cancer rehabilitation	570
Prophylactic rehabilitation	660
Preoperative rehabilitation	4502

^aSearches were conducted in March 2013.

12,000 men who reportedly underwent prehabilitation, 85% successfully completed the program, and both physical training and intelligence testing improved within 2 mos.

More recently, in 2002, Topp et al.¹² focused on improving physical function before an upcoming elective intensive care unit hospitalization and defined the goal of their prehabilitation program as "... enhancing functional capacity of the individual to better withstand the stressor of inactivity." The prehabilitation program proposed included slow walking to warm up, aerobic conditioning, strength training, flexibility, and functional tasks and was scheduled for two to three sessions per week. They concluded, "Declines in physical activity among ICU patients represents a significant health risk that may be reduced through introducing prehabilitation interventions."¹²

Numerous recent prehabilitation studies have focused on outcomes after elective orthopedic surgery.¹³⁻²¹ For example, although case studies may be difficult to extrapolate to larger populations, one interesting study compared a patient who had 4 wks of prehabilitation with another patient getting usual care before knee replacement.²² The patient who received prehabilitation had less pain and better function in the postoperative period than did the patient receiving usual care. A second case study of physical function outcomes involved a patient who had knee replacement surgery on the right with usual care that was later followed by knee replacement on the left with prehabilitation.²³ This patient demonstrated a 30% improvement in function, a 50% increase in knee strength, and decreased preoperative knee pain in the left knee. In a larger study by Swank et al.,¹⁶ researchers hypothesized that exercise before having surgery would improve outcomes and postoperative recovery. At the end of this study of 71 participants (35 in the prehabilitation group and 36 in the usual care group), the researchers concluded that short-term prehabilitation was more effective in increasing leg strength and the ability to perform functional tasks before total knee replacement than was usual care.

Jack et al.²⁴ reported on the benefits of perioperative exercise training in elderly subjects, noting that, in patients who are deconditioned ("less fit"), there is a higher incidence of morbidity and mortality. In this review, the authors also noted that there is a paucity of high-quality clinical trials of preoperative exercise training, particularly in the elderly. Although their review indicated that prehabilitation can improve objectively measured fitness in the short periods before major surgery, it was not clear

how it impacted surgical outcomes in older people. However, they went on to explain that inspiratory muscle training before surgery may prevent specific complications such as atelectasis. These authors concluded, "Taken together, these findings are encouraging and support the notion that pre- and postoperative exercise training may be of benefit to patients. There is an urgent need for adequately powered randomized control studies addressing appropriate clinical outcomes in this field."²⁴

The relationship between physical and psychological outcomes is well known, and, as such, both have been considered when examining the efficacy of prehabilitation interventions. For example, a study conducted by Furze et al.²⁵ evaluated both physical and psychological outcomes in participants who were being scheduled for coronary artery bypass graft surgery. In this study, the researchers found that nurse counseling combined with a prehabilitation program (*vs.* nurse counseling alone) significantly reduced depression and cardiac misconceptions and improved physical functioning before surgery.

Because prehabilitation had been shown to improve physical outcomes, it seemed to follow that its use might also provide an opportunity to decrease hospital lengths of stay and/or decrease healthcare costs in other ways. Arthur et al.²⁶ found that, in patients who were planning to undergo an elective coronary bypass graft surgery, those who participated in a prehabilitation exercise intervention twice per week concomitant with education and nursing follow-up by telephone spent 1 day less in the hospital overall and less time in the intensive care unit than did controls. Further, prehabilitation patients reported improved quality-of-life for up to 6 mos after surgery. Another study from the Netherlands that focused on exercise of the respiratory muscles only had a similar outcome, additionally reporting fewer pulmonary complications after surgery.²⁷ The orthopedic literature, too, demonstrated success using prehabilitation to decrease lengths of hospital stay and postsurgical outcomes in the spinal surgery population. In one study of 60 patients who underwent primary lumbar decompression and fusion in Denmark, patients in the prehabilitation group reached recovery milestones faster and left the hospital earlier than those in the control group.¹⁸ This study also found that the prehabilitation and early rehabilitation program was less costly per patient than was standard care.²⁰ Although the direct costs before surgery in the intervention group were higher because of the cost of the prehabilitation, the overall costs were lower and improved in both the direct and the indirect cost analysis of the perioperative period.

In addition to improving outcomes, decreasing lengths of stay, and improving surgical cost-effectiveness, prehabilitation has also been shown to increase available treatment options for lung cancer patients, ultimately enabling patients previously considered poor candidates for pulmonary resection to have surgery.²⁸ Moreover, the benefits of prehabilitation are not limited to patients undergoing a hospitalization or disease-related intervention and have been targeted at vulnerable populations that are likely to be high users of healthcare resources. For example, Gill et al.²⁹ studied prehabilitation in community-dwelling frail older adults and demonstrated gains in physical performance, mobility, and ability to perform activities of daily living. Finally, by providing an opportunity to obtain pretreatment baselines, prehabilitation can facilitate better understanding of both the effects of treatment and factors that promote better outcomes as well as prevent an anticipated medical condition or lessen the severity of an existing one.^{14,15}

Lung Cancer Prehabilitation: A Model for Improving Outcomes in a Vulnerable Population

In a 2013 study, Billmeier et al.³⁰ assessed predictors of nursing home admission, severe functional impairment, or death 1 yr after surgery for non-small cell lung cancer and wrote, “Patients perceive long-term disability to be one of the most undesirable complications of lung cancer treatments.” Preoperative exercise testing in this population has been correlated with prognosis, and short-term intense physical therapy has been demonstrated to increase oxygen saturation, improve exercise capacity, and reduce hospital stays.^{31,32}

A closer study of pulmonary cancer prehabilitation is warranted because it may be a model of care for other cancers in which prehabilitation has not been as well studied. Looking back at the literature, the issue of whether pulmonary prehabilitation might change a cancer patient’s outcome or a physician’s treatment options was initially examined by Weiner et al.²⁸ in 1997. In addition, it was of interest to determine whether it was possible to predict which lung cancer patients would tolerate lung resection, a potentially lifesaving treatment. This prospective and randomized study examined the effects of incentive spirometry and inspiratory muscle training on predicted postoperative pulmonary function (forced expiratory volume) after lung resection in patients with both chronic obstructive pulmonary disease (COPD) and lung cancer. Exercise interventions,

used 2 wks before and for 3 mos after lung resection, were effective in significantly improving lung function. The authors went on to hypothesize that this beneficial effect could possibly hold true for patients with more severe lung disease who were not previously thought to be candidates for resection because of their poor lung function at baseline. The study demonstrated that prehabilitation not only could improve lung function but also may alter cancer treatment options for patients with comorbid lung disease.

In 1980, Dietz³³ described “preventive rehabilitation” as an opportunity for patients who are high risk for surgery to decrease potential morbidity and mortality. Dietz recommended counseling and the teaching of techniques to overcome anxiety and fear of the unknown to all cancer patients. Preoperative breathing training was suggested for all patients but, in particular, for lung cancer surgical candidates, including breathing control and proper coughing technique to mobilize secretions.

Despite these early successes with prehabilitation interventions, in a 2001 article describing the Physical Exercise Across the Cancer Experience Framework, Courneya and Friedenreich noted,³⁴ “An overview of the physical exercise literature indicates that only 1 [one] time period (i.e., prescreening) and cancer control outcome (i.e., prevention) has received significant research attention. Some time periods (i.e., treatment and resumption) and cancer control outcomes (i.e., coping and health promotion) have received modest research attention, whereas other time periods (i.e., screening/diagnosis, *pretreatment*, and posttreatment) and cancer control outcomes (i.e., detection, *buffering*, rehabilitation, palliation, and survival) have received only minimal attention.”

More recently, Sekine et al.³⁵ compared 22 lung cancer patients with comorbid COPD who had undergone rehabilitation before surgery with 60 historical controls. Patients with clinically and radiologically defined COPD underwent a prehabilitation exercise program for 2 wks comprising inspiratory spirometry, breathing and coughing exercises with bronchodilator nebulizers (five times per day), and exercise (walking >5000 steps per day). This program was continued until hospital admission and postoperatively until discharge. The control group received chest physiotherapy only during the postoperative period. Despite a lower forced expiratory volume in 1 sec/forced volume capacity ratio in the rehabilitation group, the length of stay was significantly shortened (28% decrease). The authors also observed a decreased need for tracheostomy and prolonged oxygen inhalation in the prehabilitation group. Interestingly, although

this study included aerobic exercise (walking), it did not include any peripheral muscle strengthening; both aerobic exercise and strength training have been shown to be important elements of fitness programs.

Bobbio et al.³⁶ addressed exercise studies that incorporated both strength and aerobic components in a study in 2007. The prehabilitation program included cycle ergometry as well as trunk and upper limb free weight exercises for strength training that took place as 90-min outpatient appointments, 5 days per week for 4 wks. Twelve patients with COPD and non-small cell lung cancer were studied, 11 of whom went on to lobectomy. This prospective observational study demonstrated a significant improvement in maximal aerobic capacity, as measured by an improvement in peak oxygen consumption (maximum oxygen consumption) despite an absence of changes in the resting forced expiratory volume in 1 sec/forced volume capacity ratio.

An Italian study recently confirmed the relevance of prehabilitation concepts in eight lung cancer patients with comorbid lung disease.³⁷ Patients who were not candidates for lobectomy because of markedly impaired pulmonary function were evaluated. Prehabilitation consisted of a structured, intense 1-mo session of 3 hrs of daily (5 days per week) aerobic exercises, breathing exercises, education, and cigarette smoking cessation. Pulmonary function status (forced vital capacity) was improved significantly, as was P_{aO_2} and walking tolerance (6-min walking distance), allowing these patients to successfully undergo lobectomy. Remarkably, this study not only demonstrated the physiologic benefit of a structured preoperative exercise program in lung cancer patients but also favorably changed treatment options for lung cancer patients with pulmonary disease.

Finally, Nagarajan et al.,³⁸ in a review of ten studies of preoperative physical therapy and/or pulmonary rehabilitation, concluded that improvements in peak oxygen consumption support the hypothesis that prehabilitation programs improve exercise capacity and preserve postsurgical pulmonary function.

Cancer Prehabilitation: An Emerging Opportunity to Improve Outcomes in Oncology Care

As cancer prehabilitation research began to evolve beyond preserving pulmonary function in lung cancer patients, researchers started to examine other areas where prehabilitation might be applied. Urinary continence and erectile dysfunction are known complications in prostate cancer survivors, and, in one study, prehabilitation improved continence outcomes

in patients who received pelvic floor exercise training before retropubic radical prostatectomy. The prehabilitation group achieved urinary continence earlier than did controls, although no long-term benefit accrued.³⁹ In a 2007 review that included 11 trials ($N = 1028$), it was confirmed that preoperative pelvic floor muscle training hastened the return of urinary continence after prostatectomy.⁴⁰

In 1980, Dietz recommended that rehabilitation programs involve patients undergoing a mastectomy from the time of their initial diagnosis; however, until recently, only anecdotal information about involving prehabilitation in breast and other cancer diagnoses and treatments had been obtained.³³ For example, a case study published in 2007 focused on prehabilitation of a patient for chemotherapy. A 42-yr-old breast cancer survivor was prescribed a walking program for 1 wk before and 8 wks during chemotherapy.⁴¹ The patient demonstrated decreased fatigue and improvement in five of seven functional measures.

Mayo et al.⁴² recently reexamined data from a randomized trial of two different prehabilitation programs before colorectal surgery in patients with benign or malignant colorectal neoplasms. One group used stationary cycling plus weight training during their prehabilitation, whereas the other group received recommendations to increase their daily walking and practice breathing exercises. Remarkably, the initial trial showed no significant benefit of the prehabilitation program, and the walking/breathing group had greater functional walking capacity than did the cycling/strengthening group after prehabilitation.⁴² These results were not predicted because the benefits of strength training in addition to aerobic conditioning are well known. Because of the unexpected outcomes, these data were later used to examine other factors that may predict the success of prehabilitation in preserving patient functional outcomes. A higher rate of postoperative complications was observed in those who deteriorated during prehabilitation training. Of those who completed the prehabilitation program, 33% improved their functional status, 38% stayed the same, and 29% deteriorated.

Moreover, Cheema and colleagues⁴³ noted that, as cancer survival rates continue to improve, the emphasis on decreasing morbidity has increasingly become an issue. The researchers wrote, "Decreased mortality among older complex patients has raised patients' expectations for [colorectal cancer] treatment and engendered additional concerns among patients including quality of life, community reintegration, physical performance after cancer resection

and avoidance of treatment-related complications (i.e., patient-centered outcomes).⁴³ They concluded that more cancer patients are surviving longer and demanding more comprehensive care, highlighting the need for more research in all aspects of cancer prehabilitation.

Although prehabilitation has been shown to improve physical outcomes such as pulmonary function and urinary continence, its application and the need for its application often reach beyond physical and into psychosocial domains. In the study by Mayo et al.⁴² described previously, it was also noted that those patients who did improve in functional capacity also demonstrated improvements in mental health and vitality. Men improved more than women did, and participants who had a lower functional status at baseline improved more than those who started at a higher functional status. Further, participants with higher pretreatment anxiety levels showed greater improvement as well. Predictably, patients who believed that their fitness level aided recovery showed more improvement than those who did not hold this same belief.

The relationship between the physical and the emotional burden of cancer continues to become more clearly linked. Banks et al.⁴⁴ published a recent study examining whether the elevated levels of psychological distress seen in cancer survivors were primarily related to aspects of the cancer diagnosis, to treatment, or to a related disability. In a review of self-reported questionnaire-based data from a Medicare database of nearly 90,000 Australian men and women 45 yrs or older, Banks and colleagues⁴⁴ found that the major cause of emotional distress was disability. The researchers wrote, "The risk of psychological distress in individuals with cancer relates much more strongly to their level of disability than it does to the cancer diagnosis itself." Other studies have confirmed this link as well. For example, a study by Ponto et al.⁴⁵ of women living with ovarian cancer found that one predictor of distress was poor performance status. In yet another study of 112 Jordanian patients actively being treated with chemotherapy, the researchers found that lower scores in emotional and physical functioning were associated with higher reports of distress.⁴⁶

For the first time, a new study examined health-related quality-of-life among adult cancer survivors of all ages across the trajectory of survivorship compared with population norms.⁴⁷ The data from 1,822 cancer survivors and 24,804 individuals without a cancer history revealed that 24.5% of the cancer survivors reported poor physical health compared with 10.2% of those without cancer. Mental health

reports showed a similar imbalance, with 10.1% of the cancer survivors reporting poor mental health compared with 5.9% of those without cancer. Extrapolated according to current population data, these results represent 3.3 million United States cancer survivors living with poor physical health and 1.4 million living with poor mental health.

Cancer Prehabilitation in the Elderly

Prehabilitation may also have positive effects on specific populations, such as elderly cancer survivors. Researchers examined the prevalence of exercise participation during and after primary cancer treatment in older (≥ 65 yrs) and the oldest (≥ 80 yrs) cancer patients who were newly diagnosed.⁴⁸ In this study, 408 participants with a mean age of 73 yrs were surveyed, and symptoms before chemotherapy and/or radiation therapy, symptoms during treatment, and symptoms 6 mos after therapy ended were recorded. Forty-six percent of the older and 41% of the oldest patients reported exercising during treatment. Six months after treatment ended, 60% of the older and 68% of the oldest patients reported exercising. Patients who exercised during and after treatment reported less shortness of breath, better self-reported health, less fatigue, and even less total symptom burden. These results suggest that if exercising during and after treatment improves self-reported health, more extensive research on the benefits of prehabilitation exercise in this population is needed. In fact, in 2012, a case report did illustrate the effect of prehabilitation in an elderly cancer patient.⁴⁹ An 88-yr-old woman underwent 3 wks of prehabilitation before hysterectomy for endometrial cancer. She sustained improvements in exercise tolerance for 8 wks postoperatively. There was no evidence of postoperative delirium despite multiple medical comorbidities (hypertension, coronary artery disease, and congestive heart failure). Two additional cases published in 2012 involving high-risk elderly patients with severe COPD and abdominal cancer reported effective prehabilitation and perioperative rehabilitation.⁵⁰

Cancer Prehabilitation Using Psychosocial Interventions

In addition to physical interventions, prehabilitation provides an opportunity for psychosocial strategies that may be implemented immediately after a cancer diagnosis. Depression has been shown to increase the length of hospitalization in lung cancer patients undergoing thoracic surgery.⁵¹ Further, there is evidence to suggest that psychosocial

support immediately after diagnosis and before cancer treatments begin may improve outcomes. For example, Cohen et al.⁵² studied 159 men scheduled to undergo radical prostatectomy who were randomly assigned to presurgical stress management, “supportive attention,” or standard care groups. Researchers found that patients who received stress management had significantly less mood disturbance during the preoperative waiting time and significantly increased immune parameters after surgery. Dietz suggested that a patient undergoing a mastectomy should receive support from the time of initial examination to satisfactory return to society by offering psychological support to confront anxiety and fear of the unknown initially and promote adaptation at discharge.³³ Women with recurrent ovarian cancer described the state of living in limbo during the transition from health to illness as “characterized by loneliness” and a “vulnerable position and existential struggle.”⁵³ It has also been observed that newly diagnosed lung cancer patients expressed their greatest concerns about their illness during pretreatment planning and later after surgery.^{53a} In patients with colorectal cancer, preoperative stoma siting and education, which is usually performed postoperatively, may reduce anxiety, complications, and healthcare costs.^{54,55}

Judicious Timing of Cancer Prehabilitation Interventions

Delays in cancer treatment may negatively affect prognosis.^{56–58} Therefore, the use and the timing of prehabilitation in relationship to the onset of acute cancer treatment must be seriously considered. For example, a 2011 meta-analysis study of 15,410 patients with colorectal cancer found that a 4-wk increase in the time between colon resection and chemotherapy was associated with a significant decrease in both overall survival and disease-free survival.⁵⁹ A feasibility study in 13 patients by Jones et al.⁶⁰ examined both the timing and the effect of structured endurance exercise interventions that compose a 4- to 6-wk structured exercise program that was used to increase maximal aerobic capacity on surgical outcomes in lung cancer patients. Patients achieved significant benefit in improved exercise capacity while awaiting lobectomy for lung cancer. The gain in maximal aerobic capacity of prehabilitation patients was determined and compared with previous studies of postsurgical pulmonary rehabilitation benefit. The improvements seen after this short program were similar to those seen in longer traditional exercise programs of 12–15 wks. In a follow-up literature

review including nine additional studies, Nagarajan et al.³⁸ concluded that, “This proves that PRP [preoperative rehabilitation program] can improve exercise capacity in patients prior to major thoracic surgery.”

DISCUSSION

Cancer prehabilitation is an emerging medical discipline—one that may include unimodal or multimodal approaches—that should be tailored to the needs of the individual patient (Table 2). Certainly, the current literature seems promising and is consistent with optimizing health at every opportunity along the care continuum. However, more research is urgently needed in cancer prehabilitation to identify the best interventions to use in various patient populations. For example, answering the question of whether prehabilitation protocol A might improve compliance with acute cancer treatment protocol B is an important one. It seems reasonable to hypothesize that tailored prehabilitation protocols that better prepare patients for upcoming physical and psychological challenges would increase their compliance with acute cancer treatment protocols and, therefore,

TABLE 2 Examples of cancer prehabilitation areas of focus

<p>Musculoskeletal Balance/gait Joint range of motion Therapeutic exercise (for specific issues) General exercise (to increase physical activity) Stress/distress/coping Pain Swallowing Speech Sleep Fatigue Cognitive function Cardiovascular function Pulmonary function Smoking cessation Alcohol reduction/cessation Skin protection Diet/nutrition Urinary continence Bowel/ostomy care Activities of daily living (ADLs) Instrumental activities of daily living (IADLs) Assistive devices Durable medical equipment Home safety Workplace accommodations Psychosocial support Supportive oncology symptom management Integrative oncology interventions Other services</p>
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improve cancer treatment survival outcomes. This is an important area for future research.

Newly diagnosed cancer patients are often seeking ways to become immediately involved in their care that may go beyond decision making about upcoming treatments. A common question that oncology healthcare professionals hear from patients is, “What can I do right now to help myself?” Cancer prehabilitation affords the oncology health professional an excellent opportunity to provide expert guidance regarding targeted prehabilitation interventions that simultaneously improve physical and psychological health outcomes and create a partnership with the patient.

During cancer prehabilitation, patients receive assessments and interventions that address not only their current physical and psychological function, including preexisting impairments and comorbid conditions, but also avoidance or attenuation of future cancer treatment–induced impairments and disabilities that may negatively impact their health and health-related quality-of-life (Table 3). Approaches may include exercise, medical management, nutritional counseling, psychosocial strategies, and other

interventions designed to better prepare patients for the challenges of forthcoming cancer treatments.

Before planning any prehabilitation course or implementing any intervention, it is important to first establish the current functional status of the patient and identify any comorbidities. A recent study approached prehabilitation and the importance of obtaining baseline functional status before chemotherapy from a survey standpoint. Faul et al.⁶¹ questioned 192 patients with cancer of various diagnoses and stages about their level of independent exercise and their quality-of-life 1 wk before their first chemotherapy infusion. Two-thirds of the patients, all of whom were exercising the week before chemotherapy began (43% at a mild level and 57% at a moderate to strenuous level), had lower levels of anxiety and depression and better overall mental and physical quality-of-life than those who did not exercise. These results consequently emphasize the need to document baseline exercise levels and understand how these may affect quality-of-life outcomes when designing a patient-centered prehabilitation program.

After baseline assessment, it is necessary to then examine the many potential interventions that

TABLE 3 Goals and benefits of cancer prehabilitation^a

Pretreatment baseline	Assess and document
Pretreatment impairments	Identify and reduce
Pretreatment physical functioning	Improve
Pretreatment psychological functioning	Improve
Treatment options	Increase
Cancer treatment compliance	Increase
Treatment-related impairments	Prevent or reduce
Unnecessary testing ^b	Reduce
Time to recovery milestones	Reduce
Hospital lengths of stay	Reduce
Home care therapy visits	Reduce
Rehabilitation outpatient visits	Reduce
Hospital readmissions	Reduce
Risk for future comorbidities ^c	Reduce
Risk for cancer recurrence	Reduce
Risk for second primary cancer	Reduce
Disability	Decrease
Mortality	Decrease
Physical health outcomes	Improve
Psychosocial health outcomes	Improve
Time to return to work status	Reduce
Occupational function	Improve
Health-related quality-of-life	Improve
Direct healthcare costs	Decrease
Indirect healthcare costs	Decrease

After meeting the first goal of cancer prehabilitation—establishing a pretreatment baseline—and implementing appropriate interventions thereafter, the physical, psychological, and/or financial benefits of prehabilitation can be seen along the entire continuum of cancer care.

^aThis is not meant to be a complete list.

^bFor example, metastatic work-ups for musculoskeletal pain.

^cFor example, osteoporosis or heart disease.

might be efficacious within each approach, noting that implementation of each intervention is dependent on the location and the extent of the cancer as well as the premorbid status of the patient. For example, in a lung cancer patient who has an active nicotine addiction, applicable prehabilitation interventions may include breathing exercises and other elements of pulmonary rehabilitation, smoking cessation, and coping skills (Fig. 1). The interventions chosen will ideally complement each other to improve the physical and the psychological health of a newly diagnosed cancer patient (e.g., a lung cancer patient) before beginning acute cancer treatments.

Prehabilitation interventions should be focused on improving health outcomes. For example, smoking cessation and alcohol cessation or reduction are well known prehabilitation interventions that may improve cancer treatment outcomes.⁶² Smoking cessation in lung cancer patients before undergoing surgical resection is, then, an obvious intervention. However, there are many other types of cancer diagnoses in which smoking has been shown to be deleterious to the perioperative and postoperative recovery.^{63,64} One study in patients with brain tumors and another study in patients with gastrointestinal and thoracic cancers demonstrated both increased morbidity and mortality in current smokers.^{65,66} Both

studies concluded that cigarette smoking is associated with poor surgical outcomes, increased morbidity and mortality, and more complications postoperatively. The authors recommended smoking cessation to mitigate these risks, and one set went on to state, “smoking cessation should be encouraged prior to all major cancer surgery in the VA [Veterans Affairs] population to decrease postoperative complications and length of stay.”⁶⁶

Another area where prehabilitation might promote better health outcome is in radiation therapy. Pardo Masferrer et al.⁶⁷ investigated the use of a urea-based cream before radiation therapy. Ninety-eight patients used the lotion three times per day for 2–3 wks before therapy. Compared with historical controls who began cream application concurrent with radiation therapy, these patients demonstrated that consistent application of urea-based cream before radiation therapy made the development of radiation dermatitis less likely and reduced skin toxicity.

Prophylactic swallowing exercises in patients with head and neck cancer have also been studied.⁶⁸ In 2012, Kotz et al.⁶⁹ published a randomized controlled trial that found that patients who completed prophylactic swallowing exercises had improved swallowing function at 3 and 6 mos after chemoradiation therapy, although not immediately after chemoradiation

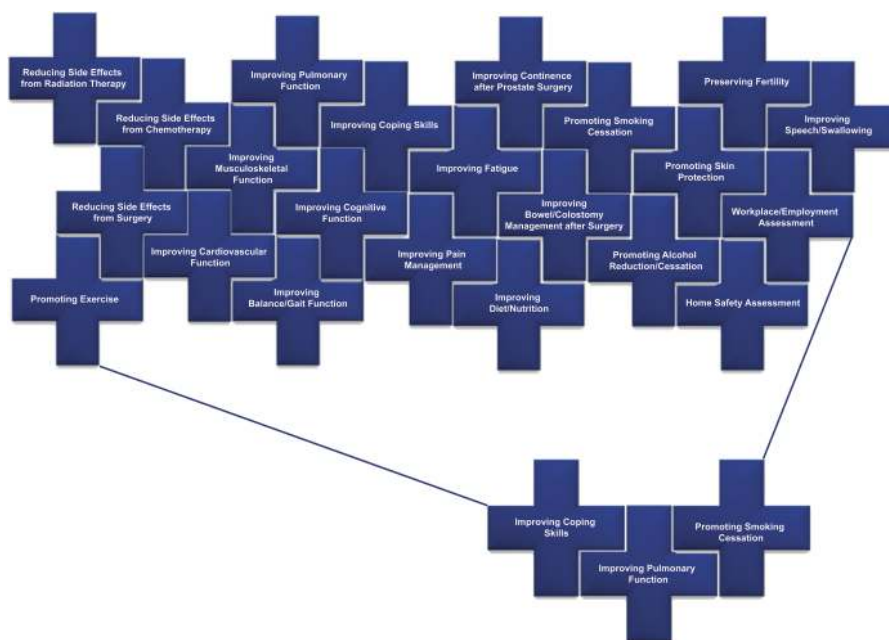


FIGURE 1 Examples of unimodal and multimodal prehabilitation interventions. Each puzzle piece represents a unimodal intervention approach that, when combined with other puzzle pieces into a group, offers a multimodal approach to prehabilitation. The three-part multimodal approach shown in this example is designed for a lung cancer patient population. However, as needed, the group could be expanded to include other interventions too (e.g., pain management). This puzzle model is an example and is not intended to include all prehabilitation interventions. Reproduced with permission from Oncology Rehab Partners, LLC.

therapy, or at 9 and 12 mos after chemoradiation therapy. Carroll et al.⁷⁰ reported that prehabilitation swallowing exercises produced measurable improvements in posttreatment swallowing function in patients with head and neck cancer who underwent organ-preservation chemoradiation therapy. Roe and colleagues⁷¹ recently surveyed speech and language therapy teams via a national network in the United Kingdom and found that, of the 42 participants who completely filled out the survey, 71.4% ($n = 30$) advised patients on prophylactic swallowing exercises. Roe et al.⁷¹ noted that this was “in keeping with expert opinion and emerging evidence.”

It is important to consider not only physical but also psychological interventions that may promote better health outcomes. The need for psychosocial support in some patients may be greatest at the time of diagnosis, as they work to acclimate to the changes that this will mean in their lives and rally for the challenges ahead. Providing support and instruction in coping skills during this waiting period, when survivors are in limbo, may be beneficial in alleviating some of their stress and anxiety.^{72,73} It is also possible that prehabilitation psychosocial interventions, including coping skills, may help patients move ahead with treatment decisions, further avoiding treatment delays.

In addition, it is also important to understand and acknowledge the concerns that patients may have regarding the initiation of their acute cancer treatments. The reduced survival outcomes in patients who delay therapy support what some cancer survivors fear: that any delay in starting treatment may contribute to a worse outcome. However, it is the exception rather than the rule that someone who is diagnosed with cancer immediately begins treatment. The duration of the waiting period between diagnosis and the start of treatment may depend on many factors, including second opinions; surgical schedules; further testing; and, sometimes, a patient's psychological state—the patient may simply feel overwhelmed and unable to readily deal with a new cancer diagnosis and the anticipated treatment. Therefore, the period between diagnosis and the start of acute cancer treatments may provide an opportunity for prehabilitation interventions that address both physical and psychological issues.

With every new cancer diagnosis, physicians weigh the benefits of treatment *vs.* the risks. Included in that analysis is always a consideration of (1) which therapies may slow the progression of the disease, put the disease in remission, or even cure the malignancy and (2) how short- and long-term effects of those therapies, often used concurrently or sequentially,

might increase the risk for significant treatment-related morbidity. Preventing or minimizing treatment-related morbidity—especially chronic impairments that may result in significant disability—should be a primary goal for all oncology clinicians.³

SUMMARY

Cancer prehabilitation, defined as a process on the continuum of care that occurs between the time of diagnosis and the beginning of acute treatment, includes physical and psychological assessments that establish a baseline functional level, identifies impairments, and provides targeted interventions that improve a patient's health to reduce the incidence and the severity of current and future impairments. In an impairment-driven cancer rehabilitation model, identifying current and anticipating future impairments are a critical first step in improving health-care outcomes and decreasing costs. The opportunity to assess baseline status and intervene to treat or prevent impairments begins almost immediately after diagnosis and continues throughout the care continuum.

Perhaps, with most new cancer diagnoses, there is an opening, whether a few days or a few weeks, to provide prehabilitation interventions. Pairing targeted psychological and physical prehabilitation interventions in a multimodal approach is likely to offer the best overall outcomes. Although the current evidence is limited, determining and taking advantage of this “window of opportunity” for each cancer patient/population are an important area of future research that should focus on identifying the most effective prehabilitation interventions—those that improve patient outcomes and reduce direct and indirect healthcare costs.

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BOOK REVIEW

Handbook of Sport Neuropsychology

Frank M. Webbe, PhD (ed). New York, NY: Springer Publishing Company LLC, 2011. 406p. \$100.00. ISBN: 978-0-8261-1571-3.

Although the intended audience of this book was primarily neuropsychologists, increasing public awareness and media attention about head injuries and sports give it much broader relevance, particularly for those who take care of athletes. The primary focus of the book is concussion in sport, and it presents a summary of the current science available on the cognitive, neuromotor, vestibular, emotional, and anatomic effects of single and multiple concussions in all levels of athletes. The appropriateness and the limitations of various types of imaging in diagnosis and management are reviewed. It also presents standardized recommendations and the existing science advising return-to-play decisions. It provides a thorough discussion of concussion management programs including the advantages and the disadvantages of various types of preseason

screening and the assistance the neuropsychologist can provide in that process. It also addresses some of the controversies surrounding head injury in sport, including “heading” in soccer in children and the possible long-term effects of multiple concussions over time, in a balanced way. The book also devotes several chapters to emerging areas in sport neuropsychology including attention-deficit/hyperactivity disorder and learning disabilities in athletes and the developmental effects of sports participation.

Overall, this is a well referenced, thorough summary of the research available on concussion in sports—its diagnosis, management from a neuropsychological perspective, and return-to-play decision making. It is a worthwhile read for anyone who manages patients at risk for concussion and a good reference with practical advice for those who may be called upon to do so.

Overall rating: ★★★★★

Bonnie J. Weigert, MD
University of Wisconsin
Madison, Wisconsin

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