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Review Article **Physiotherapy**

The Effectiveness of Prehabilitation Programs in Enhancing Post-Surgical Outcomes

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Abstract

Preoperative rehabilitation, sometimes known as 'prehabilitation', is a contemporary method aimed at maximizing patient well-being before surgery to minimize surgical risks and enhance postoperative results. Prehabilitation therapies, which were traditionally limited to enhancing cardiorespiratory fitness and reducing patient weight, can now encompass all aspects of patient health, including the biopsychosocial domains. These interventions have been adopted by surgical units globally in diverse ways. In general, prehabilitation therapies offer prospective advantages such as enhanced patient physical condition, less anxiety, improved outcomes (including shorter hospital stays and fewer complication rates), and increased patient involvement before surgery. Nevertheless, they can also be linked to potential disadvantages such as the need for a significant amount of time, expenses, physical restrictions, delays in surgical procedures, especially for individuals with cancer, and a lack of definitive proof proving the benefits for patients. Prehabilitation involves proactive measures aimed at conditioning the body in anticipation of an impending injury or trauma. This phrase refers to the preoperative activities that aim to prepare a patient for surgery and facilitate their rapid recovery and restoration of physical fitness after the procedure.

Keywords: Prehabilitation, surgical, post-operative, outcomes, multimodal.

INTRODUCTION

The published data for the number of surgical procedures per 100,000 people in 2012 was 3,399.000 in Saudi Arabia. Moreover, annual number of surgical procedures performed in the UK exceeds 8 million. Although the surgical population is getting older and more likely to have several health conditions, the overall risk of death and significant complications is still relatively low, at little below 2%. In contrast, patients with diminished preoperative functional capacity exhibit worse results. The 'high-risk' segment primarily includes older patients with multiple co-morbidities who are undergoing major surgery. This subgroup is responsible for more than 80% of postoperative deaths, although comprising only 12.5% of surgical admissions [1,2].

Considerable efforts have been made in recent years to enhance results in this vulnerable population. The focus has primarily been on measures taken during and after surgery, such as goal-directed hydration treatment during surgery, improved use of critical care resources, and extensive implementation of rehabilitation and enhanced recovery programs. These endeavors have been strengthened by enhanced surgical and anesthetic methodologies [3].

Prehabilitation is the act of increasing a patient's ability to function before surgery, to enhance their recovery after the operation. Increasing data indicates enhancements in duration of hospitalization, postoperative discomfort, and surgical complications. Prehabilitation programs, although still at the proof-of-

concept stage, are becoming common and are expected to become a standard part of the preoperative evaluation for high-risk patients before major surgery. Therefore, it is crucial for anesthetists to possess a comprehension of this rapidly developing area [4,5].

The term "prehabilitation" was coined in the 1940s. The overall well-being and physical condition of the British army recruits were deteriorating as a result of the unfavorable living conditions experienced throughout the conflict. Hence, supplementary instruction was carried out before the recruits were admitted, which was referred to as "prehabilitation". Prehabilitation, initially developed as a means to enhance the physical performance of athletes, has been applied in the field of medicine [6].

The implementation of prehabilitation in the surgical domain commenced in the early 21st century. Orthopedic doctors utilized it for preoperative preparation of their patients. Exercise regimens were designed to efficiently recover physical mobility following tissue injuries resulting from surgical procedures. Subsequently, general surgeons adopted such an approach to enhance the postoperative well-being of patients [7,8].

Historically, prehabilitation solely concentrated on enhancing physical fitness. In 2009, Furze *et al.*, expanded the definition of this concept to encompass psychological readiness through the utilization of counseling, relaxation methods, assessment of mental well-being progress, establishment of objectives, and dialogue regarding stressful matters with the patient. Subsequently, the notion of prehabilitation was expanded to include the implementation of appropriate preoperative nutrition and the discontinuation of alcohol intake, smoking, and other detrimental dependencies [9,10].

Prehabilitation Program and Its effects:

There may be a significant time gap of several weeks between the decision to continue with surgery and the actual surgery. This exemplifies what is commonly referred to as a 'teachable moment'. An advantageous moment to significantly influence a patient's health behavior, which could subsequently impact their long-term survival. Implementing a physical fitness regimen at this point in time could serve as a beneficial diversion from an upcoming significant surgical procedure. Moreover, patients may experience a heightened physical capacity for exercise during the perioperative period. Several programs mentioned in the literature typically last between 4 and 8 weeks. Programmes of shorter duration may lack effectiveness, whilst longer programmes may have challenges with compliance. In recent times, the advantages of adopting a multimodal approach have been apparent, resulting in lifestyle modifications achieved through: Medical optimizing, physical activity, dietary support, and mental health assistance [11]. The provision of these interventions involves a multidisciplinary team comprising surgeons, anaesthetists, physicians, geriatricians, physiotherapists, nutritionists, and psychologists. Initially, fundamental anthropometric data, including height, weight, and body fat percentage, are collected. Additionally, the program periodically evaluates and tracks functional capacity, nutritional health, and mood. It is advisable to maintain interventions during the postoperative period.

***Medical Optimization*:** refers to the process of improving and maximizing the effectiveness and efficiency of medical treatments and interventions.

The patient can benefit from preoperative smoking cessation, decreased alcohol use, and weight optimization throughout the postoperative period. The primary source of acute harm from smoking is attributed to carbon monoxide (CO) and nicotine. CO decreases the delivery of oxygen to the tissues, whereas nicotine, due to its sympathomimetic effects, elevates the cardiac workload. The notion that quitting smoking before surgery is advantageous has been widely acknowledged, since it lowers the likelihood of experiencing cardiac problems, wound infections, delayed wound healing and bone fusion, extended hospital stay, and mortality. The ideal date for stopping smoking before surgery has not been definitively established, however the harmful effects of CO and nicotine are no longer present within 24-48 hours. Longer periods of cessation yield even more advantages. There is no basis for the concerns that brief periods of abstinence (less than 4 weeks) lead to higher risks of pulmonary complications [12].

Alcohol misuse is associated with an increase in postoperative complications, and this association is influenced by the amount of alcohol consumed. The most commonly observed consequences include postoperative infections, cardiac problems, and episodes of bleeding. The underlying causes include immunosuppresion, cardiac insufficiency, hemostatic imbalance, and an increased surgical stress response. The occurrence of negative health outcomes after surgery decreases significantly with a minimum of 4 weeks of refraining from certain activities before the operation [3].

The underweight patient carries the highest chance of experiencing significant postoperative problems. Non-obese patients exhibit a lower incidence of wound infections, reduced intraoperative blood loss, and shorter operation durations compared to individuals who are obese. Curiously, individuals who are overweight have higher probabilities of survival after 30 days and in the long run. This phenomenon is known as the obesity paradox [13].

The full prehabilitation program also includes addressing the management of anemia, controlling blood glucose levels, and optimizing pharmaceutical therapy. Preoperative anemia is prevalent among patients

undergoing significant surgical procedures. Even a slight case of anemia can reduce one's ability to function and raise the likelihood of needing a blood transfusion during surgery, experiencing complications after surgery, and even dying. Identifying and treating the underlying cause are the main priorities in managing the situation, and if needed, elective surgery should be postponed. Therapeutic choices encompass the use of iron supplements. Parenteral iron can be considered if oral preparations are not effective, not well tolerated, or if a quick response is needed. Blood transfusion should be limited to individuals who have, or are at risk of, cardiac instability. The objective of pharmaceutical optimization is to achieve optimal management of chronic illnesses such as chronic obstructive pulmonary disease, heart disease, hypertension, and diabetes. Poor control of these conditions can lead to an increased risk of lung infections, acute coronary syndrome, and stroke [14].

***Physical Exercise*:** Physical exercise enhances blood circulation to active tissues, providing them with oxygen. Consistent exercise enhances the body's capacity to acclimate to physical stress. Although preoperative physical preparation was prioritized as the initial component of prehabilitation, there remains a dearth of explicit standards in this domain. The interpretation of physical preparation varies based on the study, encompassing activities such as augmenting daily step count or engaging in aerobic, strengthening, or stretching exercises. Respiratory training is crucial during physical preparation as it helps decrease the incidence of postoperative pneumonia. The preoperative physical training should be individualized by a physical therapist, taking into account the patient's overall health, physical fitness, and starting cardiopulmonary function. When incorporating more intricate workouts, it is beneficial to have extra encouragement and oversight to monitor the advancement. In addition, patients are less likely to adhere to treatments that are very rigorous [15-17].

Nutrition: The literature unequivocally demonstrates that inadequate nutritional status is linked to unfavorable postoperative results. These include prolonged hospital stays, increased risk of infection, higher rates of readmission, and elevated mortality rates. Factors such as the individual's pre-existing nutritional condition, the extent of the surgical injury, and the type of surgery performed (such as a significant gastrointestinal resection) all have a role in determining the likelihood of malnutrition. Starvation episodes occurring during the perioperative phase only worsen the condition. Prior to undergoing any significant surgical procedure, it is important to do a formal assessment to determine if the patient is at risk for malnutrition. If a patient is found to be malnourished, it is recommended that they get enteral nutritional assistance for a period of 7-10 days before the surgery [18].

The individuals who are most likely to benefit from preoperative nutrition therapy are those who are malnourished, regardless of the severity of the surgery, and those who are well-nourished but are undergoing high-risk major surgery. The interventions for these patients include preoperative carbohydrate loading, which reduces insulin resistance and promotes a state of anabolism, thus minimizing the loss of protein, lean body mass, and muscle function. When consumed a few hours before exercise, carbohydrates increase the storage of glycogen in the liver and muscles, facilitating the completion of the exercise session. The European Society for Clinical Nutrition and Metabolism recommends a daily protein intake of 1.5 grams per kilogram of ideal body weight in surgical patients in order to limit the loss of nitrogen, which is double the normal daily requirement. Whey protein is being considered as a high-quality and highly bioavailable source of essential amino acids [11].

Moreover, the goal of preoperative nutrition is to supply a sufficient quantity of protein in order to decrease the breakdown of body tissues and promote the activation of growth processes. Prehabilitation nutrition include not only patients who are physically malnourished, but also those who may not exhibit obvious signs of malnutrition. Laboratory studies, such as measuring levels of albumin or transferrin, are necessary to detect cases of malnutrition in certain instances. Hence, it is imperative to meticulously evaluate the patient's health before devising the treatment strategy. As per the ESPEN standards, a duration of 7-14 days or more is required to attain substantial enhancement in nutritional condition. An expedient dietary regimen should be promptly started to ensure a proficient augmentation in muscle tissue during physical training. Each patient should receive personalized treatment. Certain individuals may require an extended period of dietary prehabilitation in order to attain the desired outcomes [19,20].

An important concern in preoperative preparation is immunomodulation, which impacts the favorable immune response and reduces systemic inflammation in cancer patients. Supplementing with arginine, omega-3 fatty acids, and ribonucleotides during the 5 to 7 days before surgery leads to positive outcomes in the postoperative period, including a decrease in infection rate and a shorter hospital stay [19].

Ultimately, a crucial aspect of nutritional therapy is to the patient's instruction and enlightenment. It enhances the therapeutic outcomes throughout the entire treatment process, beginning with nutritional preoperative preparation, continuing with postoperative hospital diet, and extending to future dietary choices at home [21].

Mental health support: The causes of worry in the patient awaiting surgery are numerous and varied. The

fundamental diagnosis, surgical procedure, anesthesia, pain management, survival rate, and recuperation all give rise to apprehension. These psychosocial stressors cause a disruption in the control of the immune system through the interaction between the immune system and the brain. This interaction occurs through the same pathways that are responsible for the surgical stress response. The objective of psychological support is twofold. Firstly, in order to mitigate psychological anguish and worry linked to diagnosis and surgery, both of which contribute to heightened postoperative pain, prolonged recovery, postoperative complications, and decreased wound healing. Furthermore, in order to optimize patients' motivation and enable them to adhere to the activity and nutritional components of the program [22].

Effective psychological interventions encompass the provision of sensory information to prepare individuals for the perioperative experience, cognitive interventions aimed at fostering positive attitudes, behavioral instruction to enhance outcomes, and relaxation techniques like hypnosis and progressive muscle relaxation. Additional beneficial therapies include offering comprehensive procedural information, which entails providing detailed explanations about all elements of the patient's trip, as well as implementing emotion-focused interventions that involve discussing and addressing feelings. The latter can be enhanced by the assistance and companionship gained from interacting with other participants in the prehabilitation program [22].

The physiological basis for prehabilitation:

Research has demonstrated that cardiorespiratory fitness is a robust and autonomous indicator of death from any cause. It may even be a more potent predictor than conventional risk factors such high blood pressure, diabetes, smoking, and obesity. Training results in an elevation of cardiac output, arteriovenous oxygen difference, and consequently VO2max. Adaptations in skeletal muscle involve enhancements in both mitochondrial content and capacity for oxygen uptake. In general, the patient's functional reserve improves, enabling them to meet the heightened metabolic requirements of surgery and the postoperative phase [3].

The reaction to surgical stress is an intensified manifestation of the 'fight-or-flight' reflex. Neuroendocrine, metabolic, and immunological alterations result in heightened oxygen consumption, metabolic rate, breakdown of proteins, and an unfavorable nitrogen balance. The intensity of this destructive physiological response is contingent upon both the extent of the injury and the individual's reaction to the injury, and it impacts the length of the recovery period. Extended immobilization and limited physical activity throughout the healing phase result in a state of reduced physical fitness, characterized by muscular wasting, diminished muscle function, and decreased strength. Cardiac deconditioning leads to a decrease in VO2max, stroke volume, and cardiac output. The patient's functional capacity declines when combined [23,24].

In theory, prehabilitating the patient by enhancing their functional capacity prior to surgery results in the patient maintaining a better degree of functional ability during the perioperative period compared to those who did not undergo prehabilitation. Additionally, the prehabilitated patient has a faster recovery to a minimum level of functional independence after the operation. The variation in functional capacity is determined by the level of intensity, frequency, and duration of prehabilitation [23,24].

Overview on Post-Surgical Outcomes:

Multimodal: Evaluations of multimodal prehabilitation programs have been conducted in various surgical scenarios and postoperative outcomes, particularly in cases where prehabilitation could potentially provide benefits. This includes situations where older and weak individuals have an elevated risk of postoperative problems [25].

The systematic review reports the presence of low quality evidence indicating that multimodal prehabilitation may enhance postoperative problems in older cancer patients. The systematic review reports very limited evidence of improvement in postoperative complications for frail surgical patients. However, it does not provide any information regarding the length of stay [26].

One analysis found no evidence of reduced postoperative problems in gastric cancer surgery, which the authors classified as low-quality evidence. Similarly, two other reviews found no reduction in postoperative complications in lung cancer surgery and hepatopancreatobiliary surgery, which the authors classified as moderate-quality data [27].

Nutrition: The impact of prehabilitation with nutrition has been evaluated in cancer patients having surgery, considering the significance of nutrition in the management of comorbidity as a component of cancer treatment. The authors of a comprehensive analysis have identified moderate quality evidence that does not report any improvement in postoperative complications for older cancer patients who undergo nutrition prehabilitation [26].

Mental support: Research has indicated that psychological elements have a significant influence on surgical results, therefore suggesting that psychological prehabilitation could be advantageous for individuals after surgery. The systematic analysis found no significant enhancement in postoperative outcomes or duration of hospital stay. The research authors identified

the evidence supporting the combination of cognitive behavioral therapy and exercise for prehabilitation as being of very low to low quality [29].

CONCLUSION

Prehabilitation is a highly promising and effective approach. The growing evidence is promising, as it is both conceptually intuitive and grounded in good theoretical foundations. However, we still need to determine the optimal utilization of this tool, the most successful combination of interventions, whether they should be customized for specific types of surgeries, and the overall cost-effectiveness of prehabilitation. Enhancement in postoperative outcomes is documented. This encompasses multimodal prehabilitation aimed at enhancing postoperative outcomes in elderly cancer patients and vulnerable surgical patients. There is no known enhancement in the outcomes following surgery in evaluations examining the effectiveness of multimodal prehabilitation in gastric cancer surgery and lung cancer. The treatment involves surgical intervention, as well as psychological support through cognitive behavior therapy, and nutritional prehabilitation.

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