Understanding Prehabilitation

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KEY POINTS

- The goal of prehabilitation is to improve postoperative outcomes by increasing patient physiological reserve.
- Multimodal programmes (eg, exercise, nutrition, and psychosocial) are considered current best practice.
- Prehabilitation is increasingly shown to improve markers of preoperative fitness such as anaerobic threshold.
- The role for prehabilitation is likely to expand as surgical populations increasingly include more frail and elderly patients.

WHAT IS PREHABILITATION?

Prehabilitation is a multimodal strategy involving physical exercise as well as nutritional and psychosocial interventions to improve fitness in the preoperative period. The overarching aim of prehabilitation is to increase preoperative functional reserve, leading to better postoperative functional recovery and a reduced incidence of complications.

In practice, prehabilitation programmes may include cardiovascular and resistance training exercises, nutritional advice designed to support an increase in lean body mass, the introduction of coping strategies to deal with surgical anxiety, smoking cessation support, or treating preoperative anaemia.

THE RATIONALE FOR PREHABILITATION

Researchers and clinicians have long recognised the association between poor preoperative cardiorespiratory fitness/ functional capacity with adverse postoperative outcomes, including: mortality, complications in recovery, longer intensive care stay, extended hospital length of stay, and reduced postoperative quality of life. Addressing the impact of postoperative outcomes is increasingly relevant as the modern surgical population ages and bears an increasing burden of poor functional capacity, frailty, sarcopenia, and multifaceted morbidities.

Clinicians identifying poor preoperative functional capacity have used this information in a variety of ways: to triage patients appropriately to a postoperative location, or more accurately weigh the perioperative risks as a component of informed consent and shared decision making. However, the increasing recognition that poor functional capacity, frailty, and sarcopenia are all dynamic and modifiable states has raised the possibility that they could be addressed and improved in the preoperative period.

Depending on the surgical indication and the structure of the healthcare system, the interval between surgical referral and the day of surgery may be several weeks, creating a window of opportunity to address modifiable factors affecting fitness for surgery and, hopefully, improve postoperative outcomes.

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PREHABILITATION OUTCOMES: CURRENT EVIDENCE

Safety

Concerns that vigorous exercise may cause an unacceptable rate of adverse events in deconditioned surgical patients are not supported by the prehabilitation research.[1] Reports of serious adverse events such as stroke or myocardial infarction are rare, even among high-risk surgical patients. It is important to acknowledge, however, that patients with severe, suboptimally treated cardiorespiratory disease (such as unstable coronary artery disease or poorly controlled arrhythmias) are largely excluded from trials, and would commonly require tailored medical optimisation prior to engaging in prehabilitation.

Cardiorespiratory Fitness

Numerous studies have demonstrated that preoperative exercise training improves indicators of cardiorespiratory fitness, including gas exchange parameters such as the anaerobic threshold and peak oxygen uptake, or functional tests such as the 6-minute walk distance.[2] The well-established association between poor scores on these markers of fitness and increased surgical risk implies that their improvement via prehabilitation may translate into better postoperative outcomes.

Resistance Training

Resistance training in the preoperative period is feasible, and evidence from small studies correlates to an improvement in skeletal muscle strength, translating into improved postoperative physical function.[3] Larger trials are required to quantify and qualify the impact of strength training against a diversity of postoperative outcomes and overall quality of life.

Respiratory Muscle Training

A programme of preoperative inspiratory muscle training reduces the risk of postoperative pulmonary complications, including atelectasis and pneumonia, as well as length of hospital admission.[4]

Smoking Cessation

Patients who stop smoking at least 4 weeks before surgery are at reduced risk of postoperative pulmonary complications, while even a period of 3 to 4 weeks reduces the risk of wound-healing complications.[5]

Psychosocial Preparation

Recent studies indicate that while psychological prehabilitation does not affect traditional surgical outcomes (such as mortality and complication rates), there is evidence that it improves immunological function and, more importantly, improvement in patient-reported indicators such as psychological outcomes and quality of life.[6]

Postoperative Outcomes

There is some evidence that prehabilitation decreases the rate of postoperative complications and the length of hospital stay.[7,8] Most trials to date have been small, while efforts at systematic reviews and meta-analyses are complicated by the heterogeneity of prehabilitation protocols and variable quality. Trials to date have been insufficiently powered to more robustly assess the effect of prehabilitation on mortality.

THE IDEAL PREHABILITATION STRATEGY

An ideal prehabilitation program will address broad aspects of surgical fitness through multiple modes of intervention: exercise, nutrition, and psychosocial. Unimodal interventions, such as stand-alone aerobic exercise programmes, may be effective but adherence to a training regimen may be improved by addressing motivational issues and anxiety.[9,10] The best prehabilitation programmes harness this synergy to optimise impact in the preoperative period.

MEDICAL MANAGEMENT AND PREHABILITATION

Prehabilitation should be integrated in parallel with the medical optimisation of chronic diseases, with benefit derived from identifying synergies between medical optimisation and prehabilitation. For example, optimal management of chronic obstructive pulmonary disease is likely to improve exercise tolerance and facilitate participation in a structured exercise programme. Conversely, a prehabilitation programme consisting of exercise training and appropriate nutrition can be structured to concomitantly address diabetes mellitus and heart failure.

The Prehabilitation Team

Multimodal prehabilitation requires multidisciplinary input; most programmes are comprised of practitioners with expertise in dietetics, physiotherapy or exercise science, and psychology. Delivering a high-quality programme requires effective interprofessional communication and coordination, both amongst members of the prehabilitation team and with the greater perioperative care environment. An example highlighting this is the prehabilitation for a sarcopenic patient. This intervention is likely to involve a resistance training programme combined with a diet sufficient in protein and energy to support an increase in lean body mass. Implementation of such a programme is only possible through interprofessional collaboration. Good communication with surgical teams is essential to ensure early referral that maximises the time available for successful prehabilitation.

Patient Selection

All patients referred for major or high-risk surgery should be evaluated for benefit from a prehabilitation programme. At centres where prehabilitation is in early stages of development it may be more efficient and effective to selectively target the patients at highest risk due to the interrelated factors of poor exercise tolerance, frailty, and sarcopenia.

Individualisation

Prehabilitation should be tailored to the patient's needs. The frequency, intensity, and volume of cardiorespiratory and resistance training needs be adapted to the patient's baseline fitness and the time available.[11] *Frequency* refers to the number of exercise sessions performed in a given time period. *Intensity* refers to the strenuousness of the exercise. *Volume* is a measure of the total amount of work done, such as the number of strength training sessions performed, or the distance cycled in kilometres.

Energy intake and macronutrient composition of the prescribed diet should be based on the patient's nutritional status and ongoing requirements. Obese patients are likely to benefit from moderate energy restriction that results in weight loss, whereas frail and sarcopenic patients may benefit from an increase in protein and energy intake. With very few exceptions, a varied diet (including a balance of protein, carbohydrates, and fats) is best for patients.

Psychosocial interventions should be considered for patients who exhibit high levels of anxiety or mood disturbance on standardised screening tools, such as the Hospital Anxiety and Depression Scale, or who are felt to be at risk of such states.

Setting for Preoperative Exercise

The ideal setting for preoperative exercise remains to be determined. Hospital-based exercise allows for direct supervision by clinicians in a safe environment. However, hospital-based exercise may not be geographically feasible for some patients or economically feasible for a hospital to provide. Community or home-based exercise may be more convenient for some patients and therefore result in higher rates of compliance. Where patients are asked to exercise at home or in the community, initial face-to-face instructional sessions are important to promote effective exercise performance. The setting for these sessions can be more flexible. Ultimately medical centres should choose the setting that works best for their patient group, within the constraints of the available resources.

Goal Setting and Tracking Impact

Goals should be individualised for each patient, depending on their baseline fitness, pathophysiological states, and capabilities. The majority of patients will benefit from increasing their cardiorespiratory fitness and daily activity levels, and should be encouraged to include these among their goals.

Measuring performance improvements in the short window available for preoperative exercise may be difficult. The most rigorous and validated assessment of preoperative cardiorespiratory performance involves cardiopulmonary exercise testing (CPET). To adequately demonstrate improvement would require such testing be performed before and after a programme of prehabilitation. A less resource-intensive alternative would be the quick and easy administration of repeated 6-minute walk tests. While the walk test does not produce the more robust data of cardiopulmonary exercise testing, it is a reliable measure associated with postoperative outcomes, and is a valid, pragmatic alternative.[12]

UNANSWERED QUESTIONS AND FUTURE DIRECTIONS

Impact on Patient-Centered Outcomes

Well-conducted trials have demonstrated that prehabilitation can improve physiologic markers of fitness (such as anaerobic threshold or maximal oxygen uptake), both before surgery and into the postoperative period. In contrast, the quality of studies

demonstrating an improvement in mortality, quality of life, or complication rates is less robust. There is a clear need for adequately powered trials to investigate the effect of prehabilitation and preoperative fitness improvements on the outcomes that are of greatest importance to patients. Although, it should be acknowledged that both the intervention and the pathology are heterogeneous and complex, making outcomes research difficult, and generalisability of any results equally challenging.

Optimal Content of Prehabilitation Programmes

Most trials have compared a programme of prehabilitation against a control group receiving standard care, with few studies comparing prehabilitation regimens. Prehabilitation programmes may differ in the modalities (eg, exercise, nutrition, psychosocial) they incorporate as well as how each modality is executed, producing an enormous variation across programmes. Direct comparisons of programmes will be required to establish guidelines as to which are most effective and how to apply them to specific patient populations.

Ultimately, there is a wide variety in exercise frequency, intensity, and volume that may be prescribed to patients, with the optimal combination of these variables yet to be elucidated. What is understood though, is that nonspecific advice to ‘‘do more exercise’’ or ‘‘be more active’’ is rarely considered to be effective. Detailed, actionable exercise advice is required if patients are to make meaningful improvements in fitness.

Innovative Approaches to Exercise Delivery

Most trials of prehabilitation to date have involved hospital-based supervised exercise, which is costly and may involve time-consuming travel for patients. Future studies looking at home or community-based interventions could facilitate development and accessibility of prehabilitation programmes to more patients. Some centres are now exploring remote activity monitoring through smartphone-based apps, combined with weekly telephone advice, as an alternative to directly supervised exercise. While these programmes of ‘‘virtual supervision’’ appeal on the basis of convenience and cost, their effectiveness remains to be quantified, and they are likely to be most appropriate for the smaller subset of highly motivated patients who are at low risk of exercise-induced adverse events.

Healthcare Economics

While it is indeed possible to improve patient fitness prior to surgery (and subsequently improve postoperative outcomes), there is limited evidence supporting a cost-benefit of prehabilitation programmes. As further evidence emerges regarding the effect of prehabilitation on postoperative outcomes, it is important that the health economics and logistics of delivering this intervention be included in the analysis.

SUMMARY

- Multimodal prehabilitation can improve patient preoperative fitness, with growing evidence that it improves perioperative outcomes.
- Prehabilitation programmes should be adapted to local resources and personnel, while also individualised to each patient’s initial fitness.
- Where resources are limited, it is reasonable to focus prehabilitation on those most likely to benefit: patients who are frail, sarcopenic, deconditioned, or who are undergoing high-risk major surgery.
- Future research will clarify the optimal composition of prehabilitation programmes, as well as the cost effectiveness of different approaches.

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