

# Prehabilitation for the Anesthesiologist

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The “fast-track” and the enhanced recovery after surgery programs proposed in the late 1990s demonstrated a significant effect on postoperative outcome. Intraoperative and immediate postoperative evidence-based interventions, such as minimally invasive surgery, multimodal analgesia, early mobilization, and early feeding, were among the most impactful elements producing shorter length of hospital stay and reduction in complications, hospital readmissions, and healthcare costs.<sup>1</sup> In this context the anesthesiologist’s role evolved from being a physician providing primarily optimal surgical conditions and perioperative pain relief to that of a perioperative physician, working closely with surgeons and other health allied professions. The fast-track and enhanced recovery after surgery protocols emphasize the relevant effects of preoperative carbohydrate loading, beside the intraoperative and immediate postoperative interventions. The preoperative period represents an opportune time to prepare the patient for the stress of surgery by increasing his or her physiologic reserve. Besides medical management, preoperative optimization of cardiopulmonary functional capacity may be particularly important for the patients who are older, are frail, have cancer, are malnourished, and are experiencing social marginalization. In these populations a decline in functional capacity represents a significant surgical risk. *Functional capacity* is the term used to reflect the ability to perform activities of daily living and is determined by the integrity of the pulmonary, cardiovascular, and musculoskeletal systems.<sup>2</sup> Low functional capacity before surgery has been associated with greater chance of dying within 30 days after surgery, longer postoperative hospital stay, and higher rate of surgical complications.<sup>3</sup> The preoperative time should thus be valued as an opportunity to evaluate and stratify surgical risk and intervene. The optimum management of high-risk patients involves multidisciplinary collaborative decision making, and the anesthesiologist is an integral part of this process.

## From Risk Prediction to Risk Attenuation

Risk prediction has been of great interest to clinicians, and efforts have been made to identify a number of physiologic and clinical outcome measures that can predict adverse events related to the perioperative period. Risk prediction is even more relevant as we shift toward patient-centered care,

whereby healthcare decisions are driven by patients’ values and preferences in partnership with physicians.<sup>4</sup> Specific outcome measures, both objective (cardiopulmonary exercise test, hand grip strength, walk test, brain natriuretic peptide) and self-reported (Duke Activity Status Index), have therefore received the attention of clinicians interested in the care of high-risk patients scheduled for major surgery.<sup>4</sup> More specifically, these approaches are valuable to triage appropriate levels of postoperative care, to use intensive care monitoring, and even to decide whether to proceed or not with surgery.

If the decision is to proceed with surgery, the multidisciplinary team can then coordinate clinical optimization, not only to improve pre-existing comorbidities pharmacologically but also to modify risk factors associated with physical status to increase physiologic reserve in an appropriate time window between diagnosis and surgery. This is where risk stratification and prediction transition to *risk attenuation*.<sup>5</sup> To compare with a runner training for an upcoming marathon, preparing the patients for surgery with prehabilitation could represent a compelling strategy to intervene on those modifiable risk factors that influence postoperative outcome.

## Prehabilitation: What Is It?

Prehabilitation is not a new concept; in fact, it was applied successfully in the mid-1990s to improve the health of poorly nourished British military recruits.<sup>6</sup> The word prehabilitation itself was subsequently proposed by Topp *et al.*<sup>7</sup> as a strengthening program before an intensive care admission. Prehabilitation is a program of enhancing functional capacity of an individual to enable him or her to better withstand a stressful event. The preoperative period may be an opportune time to promote prehabilitation by addressing elements like physical unfit, malnutrition, and anxiety, with the intention to mitigate surgery-related postoperative side effects and facilitate the recovery process whereby the capacity to go back to active daily functions is of paramount importance to patients.

Prehabilitation has initially focused on exercise to improve functional health in different surgical specialties; however, it has expanded to a multimodal approach which includes: (1) structured and personalized aerobic and

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resistance, flexibility, and balance training to minimize/prevent impairments and enhance physical fitness; (2) dietary interventions to counteract the catabolic state and to support anabolism in synergy with exercise (3) antistress interventions to foster resilience and self efficacy; and (4) cessation of adverse health habits (*e.g.*, alcohol abuse, smoking).<sup>8</sup>

With regard to exercise, current recommendations include a personalized assessment followed by an intervention that combines moderate and vigorous exercise as appropriate for the individual.<sup>9</sup> In general, individuals who have been the least fit and the most sedentary show the most improvements when they commence an exercise program.<sup>10</sup> Resistance exercises are most helpful to those patients who have lost muscle mass and need to recuperate the strength necessary to carry out independent activities of daily living.<sup>11</sup> Great attention should also be given to balance and flexibility exercises in older patients (fig. 1).

The purpose of nutritional prehabilitation is to prepare (or optimize) the patient for surgery and recovery. The greater sensitivity of protein catabolism to nutritional support, in particular to amino acids, could have important implications for the nutritional management of patients during the healing process.<sup>12</sup> To stimulate muscle protein synthesis, leucine-rich dietary protein (whey protein) immediately after a bout of resistance exercise supports muscle protein synthesis.<sup>13</sup> Relaxation techniques (deep breathing exercises, progressive muscle relaxation, and meditation), cognitive behavioral therapy, guided imagery, or problem-solving and coping strategies have been shown to improve quality of life, reduce anxiety and depression, and reduce pain severity and fatigue.<sup>14</sup>

## Prehabilitation Is a Collaborative Effort

Traditionally, in surgical practice, the decision to operate or not is made between a surgeon and the patient with or without the presence of the spouse, partner, or caregiver. The patient is then sent, if necessary, to other physicians (anesthesiologists, cardiologists, pneumonologists, geriatricians, oncologists) for consultation before pursuing an elective surgical procedure.

Although such an approach is acceptable for fit patients, it may be suboptimal for those who are at high risk, frail, and old because decision for surgery should consider patient-specific factors. Engaging perioperative physicians to consider prehabilitation for their patients represents a paradigm shift from the traditional silo-driven surgeon-centric approach. The natural waiting time for surgery could be then an opportunity for many high-risk patients facing decisions about major surgery to address important questions about their health, improve their ability to be independent, and change their lifestyle. Multidisciplinary teams or tumor boards can foster collaboration and provide a platform whereby patients are screened and evaluated and interventions are planned.

The surgical prehabilitation clinic, integrated within the preoperative assessment clinic, can be the initial step where high-risk patients are sent for a detailed evaluation by either the family doctor or the surgeons or *via* the preoperative

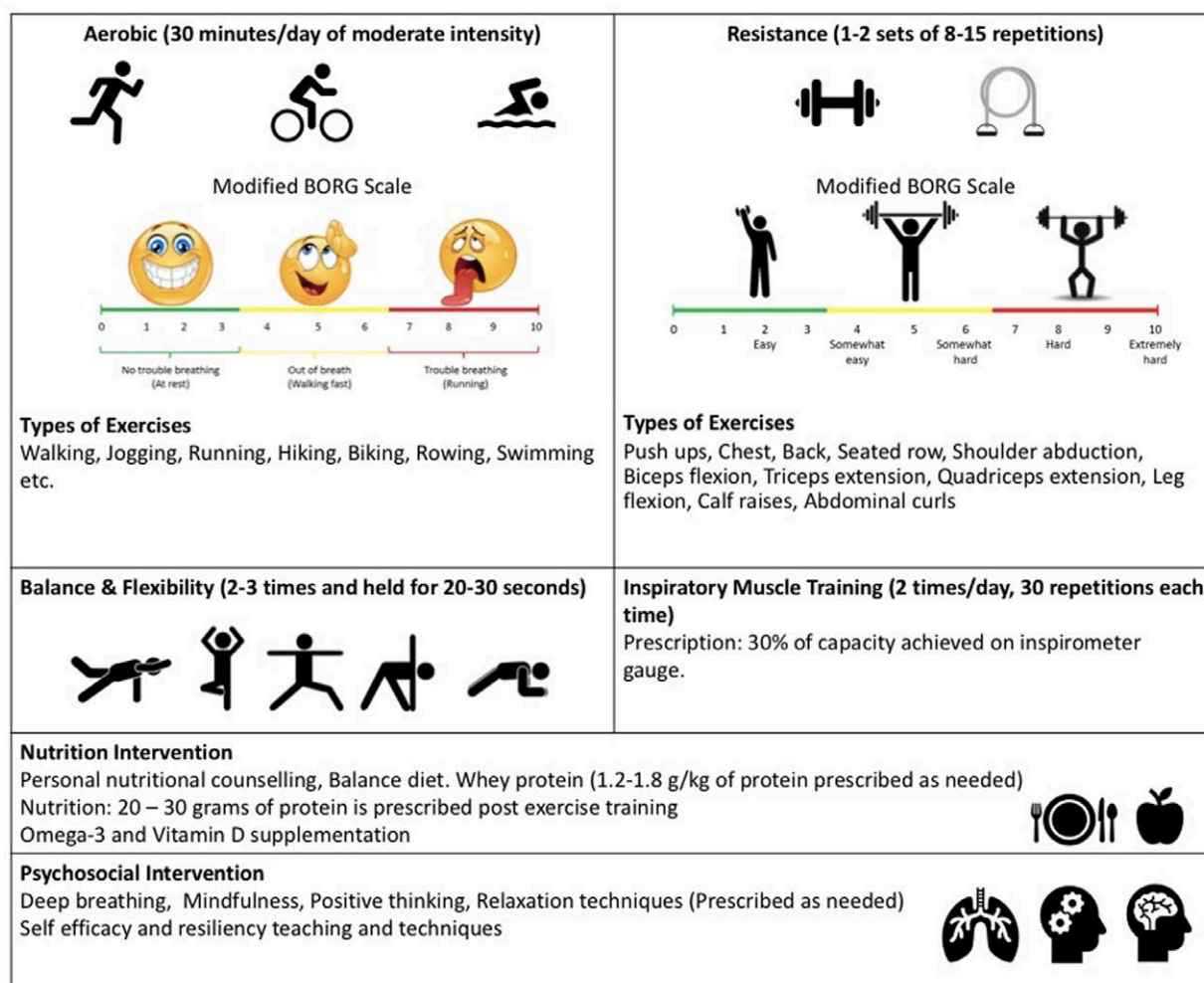
clinic itself (fig. 2). The first step in the process is the screening, for the purpose of predicting the likelihood of poor outcomes.<sup>15</sup> The second step includes a structured assessment of functional capacity and nutritional and psychologic status together with laboratory testing. This step includes the review of clinical, functional, metabolic, and emotional assessments with the patient followed by a codesigned, structured, and personalized prescription, to be discussed with the patient and the perioperative treating team. Exercise training can be either home-based for those patients who have exercised before or are familiar with exercise equipment, or supervised by a professional in case of inability to exercise alone for various reasons (poor compliance, sedentary lifestyle, older, frail). Special consideration should be given to those who are experiencing social marginalization because they may lack social support, access to good nutrition, and other resources such as transport. The necessity to monitor with regular follow-up assessments, using objective and self-reported outcome measures, and the effectiveness of the planned interventions before and after surgery are very important. If necessary it is recommended to modify them because one intervention does not fit all.

## Does Prehabilitation Work?

Many systematic reviews with meta-analyses and randomized, controlled trials have been published over the last 15 yr indicating a growing interest in prehabilitation. Although different methodologies, strategies, and outcome measurements have been used, most of the results reported that prehabilitation enhances functional capacity before and after surgery, does not harm, and can be implemented for some types of cancer surgery with no age limit.<sup>16–20</sup> Both unimodal (either exercise or nutrition alone) or multimodal (combination of exercise, nutrition, anti-anxiety strategies, smoking cessation) prehabilitation can be used for this purpose. With regard to postoperative clinical outcomes (length of hospital stay, readmissions, complications), there have been systematic reviews demonstrating an association between positive changes in fitness and lower severity and rate of complications.<sup>21–24</sup> With regard to healthcare costs of prehabilitation, recent data have been published indicating potential cost savings.<sup>25,26</sup> An association has been shown between prehabilitation and reduced tumor progression and 5-year disease-free survival in patients with stage III colorectal cancer.<sup>27,28</sup> Obviously, in view of small, single-center studies, heterogeneity of the methods, and outcomes used, caution is advised in interpreting the results. Large prospective trials are presently being conducted to reinforce the evidence and guide clinicians in the implementation of prehabilitation programs across different surgical specialties.<sup>29,30</sup>

## Prehabilitation Favors Patient Functional Recovery

Traditional audit measures like perioperative complications and hospital length of stay are of interest to clinicians and



**Fig. 1.** The Modified BORG Scale is used to assess patients' perceived effort during aerobic and resistance exercise. Aerobic: To be training at moderate intensity (aerobic exercise) the target perceived exertion should be between 5 and 7 (out of breath to trouble breathing). Resistance: To benefit from resistance training, it is important to assess the number of repetitions that can be completed with a given weight. Patients should feel that the exercise is "somewhat hard to hard" (6 to 8) when completing the required number of repetitions per set. Once the perceived exertion falls to less than 6, the weight can be progressed to maintain the level of difficulty. For the older frail patient the intensity of the progression can be assessed also with the BORG scale. Start with short bouts of aerobic exercise and low resistance number of repetitions.

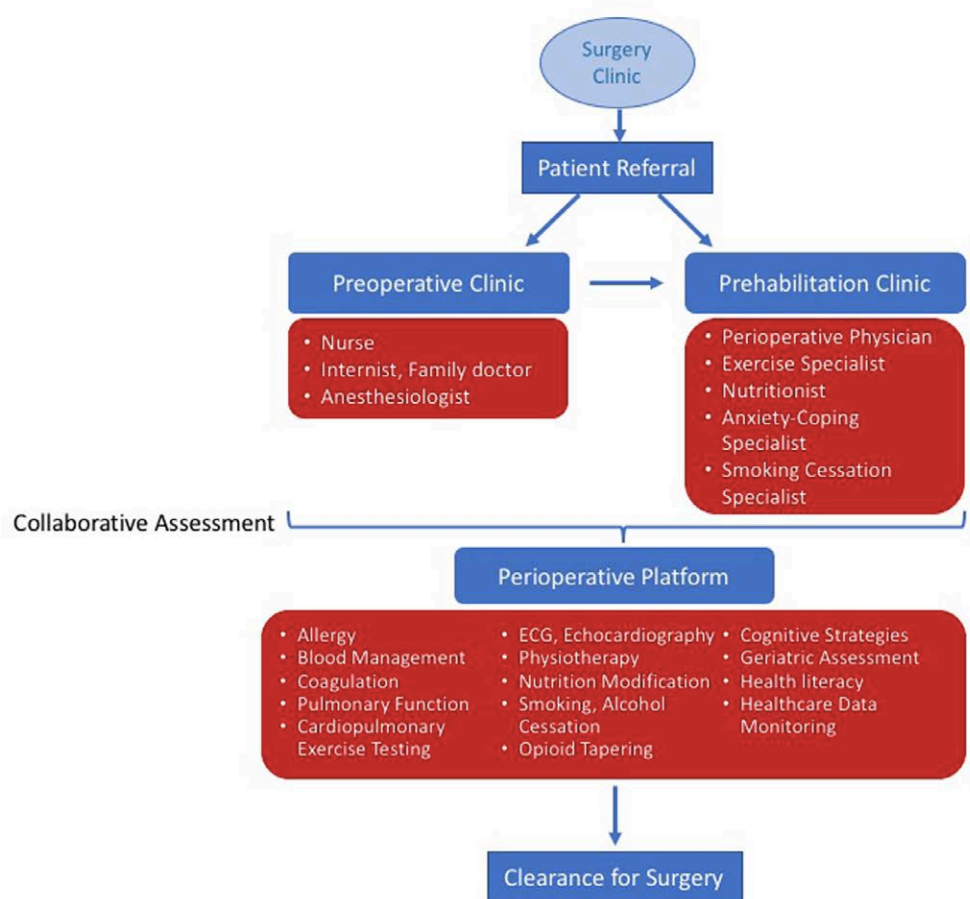
administrators, but they do not capture the complexity of the construct *recovery* or the perspective of patients.<sup>31</sup> Although one of the main benefits of enhanced recovery after surgery is the short length of stay, it is clear that patients will not be fully recovered, even after cholecystectomy.<sup>32</sup> Lawrence *et al.*<sup>33</sup> observed that, in patients older than 60 yr undergoing major abdominal surgery, the mean time to recovery to preoperative baseline values was 6 months for instrumental activities of daily living. When patients and clinicians were asked to identify recovery-related concepts after abdominal surgery, patients emphasized energy level, functional status (daily routine, recreational activities, endurance), and quality of sleep as important elements of recovery. In contrast,

clinicians put more emphasis on symptoms like pain, cognition, and bowel function.<sup>34</sup> Of the different outcomes measures available, function best quantifies patient-centered postoperative outcomes, in particular for older adults, because it represents the ability to maintain independent living at home.

## Considerations When Implementing Prehabilitation

### Duration of the Program

Referral to a prehabilitation program should occur early in the clinical evaluation of a patient likely to undergo surgery. Although the ideal intervention length has not been



Carli F, Minnella EM, Awasthi R, Baldini G, Bessissow A.  
McGill Peri Operative Program, 2019

**Fig. 2.** The McGill Peri Operative Program model: integration of preoperative and prehabilitation clinics. From the surgeons' office to prehabilitation clinic and/or preoperative clinic. Both clinics work together to better optimize the patient in preparation for surgery and avoiding duplication.

established, three to four weeks of intervention has been found to be sufficient to increase functional capacity by 5% to 10%.<sup>35</sup> However, if patients are also frail, they might need a longer time. It is plausible that the earlier the patient can be evaluated, the more likely the intervention will be meaningful. This can be done by complying with institutional and oncologic guidelines from the time of diagnosis to the time of surgery.

Guidelines on the optimal length of time from diagnosis to surgical treatment in cancer care vary from country to country, based on local consensus or outlined in the recommendations of countries' oncological and surgical societies.<sup>36</sup> Obviously within the cancer group the biology and evolution of cancer cells vary from organ to organ. The evidence to support cutoffs of four, six, or eight weeks<sup>37</sup> is not

strong, but healthcare policy makers use benchmarks for wait times as indicators. This represents a challenge when specific groups of patients, like those who are older, frail, or malnourished, or experiencing social marginalization or comorbidities, would instead need sufficient time to be optimized before surgery. A prolonged recovery period that delays adjuvant treatment may also have important implications for the survival of cancer patients. In the noncancer group the duration of prehabilitation can be extended if necessary, but a discussion with the patient and surgeon is always encouraged. Overall, there is a need for more collaboration between surgeons, anesthesiologists, administrators, and patient advocacy groups.

Patients in need of neoadjuvant chemotherapy, radiotherapy, and immunotherapy would also benefit from



prehabilitation either starting before neoadjuvant therapy or while waiting for surgery. Preliminary findings from a randomized, controlled trial showed that patients with esophageal cancer undergoing neoadjuvant therapy and receiving prehabilitation had fewer readmissions but no changes in morbidity and mortality.<sup>38</sup> Prehabilitation in patients undergoing neoadjuvant treatment for rectal cancer was also shown to be feasible and impactful on patient's functional outcome.<sup>39</sup> The prehabilitation program should then continue if possible after surgery if the patient needs adjuvant therapy. The multidisciplinary team and the tumor board should evaluate each patient and promote timely prehabilitation for high-risk patients such as those who are malnourished, sarcopenic, older, or frail, are experiencing social marginalization, and are experiencing several comorbidities.

### The Challenge of Patient Adherence and Patient Engagement

A significant barrier to effective prehabilitation is the patient's failure to follow the recommendations. Nonadherence is presented in different ways, misunderstanding either the advice or the reason for participating in the program, carrying out incorrectly parts of the program, or even ignoring the program completely.<sup>40</sup> It is important that patients understand what prehabilitation entails and the purpose of each intervention and participate in the creation of the pathway, and that every effort is made to ensure patients are able and capable to apply the intervention when they go home.<sup>41</sup> Studies on health literacy have shown that 40 to 80% of medical information provided by healthcare practitioners is retained.<sup>42</sup> For this reason, during the assessment and screening of a candidate for prehabilitation, patients are advised to bring a relative or a friend with them at the first visit to make sure they understand what they need to do at home. A diary with clear pictorial instructions on how to carry out the interventions or a video could be provided to help with adherence.

The results of patient engagement include patient-reported better quality of care, better patient experiences, and more transparent decision making.<sup>43</sup> At the highest level of engagement, *empowerment*, decisions are placed in the hands of patients who understand the potential benefits of prehabilitation and share in the cocreation of their personalized prehabilitation program. When patients are approached to participate in a prehabilitation program, they want to have as much information as possible about the time spent with the program, the possible costs associated with coming to the center for training, and whether the program will delay surgery. In this context, self-efficacy can be a major determinant in engaging patients in the prehabilitation program.<sup>44</sup> Furthermore, believing that fitness helps to promote an early and better recovery after surgery leads to an improvement in one's functional ability in spite of possible constraints and challenges associated with exercise.

### The Frail Older Patient

With aging, functional reserve and the capacity to meet the demands of different organs are decreased, thus placing older patients at higher surgical risk. Functional capacity is an important patient-centered objective, and older persons perceive consistently that maintaining their independent function needs to be a top priority.

Sedentary activity, social isolation, malnutrition, and depression are very common in older frail patients and have been recognized as risk factors for poor postoperative outcomes.<sup>45</sup> Malnutrition in the older adult develops as a consequence of inadequate nutrient intake or altered requirements and is recognized as a loss of body mass, decreased strength and function, and reduced ability to mount an immunologic defense.<sup>46</sup>

Despite the strong and well-recognized association of frailty with adverse postoperative outcomes, interventions specifically tailored to frail surgical patients are few and not always impactful on clinical outcomes.<sup>47,48</sup> It is therefore necessary to identify procedure-specific risk evaluation and prescribe personalized prehabilitation interventions in concerted action with other specialties such as geriatrics. Strategies designed to promote better balance, flexibility, and muscle power by incorporating more rapid force-generating exercises at lower speed need to be considered in addition to aerobic exercise training.<sup>49</sup> Maintaining body protein is the primary nutritional goal in older patients to prevent the development of sarcopenia and loss of function. To overcome the negative net protein balance (anabolism – catabolism), anabolism should be enhanced by increasing the quantity and by improving the quality of proteins.<sup>50</sup>

### Conclusion

Incorporating prehabilitation within the enhanced recovery after surgery program would allow the anesthesiologist as a perioperative physician to have a leadership role and work together with a multidisciplinary team. Because prehabilitation is a patient-centric program, participants would be empowered and develop a sense of purpose and resiliency as they choose to prepare themselves for an upcoming surgery. Prehabilitation is an innovative concept that requires more research to better elucidate the mechanistic aspects of how exercise intensity, in synergy with anabolic stimuli, can modulate the catabolic response to surgery and to enhance recovery. In addition, knowledge gaps remain to be addressed on issues such as outcomes to be measured, organization, technology, and costs. Ultimately patients will benefit from our efforts to improve surgical care.

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## Competing Interests

The author declares no competing interests.

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## ANESTHESIOLOGY REFLECTIONS FROM THE WOOD LIBRARY-MUSEUM

### Byline Backstory No. 8: Future Museum Curator and Geriatric Anesthesiology Fellow—Aging of the Specialty and Aging of the Patient



Rotating through medicine as a medical student, I met Johns Hopkins' Physician-in-Chief Victor McKusick, M.D. (1921 to 2008, *upper left*), a cardiologist and founding father of medical genetics. Intrigued by my mathematical genius, McKusick was dismayed, however, by my past struggles with genetics courses in college and medical school. (Victor mused that my "deficiency was not genetic.") Sighing after hearing me repeat the word "basically" an eighth time, McKusick suggested that I consider researching across Wolfe and across Monument Streets, at Hopkins institutions devoted to public health and the history of medicine, respectively. A second-generation Oslerian, Victor directed me later toward a third Baltimore connection, where many cardiologists collaborated with Edward Lakatta, M.D. (*lower left*), director of the Laboratory of Cardiovascular Science, National Institute on Aging (*right*). McKusick's clever suggestions facilitated my eventual plans to (1) pair a public health degree with my M.D., (2) curate a departmental anesthesia museum, and (3) draft the nation's first geriatric anesthesiology fellowship. (Copyright © the American Society of Anesthesiologists' Wood Library-Museum of Anesthesiology.)

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