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REVIEW

The concept of prehabilitation: What the surgeon needs to know?

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Summary Despite advances in surgical techniques, anesthesia and perioperative care, which became safer and accessible to a higher proportion of high-risk patients, major surgery remains morbid with a lot of patients not recovering their previous capacity. Indeed surgery is a physiological stress and decreases functional capacity in the postoperative period. A ''prehabilitation'' program should increase functional capacity in anticipation of an upcoming stress. It should occur after the surgical consultation and before surgery, and is based on three components: physical care, nutritional support and psychological support, during 6 to 8 weeks. The aims of prehabilitation are to improve both nutritional status and pre- and postoperative fitness, and to reduce postoperative complications. Prehabilitation demonstrated benefit on postoperative complications in cardiovascular surgery but its benefit in digestive surgery is still unclear with contradictory results. The aim of this review was to summarize results of prehabilitation on the pre- and postoperative period and to determine its possible future in digestive surgery.

Introduction

Despite advances in surgical techniques, anesthesia and perioperative care, which became safer and accessible to a higher proportion of old or high-risk patients, a significant group of patients do not recover their preoperative capacity. Almost 30% of patients undergoing major abdominal surgery have postoperative complications [1] and even in the absence of complications, major surgery is associated with a 40% reduction in physiologic and functional capacity [2]. Moreover elderly patients have more and more often access to surgery due to the continuous increase in life expectancy; as an example, almost 40% of colorectal cancers are diagnosed after 75 years and most of them are operated [3]. Elderly patients or patients with multiple comorbidity are the most likely to experience postoperative morbidity and mortality. Efforts to improve recovery have focused on the postoperative

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period, leading to the concept of rehabilitation. But rehabilitation does not improve the muscular and functional reserve at the time of major surgery. Poor preoperative physical performance has been shown to increase mortality [4] and postoperative complications [5] and to delay postoperative recovery [6]. Now several studies have reported that the preoperative functional reserve assessed by VO_{2peak}, 6 minutes walk-test (6MWT) and anaerobic threshold (AT) would be predictive of postoperative morbi-mortality [7,8]. So preoperative period could be considered as the most relevant period to increase the physical condition thus to decrease postoperative morbidity of major surgery. Indeed, major surgery induces tissue trauma, cardiovascular effort, physical inactivity with loss of muscular mass, pulmonary and decubitus complications that some patients cannot overcome [9,10]. Based on the notion that preoperative functional reserve is predictive of postoperative morbidity, prehabilitation appears as an emerging concept. Widely described in cardiovascular and thoracic surgery, prehabilitation is little known and has been little studied in digestive surgery including oncology. The aim of this review was to summarize results of prehabilitation on the pre- and postoperative period and to determine its possible future in digestive surgery.

What is prehabilitation?

Initially, the concept of prehabilitation was developed regarding the only physical status of the patients [11]. In many studies dedicated to cardiovascular surgery, prehabilitation has shown to improve cardiac function [12], respiratory recovery [13] and postoperative function [14]. A systematic review analyzed influence of these preoperative exercises on postoperative complication rate and demonstrated that preoperative exercise improved postoperative morbidity and physical function [15]. But another review suggested benefit of prehabilitation should be questioned due to a high heterogeneity between studies; particularly, physical exercises were not standardized, the type of surgery was varying, and prehabilitation did not include nutritional and psychological care in some studies [16]. A randomized controlled trial in patients undergoing colorectal surgery reported poor surgical outcomes in the prehabilitation group and identified some predictive factors of poor outcomes and poor compliance, including high anxiety, psychological stress and catabolic state [17]. This suggests that improving physical capacity only may be not sufficient and that prehabilitation should also include preoperative nutrition and anxiety treatment. So prehabilitation should be considered as a multidisciplinary preoperative program aiming to improve physical condition, nutritional status and preoperative anxiety. The optimal duration of the prehabilitation program should be determined by the best compromise between compliance and effectiveness. A prehabilitation program between 2 and 4 weeks seems to be ineffective [18] whereas to exceed a 3-month duration is associated with a very poor compliance [19]. If allowed by the underlying disease, duration ranging from 6 to 8 weeks seems to be a good compromise between feasibility and effectiveness. However, standardization of each of the 3 modalities of prehabilitation is still lacking.

Preoperative physical exercise

An initial assessment of functional capacity is performed through cardiopulmonary exercise testing such as the 6MWT, VO_{2peak} and AT. Exercises must be adapted according to these tests. Two types of complementary exercises should be performed: endurance exercises aiming to improve functional reserve through optimization of hemodynamic parameters. Walking or cycling are well adapted sports, accessible to all patients; bike will be preferred in patients with musculoskeletal diseases (arthritis, poor balance), but walking remains simple and popular even in aged people, and muscular exercises aiming to strengthen the musculoskeletal system; they should involve all muscle groups solicited in daily life (arms, shoulders, chest, abdomen, back, hips and legs). The exercises will be carried out using suitable equipment (dumbbells, resistance...) under the control of a trained physiotherapist.

Nutritional care

Nutritional status of patients scheduled for abdominal surgery is directly influenced by the presence of cancer, age, chemotherapy and stage of the disease [20]. Preoperative nutrition should be optimized to compensate the postoperative catabolic response to surgery, so undernourished patient has a greater risk to develop postoperative morbidity and mortality [20]. Recommendations of preoperative nutrition and immunonutrition are standardized, clear and with effective, so prehabilitation should follow these recommendations [21,22]. Despite recent development of preoperative nutrition, 20 to 50% of patients undergoing abdominal surgery for cancer are undernourished [23,24]. The benefit of prehabilitation on the nutritional status is double: firstly a nutritionist can perform a complete nutritional blood assessment before dieticians supervise closely observance of preoperative nutrition. If compliance is poor, nutritional products and/or the mode of administration can be adapted; secondly, nutrition support increases the benefit of physical exercise. A minimum of 140 g of carbohydrate taken 3 hours before exercise facilitates completion of the exercise session, and 10 g of proteins increases by 25% the dynamic muscular strength [25–27].

Psychological support

The first aim of the psychological support is to reduce anxiety. A 60-min visit with a trained psychologist provides techniques aiming at reducing anxiety, such as relaxation with breathing exercises at home [28]. There is no standardization of the psychological tests to perform. The second aim of this psychological care is to enhance and reinforce patients' motivation to comply with exercise and nutritional support. Indeed, anxiety and depression have been identified to affect postoperative outcome, defined by a longer length of stay, infection, functional capacity and poorer recovery [29–32].

The specificity of cancer in digestive surgery

The value of prehabilitation on postoperative outcomes in digestive cancer surgery remains debated. Prehabilitation should be offered to elderly and undernourished patients, possibly simultaneously to preoperative chemotherapy. Delay between diagnosis and intervention should be long enough to implement the protocol [33]. Neoadjuvant

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chemotherapy reduces physical fitness defined by VO_{2max} [34]. A structured exercise intervention is feasible and returns fitness to baseline levels within 6 weeks [34]. The effect of prehabilitation has been mainly studied for colorectal cancer. A randomized controlled trial in colorectal cancer reported no differences between a structured bike and strengthening regimen compared to only breathing exercises [17]. Another randomized study reported no differences in terms of postoperative complication but a higher proportion of patients of the prehabilitation arm recovered to or above baseline exercise capacity at 8 weeks compared with the rehabilitation group [28]. A subsequent study of a trimodal prehabilitation program demonstrated a better postoperative 6MWT in the intervention group [35]. Randomized studies on aerobic prehabilitation in colonic resection showed improvement in oxygen uptake, peak power output, and heart rate [18,36]. To report a benefit of prehabilitation in the postoperative outcome may be difficult in colorectal surgery because this surgery is associated with a low morbidity rate, so to demonstrate a benefit could need a large number of patients. Prehabilitation requires a multidisciplinary management, is feasible and safe, and is associated with a favorable effect on postoperative recovery but further prospective randomized studies are needed to determine the best modalities and its actual value on postoperative outcome.

Which patient's selection?

Major surgery induces a high systemic inflammatory response associated with a marked increase in oxygen consumption in the immediate postoperative period [37,38]. In patients with poor cardiorespiratory reserve, the inability to sustain this increased demand may lead to avoidable morbidity and mortality [39]. Measured or estimated exercise tolerance may indicate ability to increase oxygen delivery after surgery. Peak oxygen consumptions less than 15 $mL.min^{-1}.kg^{-1}$ and anaerobic thresholds less than 11 $mL.min^{-1}.kg^{-1}$ have been associated with increased postoperative complications after major thoracic and abdominal surgery [40,41]. For major visceral surgery (colectomy, nephrectomy, cystectomy) patients with a low preoperative VO_{2max} (< 11 $mL.min^{-1}.kg^{-1}$) had a 6.8 relative risk of death compared to other patients [39]. Before hepatic surgery, long-term survival of those with an AT of less than 9.9 $mL.min^{-1}.kg^{-1}$ was significantly worse than that of patients with a higher AT [42]. Exercise capacity and activity status have become well-established predictors postoperative morbidity and mortality. The fact that exercises capacity is a strong and independent predictor of outcomes supports the value of the exercise test as a clinical tool; it is non-invasive, non-costly, and provides a wealth of clinically relevant diagnostic and prognostic information. Improvement of functional walking capacity (defined by the 6MWT), VO_{2peak} and AT by the trimodal prehabilitation has been reported in some studies [12,18,43]. Moreover, patients who improved during prehabilitation were more likely to recover to baseline functional walking capacity in the postoperative period, compared with those who remained stable or even deteriorated [44]. So prehabilitation could be used not only to improve patients before surgery but also could help to definitively contraindicate surgery in patients with initially bad general condition and poor cardiorespiratory tests not improving after prehabilitation.

Conclusion

In conclusion, prehabilitation including preoperative physical exercise, psychological support and nutritional support is an important adjunctive measure in major digestive surgery. However, in this domain, its benefit seems to be clear regarding postoperative functional capacity but is not still demonstrated regarding postoperative outcomes. Prehabilitation could be also helpful for patient's selection. In the next future, well-designed studies evaluating standardized modalities in a large number of patients will help to determine value of prehabilitation on surgical outcome.

Keypoints

- After major surgery, a lot of patients do not recover their previous physical capacity, thus exposing to a higher risk of complications.
- The concept of ''prehabilitation'' has been developed to increase functional capacity in the perioperative period and ultimately to decrease postoperative morbidity and improve recovery.
- Prehabilitation should include preoperative physical exercise, psychological support and nutritional support.
- Duration of prehabilitation ranging from 6 to 8 weeks seems to be a good compromise between feasibility and effectiveness.
- Standardization of each of the 3 modalities of prehabilitation is still lacking.
- In digestive cancer surgery, benefit of prehabilitation seems to be clear regarding postoperative functional capacity but is not still demonstrated regarding postoperative outcomes

Disclosure of interest

The authors declare that they have no competing interest.

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