onderzoek

Optimizing perioperative physical therapy care in major elective surgery to improve surgical outcome in high-risk patients: the Better in, Better out™ concept

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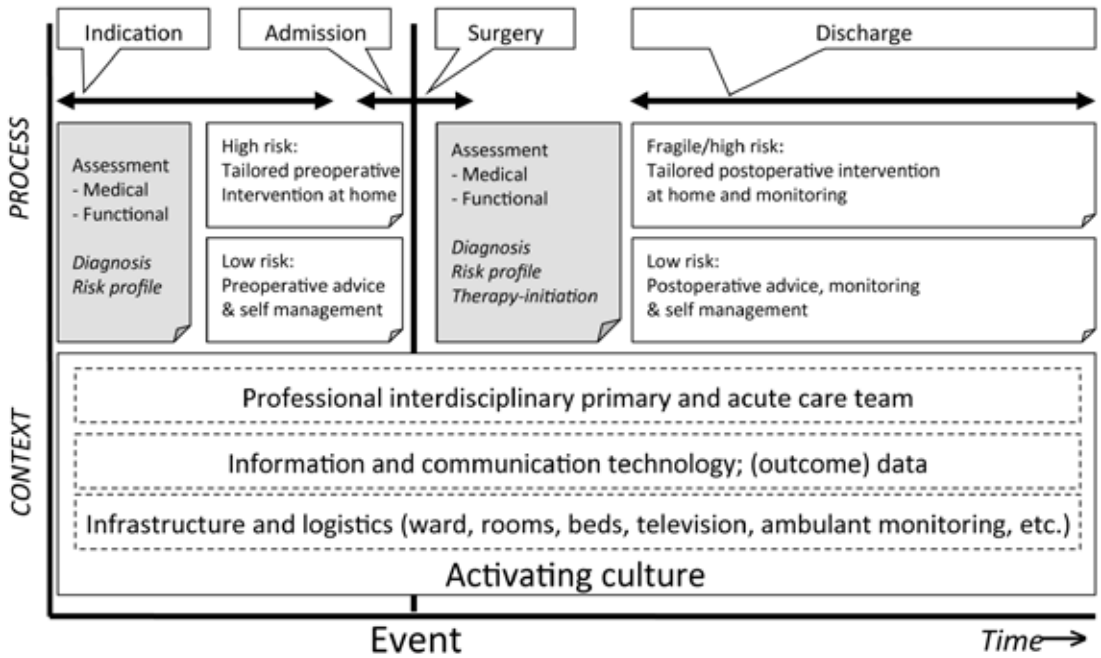

Figure 1. Comprehensive overview of the continuum of care: its process steps in time (upper panel) and more continuous contextual ingredients (lower panel). The process starts with medical and functional assessments to identify high- and low-risk patients, in both the preoperative and postoperative phases, so that the best interventions can be implemented. The contextual ingredients – team, technology and infrastructure – should provide a proactive culture where and when possible throughout the entire perioperative period. *Adapted, by permission, from [3].*

Introduction

Frail elderly patients undergoing major surgery experience a decrease of physical capacity due to their hospital stay and surgery [1]. This affects the risk of postoperative complications and their performance of activities, independence and participation. A variable fraction of the patients already experience such a decrease before surgery [2], because of their specific disease and a more generally seen sedentary "sit, wait and see approach" of these patients themselves, their relatives, his or her (in)formal caregivers and the health care sector towards frail elderly patients. After surgery, they can be faced with complications, extensive post-surgery rehabilitation and even re-admittance to the hospital.

The Better in, Better out™ (BiBo™) strategy was developed to reduce these risks through the optimization and professionalization of perioperative hospital care in a physically activating context (see Figure 1). BiBo™ includes the 1) implementation of preoperative risk stratification, 2) preoperative advice and recommendations about the importance of physical activity and physical fitness for all patients, 3) preoperative home-based functional physical exercise training for high-risk patients and 4) early mobilization and functional physical exercise training postoperatively for all patients. BiBo™ drives patient-centered, collaborative care that includes the patient especially, as well as their relatives, (in)formal caregivers, medical team, and allied health professionals. Together they aim to improve surgical outcome by preventing postoperative morbidity, mortality, and a decline in physical functioning by optimizing physical fitness before, during and after hospitalization for major surgery. This way,

THE BETTER IN, BETTER OUT™ (BIBO™) STRATEGY AND ZONMW

Pearls from ZonMw are awarded to projects that stand out in several respects. In 2009, ZonMw awarded "The Pearl" to dr. Erik Hulzebos and prof. dr. Nico van Meeteren for the BiBo™-project "Pre-Operative Respiratory physical Therapy-(the PORT study)".The PORT study showed that high-risk patients who participated in high-intensity inspiratory muscle training in the two weeks before they underwent open coronary artery bypass graft surgery significantly reduced their risk for developing a postoperative pulmonary complication. In 2011, van Meeteren was nominated by ZonMw for "The Pearl of the Pearls" for the BiBo™-concept.

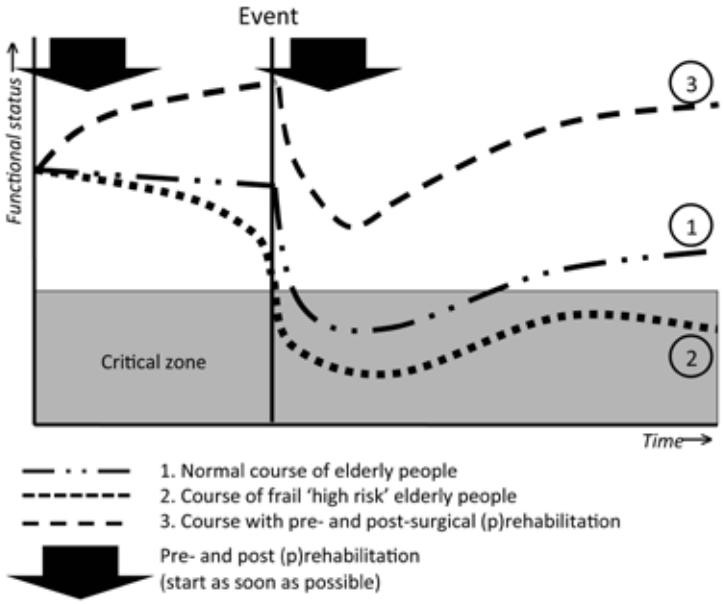

Figure 2. Surgery in elderly people may push already gradually declining physical functioning and physical fitness temporarily under the minimum level (into the critical zone), and recovery may take time. In high-risk patients, a "sit, wait and see" option may even worsen the decline in the preoperative phase in the critical zone, thereby increasing the risk of poor performance status. Recovery will take more time and may not be complete after surgery. Prehabilitation is thought to increase the psychophysiological reserves of high-risk patients before surgery, preventing them from reaching the critical zone. Immediate postoperative mobilization and activation, increasingly possible in view of recent innovations in anesthesiology, add to the protective effect of prehabilitation. *Adapted, by permission, from [3].*

length of hospital stay, discharge location (home instead of a rehabilitation center), physical functioning after treatment, community reintegration, and quality of life will be positively influenced as well. They are also involved in the process that aims to make the hospital culture and infrastructure more physically activating. Particularly the low-risk patients, who are up-and-running during their hospital stay, offer a physically more active culture by their presence. In the following three paragraphs we will outline the current BiBo™ concept and provide insights from scientific publications and experiences from daily clinical practice.

The Better in, Better out™ concept

1. Preoperative risk stratification

When surgery is agreed upon by the patient, advised by the multidisciplinary consultation team, a hospital physical therapist screens, together with the patient, for risks for delayed post-surgical recovery of physical functioning using an evidence-based prediction model. Predictive risk factors for delayed post-surgical functional recovery vary, based on the surgical procedure and the local context. In general, these risk models comprise measures related to patient characteristics, physical fitness, and multi-morbidity. In the literature, models to perform risk stratification and/or risk factors are described for several surgical procedures, such as for coronary artery bypass graft surgery [4], major abdominal surgery [5], and total hip arthroplasty [6]. In patients undergoing major abdominal surgery, those with a low cardiorespiratory fitness (ventilatory threshold <11 mL/kg/min or oxygen uptake at peak exercise <18 mL/kg/min) as measured objectively during cardiopulmonary exercise testing are generally considered as high-risk patients [7]. In clinical practice, cardiorespiratory fitness can also be estimated by use of less sophisticated (maximal) exercise tests (e.g., the steep ramp test and stair climbing or walking tests) that do not require respiratory gas analysis. However, these tests require further validation. Moreover, other parameters of physical fitness (e.g., hand grip strength, chair rise time, and physical activity) are associated with postoperative mortality and discharge destination [5]. All patients undergoing a major surgical procedure should be screened preoperatively on different components of physical fitness (e.g., cardiorespiratory fitness, muscle strength, and functional performance). Hence, hospital-specific risk stratification models can be developed and optimized for different surgical populations, as these models might differ between hospitals, as well as in time (e.g., due to improved surgical techniques and anesthetics).

Next to the preoperative screening of physical fitness, all patients are educated about the importance of physical fitness and physical activity before and after surgery. As bed rest is detrimental to one's physical fit-

ness – and should thus be avoided as much as possible [8] – the importance of postoperative fast-track mobilization [9] and physical activity [10] are explained. In case a patient is identified as having 'high-risk', the patient decides whether he or she is willing to nullify treatable risk factors before surgery. In this decision, the patient is informed by the best available evidence and knowledge provided by the hospital physical therapist [11]. In high-risk patients whose high-risk is mainly explained by a low physical fitness, preoperative physical optimization through functional exercise therapy is highly recommended (see Figure 2).

2. Preoperative physical optimization of high-risk patients

Patients, their relatives and their (in)formal caregivers should be sufficiently educated and motivated about the significance of physical activity and physical fitness before and after surgery for adequate postsurgical functional recovery. High-risk patients train in collaboration with a specifically trained physical therapist working within the catchment area of the hospital during the preoperative period, via a home-based functional exercise training program focused at the patient's individual risk factors. The overall goal of this prehabilitation program is to improve respiratory, cardiovascular and/or musculoskeletal fitness parameters to objectively optimize the patients' physiological reserves and thereby their adaptation to surgical stress and handling of postsurgical recovery of physical functioning [12]. Besides these, the goal of prehabilitation is also to create an activating culture throughout the continuum of care, in both its context and process, at home and even in the acute care setting (see Figure 1) in order to keep both low- and high-risk patients as physically active as possible [3]. In addition, there are a few key points to keep in mind when collaboratively executing home-based functional exercise training programs with high-risk patients. Firstly, the program should be personalized to the short- and long-term goals, needs, and potential of the patient [13,14]. Physical exercise training programs are typically limited to the patient's ability, but hardly ever surpass that. We need to unlock each patient's full potential to reach a higher level of functional status. Patient-specific exercises should therefore not only be progressed on intensity and repetitions, but on complexity and variability as well [15]. Secondly, the short available time before surgery requires a high-intensity training program for short-term effects and it should be targeted to elicit overload in order to improve physical functioning and cardiorespiratory fitness. When reading literature on (preoperative) exercise therapy, readers should be aware that physical exercise training programs in randomized controlled trials often lack overload, include the more healthy subgroup of patients, and fail to bring out the potential of their participants [16,17]. Thirdly, the functional physical exercise program should be planned, structured, executed and monitored with the patient and within his or her own living situation, as frail elderly patients are less likely to participate in a clinic-based physical exercise program [18] than they are in a home-based physical exercise program [19]. Finally, the program must be monitored by both patients, their relatives and their (in)formal caregivers, as well as by their physical therapist by frequently using functional tests to direct and titrate exercise dosage [20]. Patients must not only be involved in the evaluation of the therapy progress (or lack thereof), they themselves should be the ones that test their own physical capacity and monitor the progress during training-episodes. This will improve their involvement and motivation and thereby therapy adherence and satisfaction. Preferably, the patient decides, well informed by the physical therapist, the anesthesiologist and the surgeon, and also with respect to the medical condition, when he or she is fit to operate on. Thereupon the decision of planning for surgery is best made.

3. Postoperative physical mobilization and functional physical exercise training

Postoperatively, hospital culture and infrastructure should 'invite' or even persuade the patient to be physically active. In most hospitals the process of care is entirely organized around the patient's bed. Logistically speaking this system works well; however, this system also invites patients to lie in bed, even when there is no medical reason [21], as mostly is the case. To do so, hospital culture and infrastructure should be transformed in a way that it elicits physical activity and postoperative mobilization should be initiated as early as possible. For example, in case of fast-track surgery, patients are constantly in an environment where their peers are 'up and running' and participating in all sorts of household and leisure activities amongst each other. Thereby they are implicitly, or even explicitly if necessary, recommended getting out of bed, within as little as two hours after surgery provided that in line with this approach the proper personalized state of the art anesthetic regimen is used [9]. Patients themselves monitor their immediate rehabilitation progress and anticipate in going home as soon as fit and functional as possible. If necessary, high-risk patients partake in extra functional physical exercise training, led by the hospital physical therapist and monitored and adapted to the patient's individual level of physical functioning and recovery. Postoperative physical therapy care should exceed one-size-fits-all principles, in which the protocol demands that the physical therapist visits a patient once a day. However, in some situations three or four times of physical therapy is warranted, while other patients only need one quick screening session for risks in total. Here the physically activating infrastructure and culture would suffice. Postoperative recovery should be focused on reaching objective functional milestones (e.g., supine to sitting on the edge of the bed and vice versa, sit to stand, walking, stair climbing), which serve as to be (self) monitored indicators of postoperative complications, independent physical functioning and discharge from hospital to home or elsewhere. In high-risk patients, home-based functional physical exercise training is continued after discharge aiming at reaching the functional milestones. Preferably, a patient has pre- and postoperatively – if indicated – the same competent and committed physical therapist at home. Low-risk patients receive post-

operative advice about the monitoring of their physical fitness progress and suggestions for self-management of rehabilitation. When the functional milestones have been achieved and the patient is able to fulfill his or her participatory duties, the BiBo™ health care process is finished.

Opportunities

Due to the successes of innovation of surgery and anesthesiology over the past decades and the increase in the amount of (frail) elderly, surgical treatment nowadays must also focus on reducing treatment-related complications, as well as on physical functioning after treatment, community reintegration, and quality of life. It is essential to realize that postoperative risk for a delayed functional recovery is multifactorial and a function of the preoperative medical and functional condition of the patient, the invasiveness of the surgical procedure and the type of anesthetic administered. A history and physical examination, focusing on risk factors for complications by the anesthesiologist, and an objective evaluation of the patient's physical fitness of the patient in collaboration with the hospital physical therapist, are necessary to any preoperative evaluation. Currently, planning for major elective surgery is based on the availability of the operating theater and the surgical team. In the future, planning for surgery should be based on the patient's medical fitness status, as well as on the patient's physical fitness status. Advised by the multidisciplinary consultation team, the patient decides when he or she is fit to operate on. For an optimal preoperative screening it is imperative that patients, anesthesiologists and hospital physical therapists work together and inform each other adequately about the patient's medical and functional status, respectively. By identifying high-risk patients, the medical fitness of these patients should be optimized by the anesthesiologists, whereas the physical fitness of these patients should be optimized by the patients themselves, their relatives, (in)formal caregivers, and an experienced competent physical therapist. The latter requires a changing role of the hospital physical therapist, partly entering the realm of the anesthesiologist. Preoperative assessment can help detect the high-risk patients in an early stage and install preventative interventions (prehabilitation) [22]. The ultimate goal is to enhance postoperative recovery. This will prevent patients for postoperative morbidity or mortality, and to return the patient to desirable physical functioning as quickly as possible postoperatively. To succeed, patients, their relatives and his or her (in)formal caregivers should be adequately informed concerning the importance of physical fitness and physical activity, as well as about how to get fit pre- and postoperatively by both anesthesiologists and physical therapists.

Conclusion

- The BiBo™ concept focusses at the optimization and professionalization of perioperative hospital care in a physically activating context, and includes:
  - Preoperative risk stratification for all patients;
  - Preoperative advice and recommendations about the importance of physical activity and physical fitness for all patients;
  - Preoperative home-based functional physical exercise training for high-risk patients;
  - Early mobilization and functional physical exercise training postoperatively for all patients;
- Risk factors for morbidity, mortality, and a decline in physical functioning might differ between surgical procedures, might differ between hospitals, and might differ in time;
- Risk stratification models are not available for all major surgical procedures and often need external validation.

Case description

Mr. B., a 68-year-old man (BMI 19.5 kg/m^2) was scheduled for a left hemihepatectomy and a right adrenal gland resection. Preoperative screening of the patient's physical fitness was performed by the hospital physical therapist to assess his cardiorespiratory fitness (steep ramp test: 103 W), muscle strength (hand grip strength: 25 kg; five times sit-to-stand test: 15.75 s), and functional performance (two-minute walk test: 155 m; timed up-and-go test: 6.19 s). These results classified him as a high-risk patient for postoperative morbidity and delayed post-surgical functional recovery, because of his low cardiorespiratory fitness and his low muscle strength. More specifically, his peak oxygen uptake, estimated using the steep ramp test (103 W) [23], was 17.4 mL/kg/min, which is below the cut-off point described in the literature of 18.0 mL/kg/min [7]. His hand grip strength was 25 kg, which is just above the cut-off point described in the literature of 23.8 kg [5], and his five times sit-to-stand test score (a functional measure of quadriceps strength) was 15.75 s, 125% of predicted [24]. Therefore, he decided with his medical team to start prehabilitation in the form of home-based functional exercise training with one of the specifically trained physical therapists within the hospital's (specifically hereto installed) primary care network. The training was tailored to the patient's abilities, potential, and participatory needs. Based on his estimated cardiorespiratory fitness, he should be able to perform physical activities up to 5 metabolic equivalents (METs, peak oxygen uptake divided by 3.5). Training sessions focused at improving cardiorespiratory fitness and muscle strength in a functional context. The patient received seven physical therapy sessions during three weeks, which included exercises such as stair climbing, walking, cycling, and household activities. Moreover, he was strongly advised to stay physically active between training sessions. The goal was a direct discharge home after surgery, which was a very important goal for him due to his urge for autonomy. His muscle strength and functional mobility were measured weekly during this three-week preoperative period and demonstrated good progression after three weeks of prehabilitation (hand grip strength: 29 kg, +16%; five times sit-to-stand test: 11.54 s, -27%; two-minute walk test: 170 m, +13%; timed up-and-go test: 5.75 s, -7%).

Postoperatively, physical therapy started at day 1. The short-term goal was to optimize respiratory gas-exchange using the active cycle breathing technique including deep inspiration, huffing, and coughing. The patient had minimal secretions but had difficulties with deep inspiration due to pain from the incision, which made him at risk for atelectasis. In the next days at the intensive care unit, mobilization was initiated but turned out to be unsuccessful as the patient only tolerated an upright position in bed. The patient was admitted to the ward at postoperative day 4 and mobilization was extended. At postoperative day 7, the patient achieved functional independency based on the modified Iowa level of assistance scale (test to assess the capability of the patient to safely perform five activities of daily life: supine-to-sit, sit-to-supine, sit-to-stand, walking, and stair climbing) and was discharged home after 8 days. At discharge, the patient's physical fitness was reassessed (hand grip strength: 22 kg, -26%; five times sit-to-stand test: 17.07 s, +48%; two-minute walk test: 120 m, -29%; timed up-and-go test: 8.89 s, +54%). Based on these results, he received the advice to start postoperative functional exercise training in the home-based setting in order to attain former levels of physical fitness.

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