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10 years of prehabilitation: From theory to clinical practice[☆]



Marta Ubré,^{a,*} Mar Montané-Muntané,^a Iago Diéguez,^a Graciela Martínez-Pallí^{a,b,c}

^a Department of Anesthesiology, Hospital Clínic de Barcelona, Barcelona, Spain

^b Institut d'Investigacions Biomèdiques August Pi i Sunyer (IDIBAPS), Universitat de Barcelona, Barcelona, Spain

^c Biomedical Research Networking Center on Respiratory Diseases (CIBERES), Madrid, Spain

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ABSTRACT

In recent years, prehabilitation has generated high expectations as an innovative preoperative strategy to enhance clinical outcomes following surgery. Several studies have demonstrated that multimodal programs are effective in improving patients' health status and cardiopulmonary reserve, allowing them to undergo surgery in better conditions and, consequently, reducing the incidence of postoperative complications.

Most publications describe proof-of-concept studies, and literature about their implementation is more limited. The implementation of these programs requires new resources and significant organizational effort.

In this paper, we share our experience implementing a multimodal prehabilitation program as a mainstream service at a tertiary hospital. Although there are still many unknowns regarding the optimal selection of patients, as well as the duration and components of the program, this article describes our journey in this field, aiming to provide insight for teams interested in developing a similar project.

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10 años prehabilitando: De la teoría a la práctica clínica

RESUMEN

En los últimos años, la prehabilitación ha generado grandes expectativas como estrategia preoperatoria para mejorar los resultados clínicos tras una cirugía. Diversos estudios demuestran su eficacia para mejorar el estado de salud y la reserva cardiorrespiratoria del paciente para hacer frente a la cirugía en mejores condiciones y, por tanto, disminuir las complicaciones postoperatorias.

Palabras clave:

Prehabilitación

Cirugía mayor

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* Corresponding author.

E-mail address: mubre@clinic.cat (M. Ubré).

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La mayoría de publicaciones describen estudios de eficacia preliminares, siendo la literatura sobre su implementación más limitada. La incorporación de estos programas requiere de recursos adicionales y de un gran esfuerzo organizativo.

Este artículo recoge nuestra experiencia en la puesta en marcha de un programa de rehabilitación multimodal en un hospital terciario. Aunque quedan todavía muchas incógnitas sobre la selección óptima de pacientes, y la duración y componentes del programa, el artículo describe nuestra trayectoria con el objetivo de poder ayudar a aquellos grupos que quieran llevar a cabo un programa de rehabilitación.

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Introduction

The aging of the population and the multimorbidity associated with it significantly impact the results of at-risk patients who undergo major surgeries.¹ This scenario represents a challenge for the healthcare system since it translates into increased surgery-related morbidity and mortality as well as higher healthcare costs.²

A low functional reserve and poor physical condition reduce patients' ability to cope with surgical aggression, which is associated with a greater risk of complications and longer postoperative recovery.^{3,4} The wait before surgery provides the opportunity to act on modifiable surgical risk factors. In this context, multimodal prehabilitation has emerged as an attractive intervention, not only for its potential effectiveness and transversality, but also for the efficiencies it can generate due to its low cost. It is a short-term, comprehensive, patient-centered, preventive, preoperative program designed to improve aerobic capacity through physical training and the promotion of physical activity, along with nutritional and psychological support, correction of anemia, and optimization of existing comorbidities of patients candidates for major surgery.^{5,6} Its ultimate goal is to improve the overall physical condition of these patients before surgery to minimize the occurrence of complications and accelerate recovery.

In recent years, evidence about the benefits of prehabilitation has grown, especially in abdominal surgery. Various studies demonstrate its effectiveness in preventing postoperative complications and reducing hospital stay in different surgical populations.⁷⁻¹⁰ However, despite their benefits and potential cost savings, implementing these programs in clinical practice is a challenge for most hospitals given their organizational complexity and the need for additional financial resources. A comprehensive evaluation of the implementation and development process is essential to identify the key factors that guarantee the program's success and continuity so that recommendations can be generated for the transferability of the service on a larger scale.

This article presents our experience in implementing a multimodal prehabilitation program as a transversal service at a tertiary hospital. The project began 10 years ago with a randomized clinical trial (RCT) that demonstrated the effectiveness and potential economic savings of prehabilitation. This was followed by the current multimodal program that has

been redefined over time according to available resources and the experience of professionals and patients. During this process, decisive factors have been identified to promote patient adherence and completion of the program, and to ensure their long-term sustainability.

Experimental phase (2013–2016): generating knowledge

In 2013, we began our initial research study with the main objective of evaluating the effectiveness of prehabilitation to reduce postoperative complications in high-risk surgical patients who are candidates for major gastrointestinal surgery.^{8,11} Several previous studies suggested that physical training improved functional capacity before surgery, but there were no studies designed to demonstrate whether this improvement led to better postoperative results. With the aim of addressing the problem in patients who are prone to complications, in this study we included only patients with high surgical risk.¹² The central axis of the intervention was supervised physical training.

The most relevant result was that prehabilitation reduced the incidence of postoperative complications by 50%, while also reducing the number of days spent in the Intensive Care Unit. The cost-effectiveness analysis showed that prehabilitation can be considered an efficient intervention since the cost of the program was offset by the reduction in the consumption of healthcare resources due to the lower incidence of complications, readmissions and surgical reinterventions in the 30 days after surgery, thereby demonstrating enormous potential for generating value in health. Additionally, the benefits of prehabilitation observed in patient aerobic capacity and level of physical activity were maintained 3 and 6 months after surgery, respectively.

Pilot phase (2016–2017)

The encouraging scientific evidence generated during the experimental phase led to its implementation in the healthcare setting and the debut of the Prehabilitation Unit at our medical center in 2016. The project was approved by the Medical Board at our hospital and included within the

framework of Enhanced Recovery After Surgery (ERAS) protocols. Our center is a referral hospital in our region as well as a public university hospital. With more than 700 beds, it is also a community hospital for its area of influence, with a population of 540 000 inhabitants. Being a tertiary hospital, it develops highly complex lines of treatment for patients from all over the country.

During that time period, the scientific literature suggested that nutritional support and psychological well-being could be key factors to improve compliance with the program and response to physical training,¹³ so we decided to incorporate these elements. The hospital did not have a multidisciplinary team dedicated to surgical patient optimization, so we identified several motivated specialists with the knowledge necessary to work on different aspects of the program. The integration within a specific unit of anesthesiologists, physiotherapists, nutritionists, psychologists and nurses was key to minimize costs in both personnel and material resources. We located the unit in the hospital's outpatient clinics in the afternoon, when they are usually not busy. The personnel and part of the material used were partially financed by various research grants.^{8,11}

Because of the limited budget, we prioritized patients most vulnerable to postoperative complications, meaning those

with poor functional capacity, who are usually older patients with significant underlying pathology.¹⁴ Therefore, our candidates were patients over 70 years of age and/or ASA III-IV who had been proposed for major surgery, or rather patients proposed for complex oncological interventions in which the disease that creates the need for the surgery itself entails marked functional deterioration (esophagectomy, cytoreductive surgery, major pancreatic surgery, etc). We started the care program in the field of digestive surgery, but we quickly included other major surgeries from different surgical specialties.

The patient referral circuit is practically unchanged since 2016. The referral is made by the anesthesiologist from the conventional pre-anesthetic visit based on the indicated criteria. To be included in the program, the expected wait time for surgery must be at least 3-4 weeks. On the first visit, the patient is evaluated globally by all specialists (Fig. 1), based on which the different components of the program are planned (Fig. 2). A case manager is responsible for: 1) acting as a liaison with the other specialists; 2) reinforcing patient compliance; and 3) evaluating progress during the program. Follow-up and monitoring are important and must be well structured from the beginning, especially in the most complex patients. The week before surgery, patients are re-evaluated

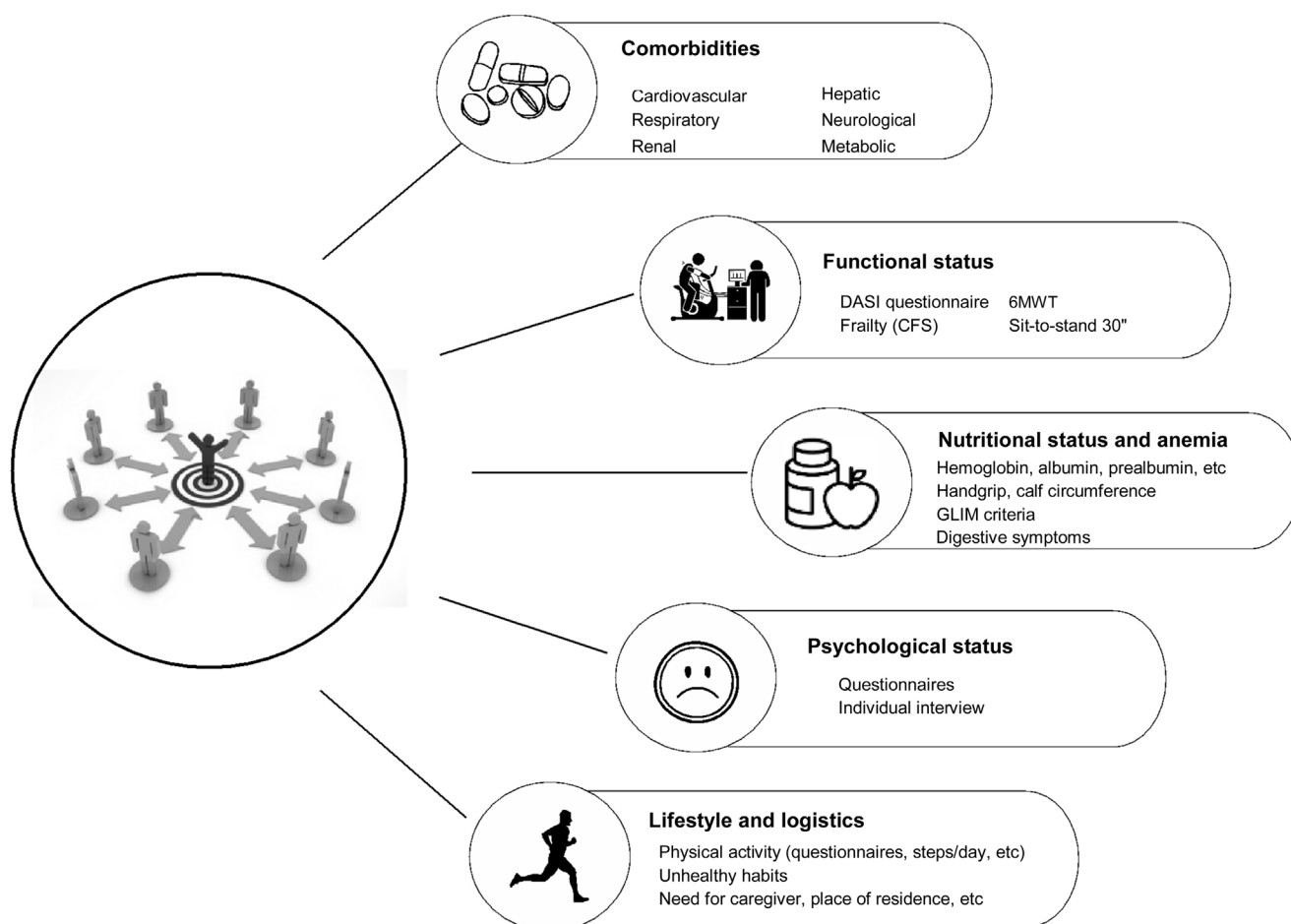


Fig. 1 – Multidisciplinary assessment.



Fig. 2 – PreHAB intervention.

and complete a survey about their experience during the program.

The design of the physical training program requires a complete baseline evaluation, including various physical activity questionnaires¹⁵ and functional tests (6-minute walk test,¹⁶ sit-to-stand test,¹⁷ etc). The initial interview with the physiotherapist is used to identify exercise habits, barriers (place of residence, need for a caregiver, lack of time, etc), facilitators (degree of motivation, etc), and preferences for performing physical activity, while also involving the patient and reinforcing her/his motivation and commitment to achieve the program objectives. During the first months, as there were no specific facilities for supervised training, the program included a plan to promote physical activity in the community, physical training at home, and one weekly functional exercise group session at the Unit. More specifically, the exercise plan in the community consisted of increasing the number of daily steps measured with a pedometer and increasing the intensity of walking according to the modified Borg scale.^{18,19} The weekly in-person session was led by a physiotherapist and included functional exercises

like going up and down stairs, sitting down and getting up from a chair, pedaling at a constant load, and peripheral muscle training with elastic resistance bands. During this visit, physical activity goals for the following week were defined.

In 2017, the availability of space and adequate equipment for a hospital gym made it possible to consolidate a supervised training program. The prehabilitation programs reported to date show great heterogeneity and include a wide variety of interventions. In fact, there are no guidelines for designing a preoperative exercise intervention. However, over a short period of time, such as before surgery, it is reasonable to assume that well-structured, supervised high-intensity physical training will be more effective in increasing aerobic capacity before surgery compared to moderate-intensity exercise training or with an exercise program in the community without supervision.^{20,21}

Due to the limited capacity of our facilities, 2 programs were developed: one based on supervised training, and another that promotes physical activity. The first is prioritized for patients with relevant comorbidities who are deconditio-

ned and have little autonomy to increase their physical activity, and/or candidates for aggressive surgeries. It includes supervised physical training sessions based on high-intensity aerobic training on a cycle ergometer and peripheral strength training. The patient performs 2–3 weekly sessions that last 45–60 min. The work pace progress is adapted to each patient's individual tolerance, with the ultimate goal of maximizing the effect of the physical exercise. The program that promotes physical activity in the community is mainly aimed at patients who cannot attend the supervised program due to logistical constraints. It is fundamentally based on outdoor walks. Additionally, other exercises can be prescribed for use with a static cycle ergometer or similar (if the patient has access to one) as well as functional exercises, such as those described above. This includes a weekly session at the hospital to reinforce instructions, assess progress and review objectives. The training programs are flexible, and patients are allowed to move from one plan to the other depending on their evolution and/or availability.

The 2 other main components of the program, nutritional and psychological support, are adapted to the training modality carried out by the patient. The nutritional intervention is directed by a nutritionist and consists of an initial individualized consultation and a personalized plan of action.^{22,23} All patients receive dietary advice in accordance with the underlying pathology and expected intake; those who require it receive nutritional supplements with adapted formulas during the program. Regarding the psychological sphere, a weekly group session is organized about mindfulness, which is open to all patients. This psychological intervention is especially recommended in patients with symptoms or signs of anxiety or depression (Hospital Anxiety and Depression Scale [HADS] score > 8²⁴). Likewise, the Unit has a psychologist for consultations and individual monitoring, if necessary.

After the operation, follow-up is carried out for 30 days using the REDCap® (Research Electronic Data Capture) platform²⁵ as support. This software allows us to create a patient care report that is accessible to all medical personnel involved in their treatment.

Consolidation phase (2017-present)

Since 2017, the prehabilitation program has been consolidated as a transversal service in our hospital. More than 250 patients from different surgical specialties participate in the program annually.

Given the efficacy-effectiveness gap, whereby the results obtained in a controlled study do not always represent real-world results, and where multiple factors may also affect the response to a given intervention, we conducted a validation study to evaluate the effectiveness of prehabilitation in a real-life scenario.²⁶ In other words, we set out to analyze our data to see whether we were replicating the positive results of our first experimental study in healthcare practice. To this end, we compared the postoperative results (complications, days of admission, etc) of all patients treated in the Unit over a 30-month period with those of a control group constructed with propensity score matching. This analysis showed that

completing the prescribed treatment is of vital importance, and that there was a high percentage of patients (66%) who, for different reasons (change in surgical scheduling and/or lack of compliance), did not complete it and, therefore, did not experience the expected benefits of the intervention. Even so, a reduction in morbidity and mortality was especially achieved in highly aggressive surgeries and/or those performed in cases of high surgical risk. These interesting data reinforce the need to restructure prehabilitation into different strata focused on optimizing available resources and improving adherence and accessibility to the programs.

Meanwhile, we have defined quality indicators with the purpose of carrying out periodic evaluations of the structure and results of the program in clinical practice. These include: service coverage (patients included in the program/total patients targeted), dropout rate, adherence rate, health outcomes (30-day postoperative complications, intensive care unit stay and hospital stay), 30-day use of healthcare resources (surgical reintervention, hospital readmission, and emergency room visits) and patient-centered outcomes (QoR-15²⁷ postoperative recovery quality questionnaire, satisfaction survey). An analysis of these data provides valuable information on the safety, quality and effectiveness of the intervention, while also demonstrating improvements necessary in overall patient care before the service reaches full maturity.

During this last stage, we have also used “design thinking” techniques to improve the workflow and facilitate the implementation of the service on a large scale, yet the reality is that we only cover 20% of the potential prehabilitation candidates at our medical center.²⁸ Design thinking is a methodology used to address complex problems and develop innovative, user-centered solutions.²⁹ These sessions have allowed us to identify different factors that facilitate the scalability of the service.

Lessons learned during the implementation of the prehabilitation program

A prehabilitation program is a complex process, and its implementation in a real-life scenario involves overcoming several logistical challenges for it to become feasible and sustainable. At our hospital, the implementation process has been evaluated using the Consolidated Framework for Implementation Research (CFIR),²⁸ which has made it possible to identify where we should focus future efforts in order to optimize the widespread implementation of the program. Below, we provide some considerations that have emerged from our experience^{26,28} to ensure the viability of long-term prehabilitation programs:

- 1 Multidisciplinary team, adequate facilities and equipment: Prehabilitation programs address specific aspects of different disciplines; therefore, they should involve and coordinate all healthcare professionals who participate in the surgical process (specialists, physiotherapists, nutritionists, psychologists and nurses). Having a program director is key, and any specialist knowledgeable of perioperative care

would be appropriate. In general, most programs are headed by anesthesiologists or surgeons. Likewise, it is important to have some sort of infrastructure to be able to develop the programs effectively (at least examination rooms for office visits, equipment and space for exercise).

- 2 Modularity and flexibility of programs: A single prehabilitation program does not work for all patients. The design of different adapted programs in the form of complementary modules can facilitate their being adjusted for each patient, thereby improving their effectiveness. Although the ideal duration of the program has not been established, it has been shown that an intervention of 3–4 weeks could be sufficient to increase functional capacity.³⁰ However, patients who are malnourished, sarcopenic, or very frail may need more time. In our opinion, the characteristics and duration of the intervention should be based on individual clinical needs and adapted to the objectives set and results expected, rather than to fixed time periods.
- 3 Patient cooperation: It is essential to involve both patients and their families to encourage participation and commitment to the program. Surgical patients are presumably more likely to comply with the program than, for example, patients with chronic lung disease, of which less than 2% of eligible cases participate in prehabilitation programs.³¹ The preoperative period has been described as a window of opportunity in which patients facing a life-threatening event can be persuaded to adopt lifestyle changes that will improve their postoperative outcome. In our experience, although patients are initially enthusiastic about participating, the dropout rate can be improved.²⁶ For this reason, it is necessary to identify the factors that determine patient compliance to redefine the program and optimize results. The need for a caregiver and travel can cause difficulties for attending scheduled sessions. Ferreira et al identified them as the main barriers to participation in these programs.³² In this context, it is highly recommended to monitor patient experience and satisfaction levels. Focus groups can help guide the implementation process.
- 4 Transference to the community, monitoring and use of digital tools: The capacity of the program is limited and cannot cover all potential candidates. However, recent studies have shown that simple interventions removed from the hospital context are capable of achieving increased aerobic capacity through greater daily physical activity,³³ although successful implementation depends largely on patient motivation. Therefore, at least a minimum of monitoring is necessary in an environment that facilitates patient compliance and its sustainability over time. Partial transfer of the program to the community, by transferring the training to sports centers or to the patient's own home environment would help provide prehabilitation to all potential candidates without overloading hospital facilities, while also saving costs. The use of digital tools to reinforce patient empowerment, monitor activity remotely, promote interaction between patients and healthcare professionals, and reinforce/encourage the acquisition of healthy lifestyle habits seems to be a fundamental requirement for the generalized use of the program. It is important to establish a collaboration network with other health services and with

technology and innovation companies that can contribute to the development of the program. In this context, during the concession process of a competitive European project (PapriKa),³⁴ our group generated a spin-off (Health-Circuit) to support a prehabilitation service (www.surgifit.es), among others. The mobile application tracks patients' daily steps, provides texting capabilities to send motivational messages, and allows patients to access educational materials.³⁵ Our platform has recently been recognized by the Organization for Economic Cooperation and Development (OECD) as a good clinical practice that can strengthen public health systems.³⁶

- 5 Continuous evaluation: Internal audits within the unit and periodic evaluations of the results are necessary measures for the continued improvement of prehabilitation programs and to ensure the quality of care.

Our upcoming challenges are, firstly, standardization of the programs based on models that estimate individualized surgical risk, and secondly, the identification of factors that determine the response to prehabilitation so we can focus our efforts on those patients most likely to improve their prognosis.

After 10 years of both clinical and experimental experience preparing patients to face surgeries with greater safety, we hope that the path taken by our Prehabilitation Unit, together with the scientific evidence generated, paves the way for future or existing Prehabilitation Units in Spain. The scientific evidence available today should be enough to demolish barriers that we have already managed to overcome, and not without great effort.

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Conflict of interests

The authors declare no conflict of interest.

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