

## HEART-M A MNEMONIC: FOR SURGICAL PREHABILITATION

Juliana de Carvalho Machado, MD, PhD\*<sup>1</sup>, Júlio Sergio Marchini, MD, PhD<sup>2</sup>, Erlon de Ávila Carvalho, MD, PhD<sup>3</sup>, Guilherme Teixeira Araújo, MD<sup>4</sup>, Melina Gouveia Castro, MD, PhD<sup>5</sup>, Paula Grisolia Soares Carvalho, MD<sup>1</sup>, Guilherme Giorelli, MD, MS<sup>5</sup> and Diogo Oliveira Toledo, MD, PhD<sup>5</sup>

<sup>1</sup>Hospital Governador Israel Pinheiro/Instituto da Previdência do Servidor do Estado de Minas Gerais, Belo Horizonte, MG, Brazil.

<sup>2</sup>Hospital das Clínicas da Faculdade de Medicina de Ribeirão Preto da Universidade de São Paulo, Ribeirão Preto, SP, Brazil.

<sup>3</sup>Instituto Mário Penna /Hospital Luxemburgo, Belo Horizonte, MG; Hospital das Clínicas da Universidade Federal de Minas Gerais, Belo Horizonte, MG.

<sup>4</sup>Núcleo de Terapia Nutricional Enteral e Parenteral, Brasília, DF, Brazil.

<sup>5</sup>Hospital Israelita Albert Einstein, São Paulo, SP, Brazil.

Received date: 11 June 2022

Revised date: 01 July 2022

Accepted date: 21 July 2022

\*Corresponding Author: Juliana de Carvalho Machado, MD, PhD

Hospital Governador Israel Pinheiro/Instituto da Previdência do Servidor do Estado de Minas Gerais, Belo Horizonte, MG, Brazil.

### ABSTRACT

Surgical prehabilitation aims to prepare the patient to fight the morbid stress before the surgical procedure. It is a multimodal strategy that includes health optimization, nutritional support prescription, alcohol and smoking cessation, stress relief, strength and aerobics training and a multidisciplinary team follow-up. HEART-M is the mnemonic that supports this strategy and alerts health teams about steps that must be followed and that may lead to a better outcome and a faster recovery for patients who need a major surgeries

**KEYWORDS:** Surgical Prehabilitation, Lifestyle, Nutritional Support, Multidisciplinary Team.

### INTRODUCTION AND MNEMONIC PROPOSAL

Surgical prehabilitation is a relevant matter widely discussed in the last five years. During this period, approximately 550 articles were published at PubMed database, considering review papers, systematic reviews, meta-analyses, randomized trials, and non-randomized ones. This pre-habilitation is recommended and useful for a wide range of surgical patients: head and neck,<sup>[1]</sup> thoracic,<sup>[2]</sup> cardiac,<sup>[3]</sup> abdominal surgery,<sup>[4]</sup> gynecological,<sup>[5]</sup> urological,<sup>[6]</sup> coloproctology,<sup>[7]</sup> neurologic,<sup>[8]</sup> and orthopedics.<sup>[9]</sup> The objective of this review article is to propose a Bundles to a multimodal care of surgical pre-habilitation, using the mnemonic HEART-M (Figure 1 and Figure 2).

Therefore, the present paper discusses each item of the proposal mnemonic, figure 1, according to the clinical evidence and recommendations, to contribute to dissemination of the multimodal care which may reduce hospital costs and an improvement of clinical outcomes of patient that will undergo a major surgery and for sure a better compliance.

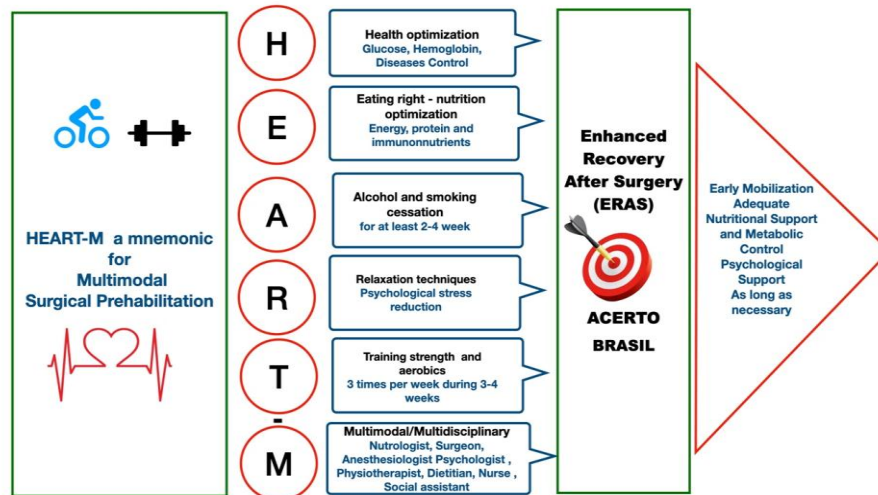


Figure 1: Mnemonic HEART-M a Multimodal approach for Surgical Prehabilitation for a better ERAS/ACERTO outcome.

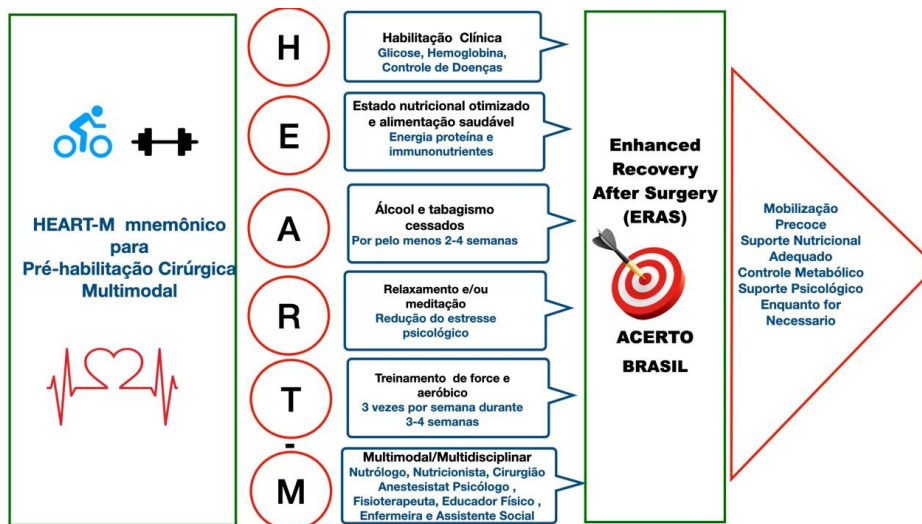


Figure 2: Portuguese version for Mnemonic HEART-M a Multimodal approach for Surgical Prehabilitation for a better ERAS/ACERTO outcome.

**Health Optimization**

Surgical trauma induces a stress response that increases oxygen consumption, mobilizes energy reserves, and promotes protein catabolism, resulting in loss of skeletal muscle<sup>10</sup>. Even without perioperative complications, surgical stress is associated with a decrease in functional capacity, a fact that can be aggravated in patients at healthy/nutritional risk, or malnourished and frail elderly and might represent an obstacle to swift “back to-baseline” to full functional capacity.<sup>[10,11]</sup>

Many morbidities combine “loss of flesh and strength” and are related to poor outcome. Most predictors of poor operative outcomes are due to impaired physiologic reserve: e.g. the tetrad of preoperative fitness (impaired exercise tolerance, malnutrition, sarcopenia, and frailty)<sup>[12]</sup> All these factors, independently, alone, or together, predict poor postoperative outcomes. Besides, the presence of one of them increases the likelihood of

the development of another one. Nevertheless, all tetrad of preoperative fitness are potentially modifiable and may improve in patient outcomes if prehabilitation applied.<sup>[12]</sup>

Prehabilitation can represent a stimulus for lifestyle improvement. In addition to promoting a model of care “towards a proactive approach that allows patients to become active participants in self-care”, improving their physical healthy before injury or surgery.<sup>[13,14]</sup>

Healthy lifestyle habits include regular daily water intake, whole grains, vegetables, legumes, olive oil, seeds, nuts, fruits, low-fat milk and dairy products, fish and seafood, and less frequent consumption of sweets, potatoes and red meat.<sup>[15]</sup> A moderate consumption of alcohol is also may be allowed (5-15 grams/day for women and 5-30grams/day for men).<sup>[15,16]</sup> In other words, the consumption of fresh or minimally processed

products should be encouraged and ultra-processed and processed products avoided.<sup>[15,16]</sup> Improvements in diet quality reduce the risk of chronic diseases such as diabetes mellitus, cardiovascular disease, obesity, cancer and promote healthy aging. Clinical management of these diseases can also be made with diet counseling.<sup>[15-17]</sup>

In diabetics patients a better glucose control is mandatory and glycated hemoglobin must be less than 6%.<sup>[5]</sup> Hyperglycemia is known to increase risk of cardiovascular disease, stroke, renal failure, poor wound healing and cause a proinflammatory state that might compromise immunity.<sup>[18]</sup>

Pharmacological approaches must be a strategy in the management of chronic disease as hypertension, chronic pulmonary obstructive disease and chronic heart disease.<sup>[5]</sup> Patients with basal hemoglobin < 11g/dL should receive iron replacement in order to improve oxygenation.<sup>[5]</sup>

#### **Eat Right: Nutritional optimization**

Malnutrition, which can result in cachexia and sarcopenia, is prevalent in surgical patients and even more frequent in elderly and oncologic ones. A malnourished patient is three times more likely to experience perioperative morbidity, five times more likely to die, have an increased hospitalization and higher costs associated with inpatient stays than a well-nourished patient.<sup>[19,20]</sup>

Screening, assessment, and management of malnutrition are major steps/approaches to cost reductions. Although many societies recommend them, only one out of five hospitals have formal nutrition screening processes, and a similar proportion of patients receive preoperative nutritional support. For every US\$ 1 spent on nutritional support/therapy, savings of US\$ 52 in hospital costs have been estimated.<sup>[21]</sup>

Screening can be made by any health care professionals using some validated tools: The Nutrition Risk Screening 2002, the Malnutrition Universal Screening Tool, the Perioperative Nutrition Screening Score (Figure 03) and the GLIM criteria are commonly used worldwide to identify patients who are at risk or malnourished.<sup>[21-23]</sup>

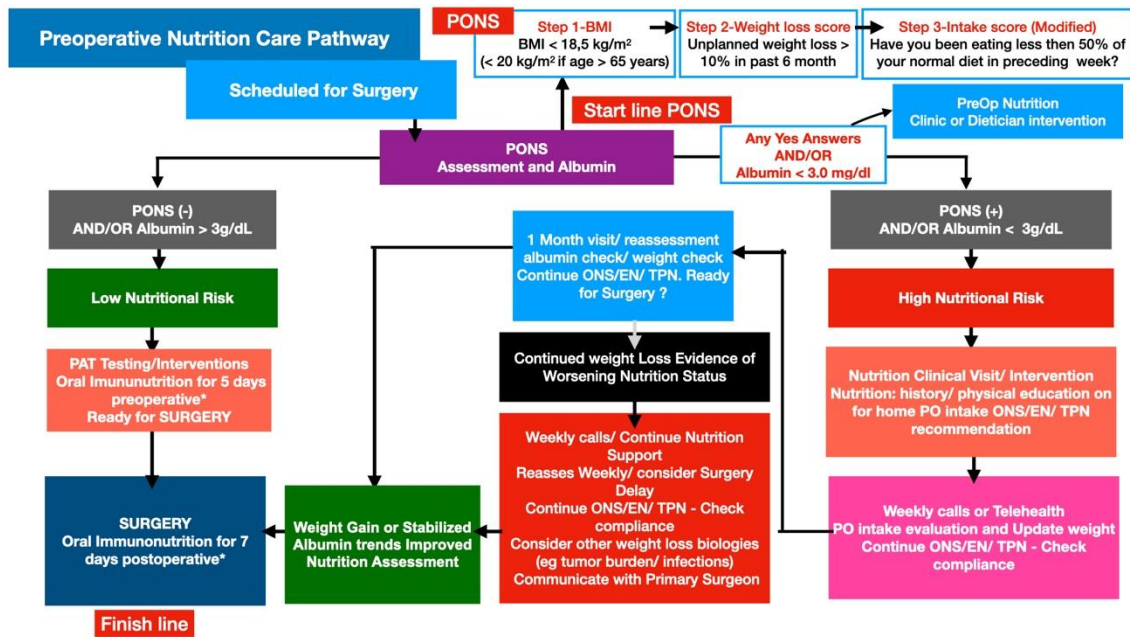
The next step is beginning the appropriate nutritional intervention (Figure 03)<sup>[21]</sup> Preoperative nutritional optimization aims at addressing the following goals: nutrient storage and metabolic reserve optimization, trauma-induced catabolism buffering, immune response enhancement and a nutrition strategy for the perioperative period.<sup>[23]</sup> Rapidly, requirements can be estimated around 25-30 kcal/kg/d and protein needs around 1.5 g/kg ideal body weight.<sup>[19,24]</sup> Some patients may require 30-35 kcal/kg/d (e.g., oncologic patients with cachexia or with undernutrition)<sup>[25]</sup>

If oral nutritional intake plus oral nutritional supplementation is unable to meet the malnourished patients' requirement, enteral nutrition (EN) is recommended and preferred to parenteral nutrition (PN). If the enteral route is contraindicated, PN must be prescribed at least for 7 to 14 days, mainly in those at risk or malnourished.<sup>[19]</sup>

Pre- or perioperative intake of Oral Nutritional Supplements (3x250 ml) enriched with immunomodulating substrates (arginine, omega-3 fatty acids, and nucleotides) for 5 to 6 days reduces postoperative morbidity and length of stay after major abdominal cancer surgery, mainly if the patient is undernourished.<sup>[19,24]</sup>

The use of carbohydrate-rich drinks (hypo-osmolar 12.5%) in the 24 hours before surgery, 800 ml the night before, and 400 ml 2 hours before surgery is also recommended. This approach does not increase the risk of aspiration,<sup>[19,26]</sup> addresses some of the immediate metabolic requirements of surgery and mitigates some of the risks of hypovolemia caused by preoperative starvation.<sup>[12]</sup>

Oral feeding must be started as soon as possible after surgery. Some studies have suggested better outcomes avoiding esophagogastric decompression or delaying oral intake even after cholecystectomy or colorectal resection. Early normal/regular food or EN, including clear liquids on the first or second postoperative day, does not impair the healing of intestinal anastomoses, and some clinical trials have proven it to be beneficial.<sup>[27-32]</sup>



**Figure 03: The Preoperative Nutrition Score (PONS score).** Preop, preoperative. Suggested low and high-risk nutrition pathways based on preoperative PONS scores. EN, enteral nutrition; ONS, oral nutritional supplementation; PAT, preanesthesia testing clinic; PO, by mouth; TPN, total parenteral nutrition. \*Mainly in oncologic patients or majors’ surgeries. Adapted from Wischmeyer, Anesth Analg 2017;126(6):1888<sup>21</sup>.

**Alcohol and Smoking cessation**

Smoking is a perioperative and postoperative risk factor as it increases cardiovascular, pulmonary and wound healing complications. Tobacco/cigarettes use must be assessed in all candidates for major surgery.<sup>[14,33]</sup> The level of nicotine dependence can be assessed with the Fagerström score, and all smokers should be offered cessation support, the best way is combining counselling and nicotine replacement.<sup>[14]</sup> Reduction in complications occurs when smoking cessation occurs 2 to 4 weeks before the procedure.<sup>[14]</sup> The cessation promotes the improvement of the tissue microenvironment, as the function of the anti-inflammatory cells is recovered after 4 weeks of smoking cessation.<sup>[14,33]</sup> Some authors report that nicotine dependence may be associated with increased sensitivity to pain and may consume a larger quantity of opioids after surgery.<sup>[34]</sup> Opioids abuse or requirement may increase incidence of ileus in major abdominal surgery.<sup>[34]</sup>

Excessive alcohol consumption can increase the risk of arrhythmias and subclinical heart failure, compromise immunity, increase bleeding time, and overstated neurohumoral response to surgery.<sup>[33]</sup> All surgical patients must have established weekly alcohol intake in units, patients with an intake of more 14 units per week, should go further assessment; AUDIT/AUDIT-C questionnaires maybe useful and must be applied in those with higher intake.<sup>[14]</sup> These patients may benefit with input from specialist alcohol services.<sup>[14]</sup> One study showed that interventions (behavioral counseling and medication) in those who consumes more than 50 alcohol units/week can reduce postoperative complications with

no effect on mortality or long-term postoperative alcohol consumption.<sup>[35]</sup>

**Relaxation techniques - reduction of psychological stress**

The relaxation response was first described by Dr Hebert and its benefits are seen when the technique is performed 15-20 minutes 1-2x/day.<sup>[36]</sup> It can promote well-being because it increments nitric oxide and reduces the heart and respiratory rates of blood pressure, as well as oxygen consumption.<sup>[36]</sup> The relaxation response is characterized by parasympathetic predominance with corresponding muscle relaxation, reduced heart rate and blood pressure, and improved mood and anxiety levels.<sup>[37]</sup>

Surgical stress causes the sympathetic nervous system’s activation, resulting in increased blood pressure and heart rate and lower skin temperature. High levels of stress can cause an increase in the serum level of cortisol, which can delay the onset of the inflammatory process and impair wound healing. Furthermore, stress can lower the pain threshold of surgical patients and reduce their pain tolerance. Although 77-98% of patients experience pain in the postoperative period, more than half report poor pain management.<sup>[38,39]</sup>

Anxiety is frequent during surgical procedures (40-76%), which is directly related to fear of an unknown environment, loss of control, death, or sequelae of the procedure.<sup>[40]</sup> While a moderate amount of anxiety is reasonable, its high levels can lead to arrhythmias and increased heart rate, blood pressure, and pain and thus prolong the postoperative period and delay recovery from surgery.<sup>[39]</sup>



Studies and a systematic review showed relaxation and meditation techniques were able to reduce patients' intensity of pain, anxiety levels and serum cortisol in the postoperative period compared to those in the control group.<sup>[39-31]</sup> The preoperative period may be considered an opportunity to identify and optimize medical conditions and a moment for teaching and alert patients to modify behaviors such as physical inactivity.<sup>[12]</sup>

Patients who are prone to undergo major surgery have stress regarding their underlying diagnosis and treatment.<sup>[14,33]</sup> Depression and anxiety are associated with worse functional status and a poor outcome in cardiac surgery. Psychologic counseling and psychotherapy are prone to promote to better patients' compliance to prehabilitation and must be included in Surgery Prehabilitation Programs.<sup>[14,33]</sup> Some authors suggest beginning 4 weeks before procedure and continue after surgery for about 8 weeks.<sup>[7]</sup>

**Training strength and aerobics**

The patients' functional reserve can be measured with cardiopulmonary exercise testing to assess both peak oxygen uptake (VO<sub>2</sub> peak) and the anaerobic threshold; although this requires equipment, personnel expertise and time.<sup>[42]</sup> In the preoperative setting, a 6-minute walk test may be applied and is validate for practical assessment.<sup>[33,43]</sup> Moreover, individual aerobic capacity determines preoperative functional reserve which, in turn, is negatively associated with post-operative morbidity.<sup>[12]</sup>

Muscular strength and aerobic training in major surgical patients have been shown to increase muscle strength, improve endurance and objective markers of physical fitness and in obese patients may reduce or prevent weight gain.<sup>[23]</sup> It's recommend starting it for at least three weeks before the surgery and have training sessions at least three times per week.<sup>[12]</sup> These efforts may be sufficient to obtain moderate gain in aerobic and muscle strength reserve: inspiratory muscle training, aerobic, and resistance exercise training.<sup>[12,23]</sup> All exercises prescription must be individualized, and in order to obtain a training effect, the physiologic stress must be higher than usual for the patient.<sup>[12]</sup> These strategies may decrease the incidence of postoperative complications in patients undergoing intra-abdominal surgery.<sup>[23]</sup>

Postoperative complications prolong the length of hospital stay, increase costs, increase readmissions, and impair "back-to-baseline" recovery.<sup>[23]</sup> Promoting prehabilitation surgery programs may reduce postoperative complications and may cause a faster back-to-baseline recovery, which means an ability to return to a pre-illness level of activity, fitness, and quality of life.<sup>[12,23]</sup>

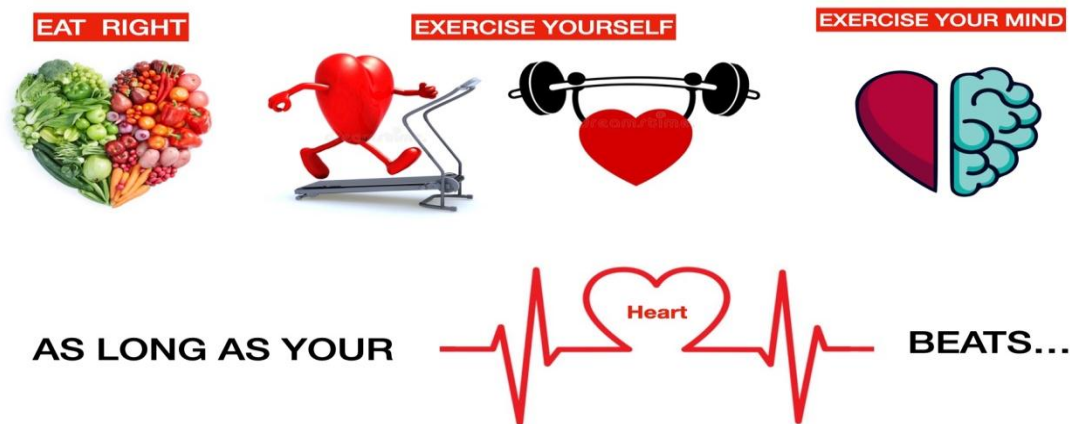
Exercise prescriptions must be combined with nutritional support, mainly in those who are at nutritional risk (Table 01). Protein supplementation in the preoperative period can maintain or support increases in lean body mass, ameliorating physical frailty and supporting the efficacy of other interventions.<sup>[23]</sup>

**Table 01: Physical intervention recommended according to Vo<sub>2</sub>max in the prehabilitation program.**<sup>[5,36]</sup>

Group (Vo <sub>2</sub> max)	Aerobic exercise* (Improve aerobic capacity)	Strength exercise* (Develop lean muscle mass)	Flexibility exercise	IMT exercise	Relaxation
<b>Mild</b> <12mL/kg/min	High-intensity interval walking of 6min (objective >5000 steps/day) <b>DAILY</b>	Wall push-ups 10x1, chair squats 10x1, chair abdominals 10x1 <b>At least 2-3x/wk</b>	Lateral and frontal arms movement 10x1 <b>At least 2-3x/wk</b>	Inspiratory threshold-loading device 10'8 hours <b>DAILY</b>	15-20 min 1-2x/day Guided <b>DAILY</b>
<b>Moderate</b> ≥ 12-14mL/kg/min	Walking of 6min rounds at highest effort objective >7500 steps/day) <b>DAILY</b>	Wall push-ups 10x2, chair squats 10x2, chair abdominals 10x2 <b>At least 2-3x/wk</b>	Lateral and frontal arms movement 10x2 <b>At least 2-3x/wk</b>	Inspiratory threshold-loading device 10'8 hours <b>DAILY</b>	15-20 min 1-2x/day Guided <b>DAILY</b>
<b>Intense</b> >14mL/kg/min	Walking of 6min rounds at highest effort (objective >10000 steps/day) <b>DAILY</b>	Wall push-ups 15x3, chair squats 15x3, chair abdominals 15x3or elastic band <b>At least 2-3x/wk</b>	Lateral and frontal arms movement 15x3 <b>At least 2-3x/wk</b>	Inspiratory threshold-loading device 10'8 hours <b>DAILY</b>	15-20 min 1-2x/day Guided <b>DAILY</b>

**IMT:** Inspiratory muscle training -develop muscle of respiration and reduce risk of perioperative pulmonary complications. **ARISCAT score** can be used to assess patient risk. Those whom most benefits are intermediate and high-risk patients.<sup>[14]</sup>

**Vo<sub>2</sub>max:** maximum oxygen consumption  
 \* Patients who practice 150 minutes of moderate intensity per week or 75 minutes vigorous intense exercise per week **plus** muscle strengthening exercise 2 or more days per week can continue usual physical activity.<sup>[14]</sup>



**Figure 04: Heathy habits must be followed during whole life and includes: physical activity, social interaction, adequate rest (sleep), relaxation. Daily hydration, whole grains, fruits, vegetables, legumes, olive oils, nuts, seeds, option daily fish and seafood, low-fat dairy. Eat more unprocessed or minimally processed foods and less ultra-processed or processed ones.**

#### **Multimodal - multidisciplinary team**

In recent years, surgical prehabilitation has promoted reductions in postoperative complications, earlier rehabilitation, return to “back to-baseline” and recovery of functional capacity and reduction in hospital costs.<sup>[4,43,44]</sup>

Surgical prehabilitation has better outcomes when performed in a multimodal way by multidisciplinary teams that, integrated, can offer better support for the patient at risk who will undergo a major surgical procedure.<sup>[4,44]</sup>

Recently, Gillis et al. showed that a trimodal prehabilitation intervention (exercises, nutrition and anxiety-reduction elements), in colon rectal patients attenuated the post-surgical lean body mass (LBM) and might have a positive impact on the cancer care course.<sup>[7]</sup>

Minella et al. showed that a bimodal intervention (exercise and nutrition) in patients undergoing esophago-gastric cancer resection was able to improve functional capacity. The prehabilitation group, compared to control group, had improved functional capacity both before surgery and after surgery, applying 6MWD.<sup>[45]</sup>

Barberan-Garcia et al. assessed the impact of personalized prehabilitation on postoperative complications in high-risk patients undergoing elective major abdominal surgery. It was a randomized blinded controlled trial. Intervention included motivational interview, personalized program to promote daily physical activity and a supervised high-intensity endurance exercise training program. Both groups had nutritional counseling, and advice on smoking cessation and reduction of alcohol intake. The incidence of complications in the overall sample of patients was 46%. When stratifying by groups, the intervention group

showed a lower rate of complications, 31% versus 62%, than the control group ( $P = 0.001$ ).<sup>[46]</sup>

#### **CONCLUSION**

Surgical Prehabilitation allows clinical improvement of patients’ Health, adequate nutritional support (**Eat right**), Alcohol and Smoking cessation, stress relief (**Relaxation**) and physical exercise (**Training**). Better results are obtained when Multimodal programs are implemented supported by multidisciplinary team: **HEART-M**. It is important that patients who underwent to prehabilitation programs, understand that after recovery they must continue applying HEART-M as long as HEART beats (Figure 04).

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