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Review Article

Multi-Therapy Preoperative Preparation Program for Cardiothoracic and Major Surgery (MPMS)

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Summary

This article proposal outlines a multidisciplinary Multi-therapy Preoperative Preparation Program for Major Surgery (MPMS) designed for vulnerable, high-risk patients undergoing major elective procedures including cardiac and thoracic surgery. It aims to reduce postoperative complications, ICU and ward length of stay, infections, and healthcare costs, while improving recovery time, survival, quality of life and overall patient experience.

MPMS is a structured, patient-centred prehabilitation pathway that integrates anaesthesiology/intensive care review, comprehensive nutritional assessment and support, psychological optimisation (including anxiety, depression, smoking and alcohol interventions), and targeted physiotherapy-based prehabilitation. It uses frailty and nutritional screening to select candidates, focuses on modifiable risk factors, and embeds robust outcome measurement (clinical events, length of stay, days at home, and patient-reported outcomes) supported by a smartphone application, aligning with contemporary value-based perioperative care models.

Introduction

The complications after cardiac, thoracic and other major surgery are widespread causes of admission in intensive care medicine, hospital acquired pneumonia, pulmonary atelectasis, re-do procedures, intrahospital infections, and postoperative morbidity and mortality factors. They increase dramatically the cost of care and affecting the quality of life and functional capacity outcome of our patients. This is particularly more severe in the high-risk patients with previous major procedures or major pathologies. Postoperative complications are a heavy factor for both the healthcare system and the individual patient and are associated with inferior outcomes and higher healthcare costs. In the United States, a study had a total of 5,880,829 patients undergoing major surgery were included. Particularly the incidence rates of four complications were found to be decreasing: superficial SSI (1.9 to 1.3%), deep SSI (0.6 to 0.4%), urinary tract infection (1.6 to 1.2%), and patient unplanned return to the operating room (3.1 to 2.7%).

When adjusted, regression analyses indicated decreased odds ratios (OR) through the study period years for particularly deep SSI OR 0.92 [0.92–0.93], superficial SSI OR 0.94 [0.94–0.94] and acute renal failure OR 0.96 [0.95–0.96] as the predictor variable (study year) increased ($p < 0.01$). However, OR's for organ/space SSI 1.05 [1.05–1.06], myocardial infarction 1.01 [1.01–1.02] and sepsis 1.01 [1.01–1.02] increased slightly over time (all $p < 0.01$). (1)

The overall outcome of the patient after the procedure is determined by the correct undertaking of the surgical procedure and also by preoperative conditioning and postoperative care. Preoperative preparation decreases the surgical stress response and increases the preparedness of the patient to undergo a planned surgical procedure. Preoperatively structured inspiratory muscle exercises, cardiopulmonary fitness program, and planned exercise program for muscles of limbs, back, abdomen, head, and neck allow an overall upliftment of the physiological capacity of the patient to better cope with the surgical stress. Optimization of dietary status by macronutrients, micronutrients, and protein optimizes the recovery and shortens the overall hospital stay. Preparing patients for the scheduled surgery and alcohol and smoking cessation programs bust the patient's mental health boost the healing process and decrease the risk of mental diseases in the ICU like delirium and depression. This program few weeks before surgery is equally beneficial compared to enhancing operative procedures and postsurgical care. (2).

Along the intrahospital attention many safety and quality measures had been systematically implemented along the last 50 years and the preoperative evaluation is performed rutinary to identify the high-risk patients with good results, however still many patients have still severe complications and complications despite our best efforts even in the best high quality health care systems.

In all the western world does not exist a complete systematic preoperative multidisciplinary program involving psychology, physiotherapy, nutrition, anaesthesiology and internal medicine to prepare patients with high risk for cardiothoracic and major surgery. The idea is to design this program to optimize the clinical condition of our patients increasing the possibility of survival and decrease complications, morbidity and mortality optimizing life quality after the procedure.

Objectives of the Program

1. Reduce the morbidity, mortality, and potential complications after cardiothoracic and major surgery.

2. Reduce the time of recovery after major surgery for high-risk patients

3. Reduce the incidence of post-surgical infections.

4. Create a more pleasant and safe experience for our patients in the hospital.

5. Reduce the cost of health care for the insurance companies and public hospitals.

6. Follow the recovery and quality of life in the short term and middle term after major surgery in high-risk patients to measure the impact of our program.

7. Create and design a new product for our hospital increasing rentability and adding value as a leader in the sector.

8. Reduce ICU and ward time after major surgery.

Definition of Multi-Therapy Preoperative Preparation Program for Multiple Pathology for Major Surgery (MPMS)

MPMS is a tactic of enhancing the general health and well-being of the patient preoperatively to modify the probable risk factors thus uplifting the physiological reserve and decreasing the adverse stress response.

Though surgical interventions are indicated for the cure or palliation of various diseases, the surgery itself acts as an aggressive and stressful event and thus has a deep impact on performance and quality of life postoperatively. Despite our advancements in anaesthesiology, surgery, intensive care medicine, and perioperative care, many patients don't achieve functional and physiological recoveries. Different research on adjustable risk factors has identified some protective elements for surgical complications and postoperative recovery, which include good physical fitness, functional reserve, absence of risk habits, weight, and a good level of nutrition. These preoperative factors are vital to counter the expected stress linked with surgery.

The MPMS should be patient-centred and should emphasize factors like the type of surgery, the current state of health, and the patient's pathologies. The MPMS combines a multifactorial and interdisciplinary methodology. All the patients should be tactically primed for major surgeries as the preoperative period is the vital link to ultimate treatment methods and avoidance of adjustable risk factors. For this purpose, creating reproducible approaches and describing homogenous outcome breakdown tools strengthen the base for the program.

Assesment of Risk Factocr for MPMS

Frailty assessment measures an old patient's strength, energy, cognition, health status, functional waning, and its impact on daily activities should be selected to guide the MPMS. The Canadian study of Health and Ageing Frailty Index (CSHA-FI) has been endorsed in the geriatric population to predict the risk of death and prolonged admission. It is a judgment-based 9-point scale tool to monitor frailty and stratify degrees of fitness and frailty and could be a good option. It condenses information from a clinical meeting with an elder patient and roughly quantifies the patient's overall health status. The second context for defining frailty is contemplating frailty as a build-up of deficits through functional, physical, reasoning, and social measures. Various tools are developed to derive a cumulative score from factors such as nutrition, comorbidities, functional status, disability, and mental health. We have to select the optimal tool for this assessment.(7).

Criteria of admission for MPMS

- One criteria.
- American Society Anaesthesia score >3
- Ischaemic Heart Disease
- Arrhythmia and Chronic AF
- COPD
- Liver failure
- Renal failure
- Previous mayor Surgery
- Type 1 Diabetes mellitus
- Type 2 Diabetes mellitus

- Patients after or during Cancer therapies
- Previous Intensive Care Unit admission care superior 3 days – organ multi failure / sepsis.
- Low BMI with sarcopenia – Nutrition pathology
- Morbid Obesity
- Older than 75 years old.
- Heavy smokers and heavy drinkers.
- Psychiatric past medical conditions.

Surgical procedures with a requirement of MPMS

- Transplant surgery of any organ
- Hip, Knee, ankle, shoulder replacement
- Major Oncologic surgery
- Thoracic Surgery
- Cardiovascular Surgery
- Neurosurgery
- Major Vascular Surgery
- Bariatric Surgery

MPMS activities

Multi-Therapy Preoperative Preparation Program

The complete assessment of our high-risk patients involved a deep medical review, a complete individualized laboratories and tests according to anaesthesiology guides and the identification of the major risks requiring intervention.

The professionals involved are the anaesthesiologist or ICU specialist in case the patient case will need ICU, a physiotherapist trained in post-surgical major patient's management, a hospital dietitian and a clinical psychologist. All these professionals combined can get a complete picture of the patients' condition and define a strategy to implement previous to the procedure.

The team should define the personalised plan to implement in the previous 15 days and verify its full implementation.

1. Anaesthesiology and ICU Review

2. Nutrition Assessment and Nutraceutical supplementation.

3. Psychologic assessment

4. Physiotherapy assessment

5. Physiotherapy sessions 7

1. Anaesthesiology and ICU Review:

Define the anaesthetic risk, and strategy and explain to our patient's pain management and possible ICU care with its stress factors, inform about blood tests. Identify possible target points for psychology, Physiotherapy, and Nutrition. Discussed with the patient about the process and answering all doubts and questions increasing his/her commitment with physiotherapy, and oral intake.

2. Nutrition Assessment

Perioperative malnutrition is associated with greater morbidity and mortality and, even knowing this reality, up to 65% of patients who are going to undergo a major surgical intervention present criterion for malnutrition and two thirds of the patients undergoing surgery experience weight loss during the stay. There is a close relationship between malnutrition and the appearance of complications in patients. 33% of patients with pre-surgery weight loss of more than 20% died, compared to 3.5% of those with pre-surgery weight loss of less than 20%.(6).

Fifty years later, despite the advance in surgical and anaesthetic techniques, malnutrition prior to the intervention in patients with digestive tumors was associated with a higher rate of post-surgical complications (72 vs 29%) and mortality (23 vs 4%) compared to those who are normonourished.

Despite the great development of clinical nutrition in recent years and its contribution to routine medical practice, the practices of preoperative fasting and post-surgical digestive rest are currently still maintained in a large majority of hospital centers. Preoperative malnutrition in gastrointestinal surgery is caused in most cases by one of these 2 factors, tumour cachexia or decreased intake.(7).

Pre-surgery nutritional screening

In recent years, tools have been developed for the screening and diagnosis of malnutrition. Numerous studies have analyzed the relationship between preoperative nutritional status and risk of malnutrition and postoperative results and confirm that malnutrition associated with the disease is associated with greater morbidity and mortality and hospital stay. higher readmission rates and higher treatment costs compared to normonourished patients. From these conclusions, it can deduce the importance of having good tools for screening and diagnosing malnutrition.

Although it is known that malnutrition is not corrected in a short time and that postponing surgery allows a slight improvement in nutritional status, the scientific evidence compiled about pre-surgical nutrition especially in moderately or severely malnourished patients, has led to a series of recommendations in the ASPEN guidelines (American Association of Parenteral and Enteral Nutrition).

An assessment including weight, height, and waist circumference, body mass index, and body composition assessment are crucial elements in the evaluation of patients' nutritional status. Various studies have demarcated severe nutritional deficiency as per the European society for clinical nutrition and metabolism (ESPEN) guidelines: weight loss >10-15% in past 6 months, BMI <18.5 kg/m2, subjective global Assessment (SGA)= c, nutrition risk screening (NRS-2002) >5, or albumin <30 g/l.21 Nutrition that is anticipated to be less than one half of patient's daily dietary total must be augmented pre-operatively and continue post-operatively. If enteral means do not meet energy requirements, then parenteral nutrition can be applied. As such preoperative supplementation of 10 days has been shown to decrease complications. Other secondary methods of nutrition status involve the evaluation of strength and function and albumin levels in blood.

Malnutrition activate defensive mechanisms that decrease basal metabolic rate and weakens physical performance to preserve nutrient reserves. Using a standard etiquette to ascertain handgrip, gait speed, 6-min walk test, timed up and go, short physical performance battery, and 30-s sit-to-stand are other measures for assessing the physical fitness status of the patient. Other preoperative nutritional status assessment comprises poor oral intake, insufficient protein energy ingestion, compromised nutrient consumption, altered gut function, inadvertent loss of weight, and underweight. Various additional tools have been authorized for use on admitted patients, such as the malnutrition universal screening tool (MUST), short nutrition assessment questionnaire (SNAQ), and the malnutrition screening tool (MST) but there is no undisputed screening tool for use in the preoperative "at risk" surgical patients.

Supplementation with collagen dipeptides, whey protein, multivitamins, taurine, acetylcysteine, and other nutraceuticals can be the subject of new and further studies.

3. Psychologic Assessment

Although emotions and health were studied long before, since the Greek philosophers, it was not until the last century that they began to undertake research in this field. In recent years with more boom, greater experimentation has been done thanks to the incursion of Psychology. Health in the medical area. And it has been seen that psychological techniques have a benefit for patients in their coping with the disease, their postoperative recovery and also as an economic benefit. It is important to mention that

the concept of anxiety in the medical environment is defined as responses related to fear that originate in or an environment. In this regard, the most traumatic experiences are those related to hospitalization, procedures such as the insertion of intravenous needles, side effects of the treatment and possible isolation of the patient, thus affecting the individual physically and psychologically, in their work environment and/or school. Fear is not unknown to the medical and dental team, nurses, assistants, hygienists, who in turn play a very important role in reducing and managing this phenomenon of anxiety and stress. Therefore, it is important that the management of surgery requires interaction between surgeons, psychologists and patients, since with a correct pre-surgical treatment plan there will be better results if a negative emotion is adequately managed. In this way, in recent decades, research on the nature of anxiety and stress and their relationship with physical and mental health has multiplied, which has helped to better understand these phenomena in the face of illness, in addition to the design of programs. psychological intervention for some pathologies and their management. Likewise, psychological strengths and resources have been described as protective factors to overcome some health problems and medical surgical interventions.(47).

The trends in psychological preparation include different types of psychological intervention before surgeries, which have been increasing with multidisciplinary work and these have focused mainly on procedures such as heart surgery, oncological surgery and bariatric surgery.

Alcohol and tabacco:

Smoking is a recognized perioperative risk factor affecting up to one-quarter of surgical patients. Its effects on cardiac, respiratory, and immune function contribute to deteriorate the patient's postoperative outcome. Most of the people planning for surgery who have a presurgical history of smoking, asthma, chronic obstructive pulmonary disease, or other respiratory ailments, have all been related to a postoperative respiratory complication. Preoperative abstinence of 4-6 weeks of smoking results in a significant decline in postoperative complications.

Above two units daily, alcohol appears to aggravate the neuroendocrine response to surgery leading to dose-related perioperative complications. Perilous alcohol consumption affects around one-quarter of patients undergoing surgery. Thus, reducing consumption to within recommended limits lessens the occurrence of those complications. A risky drinking is defined as any alcohol ingestion of more than 3 alcohol units (AU)/day or 21 AU/week (with 1 AU equating to 12 grams of ethanol) with or without symptoms of alcohol abuse or dependency. For an intake of more than 2 to 3 AU/d (28 grams/unit per day), the postoperative complication rate is augmented by about one-half. The complication rate for patients drinking more than 5 AU/d is increased thrice.(7).

Stressors that affect diagnosis, surgical procedure, anaesthesia, pain, survival, and recovery, are all causes of worry and anxiety for the patient which finally affects postsurgical recovery in varied ways. Eventually, these preoperative stressors slow healing via innumerable psychological and immunological processes. Psychological factors like anxiety, depression, and poor self-esteem deteriorate physiological haemostasis and quality of life postoperatively. Hospital anxiety and depression scale (HADS) covers two subscales i.e., anxiety and depression, each having seven items and scored from 0 to 3. A score greater than 8 on each of these subscales indicates mood disorders. A comprehensive preoperative clinical review should also be emphasized when risk factors, such as smoking, diabetes mellitus, anaemia, and other comorbidities, can be controlled.(11).

4. Physiotherapy Assessment

Before performing an intervention, it is important to prepare the body in order to improve and accelerate the post-operative period. Pre-operative physiotherapy treatment aims to strengthen, mobilize, and

harmonize so that the patient arrives at the operation in optimal conditions. In this way, better muscle quality will be available and post-surgical recovery will be more effective and faster.

Studies show that if before undergoing surgery for a trauma injury, the affected area is worked on, it not only responds better to the intervention, but the recovery process is optimized. If patients who are going to undergo surgery have worked on the affected area so that it is in the best possible conditions and in this way facilitate the recovery process.

What is pre-surgical physiotherapy?

When surgery is necessary, we start working as soon as possible. With physiotherapy we can improve pain and quality of life until the intervention, applying pre-surgical physiotherapy, thus keeping the muscles and joints in good condition.

There are certain cases in which this type of surgical intervention is scheduled and therefore the Physiotherapist must give instructions to the patient to prepare them for said operation. This preparation will consist of performing a series of exercises one month before the intervention.(48).

Pre-surgical physiotherapy

It has long been known that patients who are in better physical condition before surgery tend to recover more quickly. However, only recently have doctors and physical therapists discovered how beneficial even a few physical therapy sessions can be before surgery. Patients don't have to be an athlete to benefit from some exercise before surgery, especially if the exercise is targeted to the patients' specific needs. A physical therapist is the perfect person to help you find and perform the right exercises before surgery.

Preparation prior to surgery helps to strengthen and make you more flexible, but it also helps you improve your mentality. Doing a little prep work for surgery allows you to feel more involved in the process. The exercises that physical therapist does in preparation before surgery will also be similar, if not the same, to the exercises patients will do after surgery, so it can train them when they are in good health. This training will make it easier to perform the exercises after surgery.

How does preoperative rehabilitation work?

The preoperative rehabilitation process is not complicated; the physical therapist will perform a thorough examination and design a series of exercises based on patient body and upcoming surgery. Patients will then do the exercises with their physical therapist and probably at home on their own. Ideally, they can perform several prehabilitation sessions before the surgical intervention.

FINANCIAL ASPECTS OF MPMS

TDABC Cost for the program:

MULTI-THERAPY PREOPERATIVE PREPARATION PROGRAM			
Price and time per case	Time min	Price euro	
Anaesthesiology Review	30	€	40.00
Nutrition Assesment	30	€	20.00
Psichologyc Assesment	30	€	20.00
Physiotherapist assesment	30	€	20.00
Physiotherapy sessions 7	140	€	105.00
Nutraceutical supplements (average price)		€	250.00
Total TDABC per case	260	€	455.00

Time for the design of the MPMS: 1 week

Team: Consultant Anaesthetist and ICU program director, physiotherapy director, dietitian director, and Clinical Psychologist.

The financial cost of week design: 6500 euro time value of professionals involved.

Financial Impact of MPMS

Post-surgery complications represent serious problems in the health care systems, moreover, the occupation of ICU and wards of these complicated patient blocks the rotation of new patients affecting productivity in theatres and increasing the use of resources in capitation contracts for public hospitals. This cost has not been calculated in Ireland. It would need to calculate the following index to make more precise the financial impact of MPMS

1. Financial calculation of high complexity hospital and ICU/bed occupation of surgical complications.

2. Financial calculation of surgery cancelled for hospital occupation.

3. Identification and financial average cost of complicated cases potentially evitable with the MPMS.

Imoact on Patient Satisfaction and Quality Improvement of the Program

Hospital Indicators:

It is necessary to do an assessment of all measures in the outcome of the patients. There are in this article some quality indicators that could be consider to implement the follow up and create a Plan - do -verify - adjust process in every area according to clinical diagnose and pathologies.

Cardiac Surgery:

- Acute complications of treatment (PCI & CABG)
- Acute renal failure: New requirement for dialysis
- AMI, haemorrhagic stroke, ischemic stroke or heart failure
- Stroke and stroke type Ischemic; haemorrhagic; unknown
- Deep sternal wound infection Requires operative intervention, positive culture & antibiotics

General indicators:

- Mortality post procedure Date of death Within index hospitalization + within
- 30 days of procedure All-cause mortality
- Date of death Tracked for 5 years after index event—reported at 1- and 5-years admissions.
- Date of each admission & discharge. Length of Stay.
- Mortality post procedure Date of death Within index hospitalization + within 30 days of procedure
- Prolonged ventilation Mechanical ventilation >24 h post-surgery

- Reoperation required Return to operating theatre (for other than wound)
- Intensive care unit and hospital length of stay

Patient- reported follow up Indicators in the next 5 years:

Health status (All), Angina, dyspnea, depression, functional status, health-related quality of life SAQ-7, PHQ-2.

Quality of life: measured by the Short Form 36 version 2 (SF-36v2®, Australian English) [35] at baseline (4-8 weeks preoperative), within the week before surgery, discharge day, and 3 months postoperative.

Postoperative morbidity: Further investigations on postoperative morbidity will be conducted as a secondary outcome measure:

Days at home within first 30 days after surgery (DAH-30): DAH-30 is a composite measure that accounts for the length of stay in the hospital following index surgery (Day 0), readmission to either the index or any other hospital, hospital discharge to a rehabilitation center/hospital or nursing facility, and early deaths after surgery within a single metric. DAH-30 (number, value between 0 and 30) will be calculated using mortality and hospitalization data from the date of the index surgery (day 0). For example, if a patient dies on postoperative day three, they will be assigned 0 for DAH-30. If a patient is discharged from the hospital on day six after surgery but is subsequently readmitted for 4 days before their second hospital discharge, the patient will be assigned 20 (=30-6-4) DAH-30. If a patient has complications and spends 16 days in the hospital, then is transferred to a nursing facility for rehabilitation, and spends 24 days there before finally being discharged to their own home, the patient would be assigned 0 (30-16-24 = − 10, set to 0) for DAH-30. If a patient dies within 30 days of surgery, irrespective of whether the patient has spent some time at home, DAH-30 will be scored as zero (0) [40, 41].

Health resource use (costs) and productivity losses: Information on patient out-of-pocket and health system resource use (in Euro), including the cost of the exercise intervention, will be collected (via follow-up questionnaires) from randomization up to 3 months postoperative [11]. Information about the impact of the intervention and surgery on return to work and leisure activities will be used to inform productivity losses.

Duke Activity Status Index (DASI): functional capacity will be measured at baseline and within a week before surgery. The DASI is a 12-item scale in the form of a self-reported questionnaire. The final score ranges from 0 to 58, where a higher score indicates higher functional capacity [43].

Self-reported physical activity: Self-reported physical activity will be measured at baseline, within a week before surgery, and postoperatively on discharge day and after 3 months using an application on the patient's phone.

Satisfaction: Patient satisfaction of the intervention will be measured at the follow-up visit within 1 week before surgery using a self-reported questionnaire using an application on the patient's phone.

Fatigue: Fatigue will be measured using the Fatigue Severity Scale at baseline, within 1 week before surgery, and postoperatively every week using an application on the patient's phone.

Treatment and Health Services: The use of treatment and health services will be collected (via follow-up questionnaire using an application on the patient's phone) up to 3 months after surgery for the cost-effectiveness analysis. This would include information about treatments (physiotherapy, etc.), diagnostic imaging, visiting GP/specialist clinics, emergency department visits, and hospital readmissions.

MPMS in Strategy and Values with the Hospital undertaking the program:

The MPMS could be a crucial tool of aggregated value keeping in mind the potential benefit for the patients, the decrease of health care cost, and the follow-up of the quality. There is no other complete integrated program of these characteristics that helping to achieve the exceptional patient care goal. Committed to ensuring the best possible outcomes for all their patients by empowering our team of experts with the resources they need.

The MPMS will increase the communication with our high-risk patients and between the members of the team and will provide powerful tools of feedback as well. Patients will be treated with the utmost dignity and respect at all times.

The MPMS will be a powerful tool to recognise and individualise health care practice giving us a very precise perspective of every high-risk patient.

Conclusion and Reflection

The multidisciplinary approach in medicine is the best way to provide excellent health care; this is particularly true in high-risk patients on major surgery having in mind the potential complications of these major procedures and the heavy stress they have to suffer along all the process despite our best efforts and care.

The preoperative medicine is not fully integrated in one team approach in the majority of health care centres. The article is aimed to offer a tool able to focus and coordinate the efforts of all team members to prepare physically and mentally patients to pass through surgery and rehabilitation in the best possible conditions, increasing the probabilities of success and making the recovery as fast as possible.

With a low-cost investment in this program, the combination of team members skills and the use of a simple smartphone application, it could be achieved a complete preparation for vulnerable patients with a complete feedback from every kind of post-surgical procedure, making simple and precise follow-up and customizing the tool for every type of surgery and risk.

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