

# Benefits of Preoperative Exercise Therapy in Surgical Care; it Does Work, but how do we Need to Continue?



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## Opinion

Preoperative physical function is shown to be an independent predictor of post-operative morbidity and mortality [1-3]. Surgical stress often leads to a substantial decrease in physical functioning through different pathways. In addition, prolonged periods of physical inactivity in the postoperative phase induces loss of muscle mass, cardiopulmonary deconditioning, pulmonary complications and psychological distress. These phenomena may result in a decreased quality of life postoperatively, increased morbidity and occasionally premature death [4-7].

In terms of cancer, most forms are prevalent in an elderly population that mainly unfit to undergo major surgery. Lung cancer for instance is one of the leading causes of cancer death worldwide [8]. It is frequently diagnosed at a late stage due to its initial asymptomatic course often leading to a poor prognosis. Surgical removal remains the best [curative] option for patients with stage I and II Non Small Cell Lung Cancer [NSCLC] and for selected patients with locally advanced disease [stage IIIA] [9]. However most patients selected for surgical removal have limited functional capacity, owing to associated comorbidities and/or the stage of the disease [10]. As preoperative physical capacity predicts postoperative recovery, especially in elderly patients, a substantial body of research is directed towards studying the effects of various regimens of Preoperative Exercise Therapy (PET) [11-14]. A number of postoperative outcome measures such as complication rate, length of hospital stay and time of convalescence were previously reviewed [15-17]. However, based on these reviews univocal conclusions cannot be obtained, in terms that PET is able to significantly reduce postoperative complications. PET has been identified as a successful therapy to improve overall physical and psychological

well being in some cancer populations [mainly breast cancer] [18]. There is increasing evidence in the field of lung surgery [19-21] and also in other surgical specialties [15,17,22] that a preoperative exercise therapy (PET) program has beneficial effects on the postoperative course, especially on the prevention of postoperative complications, the length of hospital admission, physical fitness and quality of life. With such an increasing body of evidence, why aren't we able to further implement these PET programs in our daily practice? This review will address several aspects.

## Definitions of exercise physiological variables

In exercise physiology different terms are used to describe and measure the effect of a PET program. For describing those effects two different terms are often used, physical activity and physical fitness [23]. Physical activity is defined as any bodily movement produced by skeletal muscles, which results in energy expenditure, which can be measured in kilojoules (kJ) or kilocalories (kcal) [23]. Physical capacity/fitness or 'being physically fit' is defined as: 'the ability to carry out daily tasks with vigour and alertness, without undue fatigue and with ample energy to enjoy leisure-time pursuits and to meet unforeseen emergencies [23]. For measuring the effect of PET programs, the most widely used parameters are ventilatory threshold and  $VO_2$  peak [24].  $VO_2$  peak is defined as the highest value of  $VO_2$  attained at a maximal incremental exercise test [24]. The ventilatory threshold is the point during exercise at which pulmonary ventilation becomes disproportionately high with respect to the oxygen consumption. This point is believed to be the onset of usage of the anaerobic pathway (anaerobic threshold) [24].

## Implementing problems

There is promising evidence for the effect of PET, but currently there are three problems when appraising the studies performed: 1) heterogeneous patient populations; 2) non-comparable PET programs and 3) lack of guidelines for the use of PET programs and reported outcome measures. The heterogeneity of PET programs makes comparisons difficult and according to several studies [15,25-28] it is not evident as to what the optimal exercise programs should be for this patient population. The timing around surgery is also a point of discussion. Preoperative exercise and postoperative exercise should be considered as separate entities mainly due to the time period available and the physical status of the patient in each setting [29].

Due to the small preoperative time period (from diagnosis to surgery), PET programs were shorter in duration (maximum of 4 weeks) and more intense in prescribed sessions a week to enable the maximum possible benefit. An example is study 1 of Benzo et al. [30] the presumed PET program was to long and health professionals were not willing to delay the surgery date. Studies investigating postoperative exercise programs have a much longer time period [21,29,31-34]. A shorter exercise program with a higher frequency of exercise sessions can be a problem for the relatively unfit patients. In a study of Jones and colleagues is described that their short and intense exercise program may have worsened fatigue due to its intense and demanding nature in a population that was deconditioned and had significant comorbidity [35]. So far the majority of the included studies use the physical activity guidelines for adults, which recommends exercise sessions of 30 minutes five times a week [36].

It is evident that the setting of the exercise intervention (PET or postoperative exercise) is an important influencing factor. Inpatient studies frequently had supervision during the exercise sessions. It remains questionable if this is feasible in an outpatient setting, due to costs and because of the fact that travel (distance) is an important barrier for attending an exercise session [37,38]. Realistically due to the financial aspects, home-based or outpatient studies may be more manageable in the longer term. Also, in a review by Dalal et al. [37] it was described that home-based cardiac rehabilitation programs have superior adherence rates than centre-based programs.

## Adherence/Participation

In cardiac rehabilitation, exercise interventions are the cornerstone of rehabilitation but participation rates remain low. This might be due to three barriers that have been identified in the literature regarding participation; service and system level barriers (physician recommendations and misconceptions about the rehabilitation program), practical barriers (transport and parking), and personal barriers (perceptions of the ability to control the disease) [29,38]. In future research these barriers

have to be taken into account to develop a more suitable interventions, which will result in higher adherence rates.

## Exercise capacity

Exercise capacity, measured with the  $VO_{2max}$ , is an important consideration in decision-making whether a patient is suitable for surgical resection. Peak  $VO_{2max}$  is reported as the strongest independent predictors of surgical complications [39]. Poor exercise capacity has been shown to be a major determinant of morbidity and mortality after lung resection surgery [40-42]. Therefore interventions aimed to improve the exercise capacity and  $VO_{2max}$  might lower postoperative complications, length of stay and costs of hospital admissions [15,22,29,43-45]. Interestingly, several of the included studies showed that recruited patients who had impaired exercise capacity at baseline ( $VO_{2max} < 15ml/kg/min$ ) [46-49], were those who benefitted the most from the exercise intervention.

## Directions for future research

The goal of a PET program is to prepare patients for surgery in the best possible way with the objective to reduce post-operative complications, length of stay, and the healthcare costs. The results seem promising, but a necessity for future research remains. To be able to perform high quality research in the near future, definitions of PET, including timing, (acceptable) duration, intensity and exercise training methods should be determined and compared. Also the effects of PET need to be studied in specific patient groups, per example patients with COPD compared to patients without COPD (both scheduled for lung resection surgery). Future improvements in standards of care and optimal pre-operative preparation should not only focus of the surgical team and the hospital organisation but also on incorporating the active role of the patient.

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