Prehabilitation

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Take Home Pearls

- Exercise and improving physical capacity is beneficial for the elderly across a wide spectrum of medical conditions.
- Prehabilitation is the process of enhancing the functional capacity of an individual to enable him or her to withstand a stressful event.
- In the context of surgery, prehabilitation has been described to be the use of exercise training preoperatively to improve postoperative outcomes.
- A more holistic approach including attention to the physical ability, nutrition, and psychosocial needs is likely to lead to more success.

7.1 Introduction

It is well recognised that exercise is beneficial for the elderly across many medical conditions. Studies have demonstrated a relationship between regular exercise and improvements in outcome measures such as coronary artery disease, hypertension, type 2 diabetes mellitus, stroke disease and osteoporosis. The American College of Sports Medicine and the American Heart Association published recommendations for physical activity in older adults in 2007. These recommendations include

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incorporating moderate-intensity aerobic activity, developing muscle strength with resistance training and flexibility/balance exercises.

While factors such as chronological age, a reduction in the ability to respond to stress, frailty and co-morbid illnesses influence postoperative complications, there is also an association between physical fitness and outcomes following surgery. Patients who are less fit with poor baseline physical performance capacity tend to have a higher incidence of perioperative complications. Cardiopulmonary exercise testing can be useful in identifying patients at increased risk of adverse outcomes following non-cardiopulmonary surgery.

Since physical fitness plays a role in postoperative outcomes, improving physical fitness preoperatively should lead to better outcomes. Unfortunately, there is currently little evidence to suggest that exercise training preoperatively may improve postoperative outcomes in the elderly.

Previous studies have explored the restoration of function in disabled elderly patients through rehabilitation after an acute medical illness such as a stroke or after surgical procedures. There have been few studies evaluating strategies aimed at the prevention of functional decline in elderly patients who have not had an acute illness or injury or undergone surgery.

The process of enhancing the functional capacity of the individual to enable him or her to withstand a stressful event has been termed ‘prehabilitation’.

In a study published in 2002, Gill et al. conducted a randomised clinical trial of a home-based programme designed to prevent functional decline in a high-risk group of frail elderly persons living at home. In this trial, 188 frail elderly persons aged 75 years or older who were living at home were randomly assigned to undergo a 6-month, home-based intervention programme that focused on improving physical function which included muscle strength, balance and mobility or to undergo an educational programme (control). The primary outcome was the change between baseline function and 3, 7 and 12 months in the score on a disability scale based on eight activities of daily living.

Participants in the intervention group were visited at home by a physical therapist an average of 16 times over a 6-month period. Recommended interventions included progressive resistance exercises using elastic bands, training in the proper use of assistive devices, removal of hazardous obstacles (e.g. loose rugs, cords, clutter), instruction on safe techniques for facilitating activities, improvement in lighting, repair of walking surfaces and installation of adaptive equipment in the bathroom.

The control group received 6 monthly home visits by a health educator where general practices promoting good health such as proper nutrition, sleep hygiene and management of medications were reviewed. The results showed that, compared to the control group, participants in the intervention group experienced less disability at 7 and 12 months. The benefits of the intervention were mostly among participants with moderate frailty. Persons with severe disability experienced worsening disability over time, despite the intervention. The reason for this is unclear.

7.2 Effect of Prehabilitation on Postoperative Outcomes After Hip and Knee Replacement Surgery

Apart from a few studies demonstrating the beneficial effects of preoperative exercise training on postoperative outcomes following hip and knee replacement surgery, most have tended to show little significant change in outcome measures.

A study by D'Lima et al., published in 1996, compared the effects of preoperative physical therapy which included muscle strengthening exercises as well as cardiovascular conditioning exercises on total knee replacement outcomes. Thirty patients were randomised to 1 of 3 groups. Group 1 was the control group, Group 2 participated in a programme to strengthen upper and lower limbs and Group 3 participated in a cardiovascular conditioning programme. All 3 groups showed significant improvement postoperatively as measured by the Hospital for Special Surgery Knee Rating Scale, the Arthritis Impact Measurement Scale and the Quality of Well-Being Measurement Scale. However, neither type of preoperative exercise added to the degree of improvement after surgery at any of the postoperative evaluations.

In a study by Rodgers et al. (1998), ten patients completed 6 weeks of physical therapy prior to total knee arthroplasty and another 10 patients served as controls. Subjects were tested at baseline, before surgery, 6 weeks after surgery and 3 months after surgery using various parameters such as walking speed, thigh circumference, isokinetic knee flexion and extension testing and computed tomography scanning to determine cross-sectional muscle area. Physical therapy produced modest gains in isokinetic flexion strength but no difference in extension strength. The decrease in isokinetic strength after surgery was unaffected by preoperative physical therapy. Muscle area did not decrease significantly for the physical therapy group, but it did decrease for the control group after surgery.

Beaupre et al. (2004) looked at the effectiveness of a preoperative exercise/education programme on functional recovery, health-related quality of life (HRQOL), health service utilisation and costs following primary total knee arthroplasty. One hundred and thirty-one patients were randomised to either a control or treatment group 6 weeks before surgery. Patients in the treatment group underwent a 4-week exercise/education programme before surgery. No differences were seen in knee measurements (range of movement and strength), pain, function or HRQOL between the 2 groups following the intervention programme or at any postoperative measurement point. Patients in the treatment group used fewer postoperative rehabilitation services and stayed for a shorter time in hospital than the control group, but these differences did not attain statistical significance.

One of the few studies showing beneficial effects of preoperative exercise therapy in patients undergoing hip/knee replacement surgery was published by Rooks et al. in 2006. In this study, 108 men and women scheduled for either total hip or total knee arthroplasty were randomised to a 6-week exercise or education

(control) intervention prior to surgery. Outcome measurements, which included questionnaires and performance measures, were measured preoperatively, immediately postoperatively, 8 weeks and 26 weeks post-surgery. Among the hip replacement patients, the exercise intervention was associated with improvements in the questionnaire data in the intervention group. No significant differences were noted in the knee replacement group. Muscle strength increased in both the knee and hip replacement patients in the intervention group.

7.3 Effect of Prehabilitation on Postoperative Outcomes After Colorectal Surgery

A randomised controlled trial of prehabilitation in patients undergoing colorectal surgery was published by Carli et al. in 2010, where the extent to which a structured prehabilitation regimen of stationary cycling and strengthening optimised recovery of functional walking capacity after surgery was compared with a simpler regimen of walking and breathing exercises. In this study, 112 patients were randomised to either a bike and strengthening regimen (bike/strengthening group) or a simpler walking and breathing regimen (walk/breathing group). The mean time to surgery available for prehabilitation was 52 days and the follow-up was for 10 weeks after surgery. The primary outcome measure was functional walking capacity measured by the 6-min Walk Test. This test evaluates the capacity of a person to maintain a moderate level of walking for a period of time.

There were no differences between the groups in mean functional walking capacity over the prehabilitation period or at postoperative follow-up. However, a greater proportion of patients assigned to the walk/breathing group recovered functional walking capacity postoperatively compared to those assigned to the bike/strengthening group.

More recently, a reanalysis of the trial data was carried out to determine the extent to which physical function could be improved with either prehabilitation intervention and to identify variables associated with a positive response. Of 95 patients who completed a prehabilitation programme while awaiting colorectal surgery, 33% improved their physical function, 38% remained the same and 29% deteriorated. Patients randomised to the walk/breathing group were more likely to improve compared to the bike/strengthening group. At postoperative follow-up, those who improved during prehabilitation were more likely to have recovered to baseline functional walking capacity compared to those who did not change or who deteriorated. Patients who deteriorated while awaiting surgery were at particular risk for more serious surgical complications.

Improved preoperative functional capacity remained a predictor of recovery after adjusting for variables such as age, diagnosis, complications and baseline physical capacity. The analysis suggests that a prehabilitation programme based on walking and breathing exercises can improve functional exercise capacity in patients awaiting colorectal surgery, and this improvement is associated with improved postoperative recovery.

7.4 Effect of Prehabilitation on Postoperative Outcomes After Spinal Surgery

In randomised clinical trial conducted by Nielsen PR from 2003 to 2005, 60 patients were assigned to either prehabilitation (exercise programme) and early rehabilitation or to standard care. The outcome measures included postoperative hospital stay, complications and patient satisfaction.

The patients in the prehabilitation group had faster improvement in function, shorter hospital stays and higher satisfaction, without more complications or pain.

7.5 Effect of Preoperative Inspiratory Muscle Training on Postoperative Outcomes After Cardiac or Major Vascular Surgery

Pulmonary complications after cardiac surgery are a major cause of postoperative morbidity and mortality. Respiratory muscle weakness may contribute to the postoperative pulmonary complications. Several studies have used inspiratory muscle training as the intervention in elderly patients undergoing coronary artery bypass grafting or abdominal aortic aneurysm surgery.

Hulzebos et al. (2006) evaluated the effect of preoperative inspiratory muscle training on the incidence of postoperative pulmonary complications in high-risk patients scheduled for elective coronary artery bypass grafting. The results showed that preoperative inspiratory muscle training reduced the incidence of postoperative pulmonary complications and duration of postoperative hospitalisation.

In a study by Dronkers et al. (2008), 20 high-risk patients undergoing elective abdominal aneurysm surgery were randomly assigned to receive either preoperative inspiratory muscle training or usual care. Outcome measures included atelectasis, inspiratory muscle strength and vital capacity.

Fewer patients in the intervention group developed atelectasis compared to the control group, but the incidence of postoperative pulmonary complications was not significantly reduced.

7.6 Prehabilitation in the Context of Geriatric Surgery

The failure of available data to show consistent benefit in their study cohorts is somewhat puzzling. Indeed, if time is taken to improve physical and cardiorespiratory function prior to surgery, why would it be unsuccessful? It is our opinion that this phenomenon may be secondary to the lack of a holistic approach to prehabilitation. While trying to conduct very scientific experiments, many of the described studies had failed to consider the patient as a whole. It should be realised that prehabilitation is not just about improving one aspect of the patient; rather the approach should be more holistic and the aim should be to improve the entire well-being of the patient. It cannot be just about physical aspects, psychosocial and nutritional aspects are equally important.

Our suggested framework for prehabilitation for elderly surgical patients aims to address the various facets important to the entire well-being of the patient. The key elements include:

- Education and empowerment of the patient in their own recovery process
- Attention to psychosocial needs
- Cardiopulmonary strengthening
- Walking and mobilising
- Muscle strengthening
- Attention to nutrition
- Attention to activities of daily living

The delivery of such a holistic process can only be facilitated by a transdisciplinary team. Constant review, reassessment and setting of goals with open communication between the team, patient and carers are the cornerstones of successful care delivery. Table 7.1 shows the Khoo Teck Puat Hospital Geriatric Surgery Programme prehabilitation goal setting in the various elements of our programme.

The duration and time frame for prehabilitation has to be tailored to the urgency of the surgery. Prehabilitation is most ideally done in the comfort of the patients' own homes. However, day centres are also viable options. Inpatient prehabilitation should only be performed for the very frail.

Table 7.1 Khoo Teck Puat Hospital Geriatric Surgery Programme: prehabilitation goal setting

Component	Initial assessment	One week after prehabilitation		Two weeks after prehabilitation		Target
Education and compliance	Understands disease and indication for surgery	Patient understands disease and indication for surgery	Yes □ No □	Patient understands disease and indication for surgery	Yes □ No □	Patient understands disease and indication for surgery
	Knows what to expect	Patient knows what to expect	Yes □ No □	Patient knows what to expect	Yes □ No □	Patient knows what to expect
	Preparation for operation	Patient knows what to do	Yes □ No □	Patient knows what to do	Yes □ No □	Patient knows what to do
Weight change	Current weight:	No weight loss	□	No weight loss	□	No weight loss over past 2 weeks
		Weight loss ≤5%	□	Weight loss ≤5%	□	
		Weight loss >5%	□	Weight loss >5%	□	
Dietary intake	Usual intake:	Achieved 100% of dietary requirement 5 in 7 days	Yes □ No □	Achieved 100% of dietary requirement 5 in 7 days	Yes □ No □	Achieved 100% of dietary requirement 5 in 7 days
Chair to stand	No of reps:	No of reps:		No of reps:		No of reps:
		Significant improvement (>10%)	□	Significant improvement (>10%)	□	Achieved significant improvement (>10%)
		Good improvement (5–10%)	□	Good improvement (5–10%)	□	
		No/little improvement (<5%)	□	No/little improvement (<5%)	□	

Table 7.1 (continued)

Component	Initial assessment	One week after prehabilitation		Two weeks after prehabilitation		Target
10-m walk test	No of steps:	No of steps:		No of steps:		No of steps:
		Significant improvement (>3%)	□	Significant improvement (>3%)	□	Significant improvement (>3%)
		Good improvement (1–3%)	□	Good improvement (1–3%)	□	
		No/little improvement (<1%)	□	No/little improvement (<1%)	□	
	Time taken (s):	Time taken (s):		Time taken (s):		Time taken (s):
		Significant improvement (>3%)	□	Significant improvement (>3%)	□	Significant improvement (>3%)
		Good improvement (1–3%)	□	Good improvement (1–3%)	□	
		No/little improvement (<1%)	□	No/little improvement (<1%)	□	

Conclusion

The results from the limited number of trials in prehabilitation are promising but inconsistent. It is likely that only a more holistic team-based approach can afford better results. Prehabilitation processes in elderly surgical patients remain a work in progress.

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