The impact of prehabilitation in upper gastrointestinal cancer underwent major surgery

Ramizah Mohd Shariff, MBBS[1], Tee Sze Chee, MMed Surg[1], Mohammad Shukri Jahit, MMed Surg[1], Abdul Aziz Harith, MPH[2,3], Nurul Hannan Shahabuddin, MBBS[1], Saiyidah Adila Adibi, MBBS[1]

[1]Surgical Department, National Cancer Institute, Ministry of Health Malaysia, Putrajaya, Malaysia, [2]Occupational and Aviation Medicine, Medical Department, University of Otago, Wellington, New Zealand, [3]Institute for Public Health, National Institutes of Health, Ministry of Health Malaysia, Shah Alam, Selangor, Malaysia

ABSTRACT

Introduction: Several risk factors found to be associated with postoperative complications and cancer surgery, which carry a significant morbidity risk to cancer patients. Therefore, prehabilitation is necessary to improve the functional capability and nutritional status of a patient prior to surgery, so that the patient can withstand any postoperative activity and associated deterioration. Thus, this study aims to assess the effectiveness of prehabilitation interventions on the functional status of patients with gastric and oesophageal cancer who underwent esophagectomy and gastrectomy.

Material and Methods: An interventional study was carried out among oesophageal and gastric cancer patients who had undergone surgery at the National Cancer Institute of Malaysia. The prehabilitation process took a maximum of two weeks, depending on the patient's optimisation before surgery. The prehabilitation is based on functional capacity (ECOG performance status), muscle function (handgrip strength), cardio-respiratory function (peak flow meter) and nutritional status (calorie and protein). Postoperative outcomes are measured based on the length of hospital stay, complications, and Clavien-Dindo Classification.

Results: Thirty-one patients were recruited to undergo a prehabilitation intervention prior to gastrectomy (n=21) and esophagectomy (n=10). Demographically, most of the cancer patients were males (67.7%) with an ideal mean of BMI (23.5±6.0). Physically, the majority of them had physical class (ASA grade) Grade 2 (67.7%), ECOG performance status of 1 (61.3%) and SGA grade B (51.6%). The functional capacity and nutritional status showed a significant improvement after one week of prehabilitation interventions: peak expiratory flow meter (p<0.001), handgrip (p<0.001), ECOG performance (p<0.001), walking distance (p<0.001), incentive spirometry (p<0.001), total body calorie (p<0.001) and total body protein (p=0.004). However, those patients who required two weeks of prehabilitation for optimization showed only significant improvement in peak expiratory flow meter (p<0.001), handgrip (p<0.001), and incentive spirometry (p<0.001). Prehabilitation is significantly associated postoperatively with the length of hospital stay (p=0.028), complications (p=0.011) and Clavien-Dindo Classification (p=0.029).

Conclusion: Prehabilitation interventions significantly increase the functional capacity and nutritional status of cancer patients preoperatively; concurrently reducing hospital stays and complications postoperatively. However, certain cancer patients might require over two weeks of prehabilitation to improve the patient's functional capacity and reduce complications postoperatively.

KEYWORDS:
Prehabilitation; upper gastrointestinal; oesophageal cancer; gastric cancer; preoperative; postoperative

INTRODUCTION

Oesophageal and gastric cancers are lethal tumours which carry a high risk of morbidity and mortality. The number of new cancer cases and deaths for oesophageal and gastric cancers in the United States is estimated at 43 300 and 26 400 respectively.[1] Surgery is the cornerstone of curative intent treatment for localised or locally advanced oesophagogastric cancers and it is associated with important adverse events.[2,3] The combination of neo-adjuvant chemotherapy or chemoradiotherapy treatment for esophagogastric cancer has posed an enormous challenge to the patient. The current best surgical practice involves the Enhanced Recovery After Surgery (ERAS) program, which has been shown to have a positive association in terms of length of hospital stay, resource use and complications.[4,5]

Risk stratification optimisation of pre-existing organ function is essential in ERAS elements for preparing patients facing surgery. Hence, it is vital to avoid a silo mentality and require a multidisciplinary approach to prepare patients and prehabilitation prior to surgery. Another parameter that can measure the effectiveness of prehabilitation would measure walking distance, for example, the 6-minute walk test (6MWT).[6] This has been predicted to determine the rate of mortality in patients undergoing major surgery. It also correlates inversely with sarcopenia and peak flow oxygen consumption in predicting postoperative cardiopulmonary complications.[7]

Certain types of exercises with resistance training are considered fundamental elements in building patient functional capacity and it has a role in attenuating and even reversing adverse impact postoperative outcomes. Resistance

This article was accepted: 23 November 2022
Corresponding Author: Ramizah Mohd Shariff
Email: skyzlimit49@gmail.com

training can counter myopenia and promote hypertrophic adaptation in skeletal tissue, increasing muscle mass, strength, and function. A handgrip test can assess these. Reduced handgrip strength has been a predictor of impaired short-term outcomes, such as increased postoperative complications, increased length of hospital stay, decreased physical status and increased readmission rate. Jamar dynamometer could measure the average value of three successive measurements of the dominant hand to determine the grip strength.[8]

Despite these advances, esophagogastric surgery is still associated with short-term and long-term adverse effects. It includes high rates of postoperative complications and mortality, decreased muscle strength and cardiorespiratory fitness, fatigue, depression, emotional distress, anxiety and poor quality of life.[9,10] Consequently, surgical complications and subsequent impaired (nutritional, physical, and performance status), most patients are not able to receive the complete sequence of perioperative or adjuvant therapy. Surgery alone is inadequate for loco-regional control in patients with locally advanced disease, and overall, 5-year survival remains poor. Therefore, optimising pre and perioperative functional capacity is an interesting aim in these patients.[11,12]

Interventions in the preoperative period are directed to enhance recovery after surgeries collectively called 'prehabilitation'. Prehabilitation is known to be the "new frontier" in preoperative care, especially for major upper gastrointestinal (GI).[13] It focuses on preoperative conditioning intervention to increase the physiological reserve before the stress of surgery to improve postoperative outcomes.[14] Prehabilitation aims to improve nutritional status, pre and postoperative fitness, and to reduce postoperative complications.[15] The prehabilitation is moving towards a multimodal approach, encompassing medical optimization, preoperative physical exercise, nutritional support, and stress/anxiety reduction.[16,17]

Prehabilitation of surgical patients seems to be better placed to cope after surgery compared to others. Increasing evidence shows that prehabilitation improves perioperative physical function in major abdominal surgery.[18,19] Integration of prehabilitation was found to improve hospital length of stay, postoperative pain, and postoperative complications.[20] Prehabilitation uses multimodal intervention which includes physical exercise, nutritional support, medical optimisation and psychological support.[21,22] The impact of the prehabilitation can be measured using the ECOG Scale of Performance Status developed by the Eastern Cooperative Oncology Group (ECOG) and is now part of the ECOG ACRIN Cancer Research Group.[23]

The effectiveness of the prehabilitation program has been demonstrated in several specialities, including cardiothoracic and bariatric surgery.[24] Nevertheless, upper GI surgery presents a unique challenge in clinical management because of the high-risk population and treatments. Furthermore, few trials in major abdominal surgery found a significant reduction in overall and pulmonary morbidity post-surgery with prehabilitation.[25] Prehabilitation through exercise therapy and chest physiotherapy seems to have improved the physical fitness of a patient and reduced pulmonary complications.[26] Since functional status is a key and modifiable factor in major upper GI surgery, prehabilitation is a notable intervention in these patients. Intervening with early prehabilitation rather than late or after surgery (rehabilitation) in this high-risk group appears to be more beneficial.[27]

Based on the Malaysia National Cancer Registry Report 2012-2016, the age-standardised incidence rate of stomach cancer is 3.1 and 1.9 per 100,000 populations for males and females, respectively. For oesophageal cancer, the age-standardised incidence rate is 1.4 and 0.5 per 100,000 populations for males and females, respectively.[28] Although it is a relatively small number compared to Korea, China and Japan, stomach cancer is still in the top ten lists of common cancers among males in Malaysia. A study by Zalina at Malaysia Hospital shows three over four gastrointestinal cancer patients are malnourished (moderately malnourished stage B (25.7%), severely malnourished stage C (48.6%)), two over five having low physical activity and one over three having a low quality of life.[29] A large cohort study by Jessica Spence among Canadians found that 44.9% of deaths within 30 days of post-surgery among 40,000 non-cardiac surgical patients were associated with 3 complications: major bleeding, MINS (myocardial injury after non-cardiac surgery) and sepsis.[30] Furthermore, this study suggested that preoperative identification and management of complications in patients is needed to reduce post-operative complications and mortality.

In Malaysia, the National Cancer Institute started the prehabilitation program for oesophageal and gastric cancer in October 2020. Prehabilitation is effective in certain surgeries, but a limited study was found on oesophageal and gastric cancer, including in Malaysia.16 This study would support the evidence and contribute to the knowledge of prehabilitation prior to upper gastrointestinal cancer surgery. Therefore, this study aimed to assess the effectiveness of prehabilitation on the functional status of patients with gastric and oesophageal cancer who underwent esophagectomy and gastrectomy in Malaysia.

MATERIALS AND METHODS

Design and Study Sample

This was an interventional study conducted using data collected from the surgical department among oesophageal and gastric cancer patients, who had undergone esophagectomy and gastrectomy surgery at the National Cancer Institute of Malaysia. Thirty-one patients' data from the Enhanced Recovery After Surgery (ERAS) assessment forms underwent esophagectomy or gastrectomy was retrieved from October 2020 to June 2021. The postoperative follow-up period is 30 days after the surgery. Therefore, patients recruited for this study started on 1st October 2020 until the end of May 2021, as the remaining 30 days will be the postoperative follow-up. Data collected includes demographic data, disease stage, nutritional status and functional status parameters, as in the ERAS assessment form.

Intervention

Nutrition

The dietician screened and assessed all the preoperative patients. Nutritional therapy was initiated according to a recommendation based on ESPEN practical guidelines in cancer 2021.[31] Total energy expenditure is calculated based on a predicted formula of 25-30kcal/kg/day, while protein requirement is aimed to be above 1.2g/kg/day, if possible, up to 1.5g/kg/day.

Exercise

During the hospital stay, patients were required to ambulate in the ward. The standard walking exercise was done to achieve over 10 meters per session. Thera band loops with different levels of resistance and colour coding (e.g.,: yellow, green, red, black, grey and orange) were supplied to the patient. These allow an individual to progress to gain muscle strength in the upper/lower limbs and abdominal muscles. The aerobic and resistance exercise supervised the physiotherapy unit, including the usage of these Thera bands for different types of muscle strengthening in our body. Meanwhile, cycling on an ergometer bike for 10-15minutes and weight-lifting exercises using dumbbells with different weights was also supervised by the physiotherapist. Training of inspiratory muscles was also associated with decreased postoperative respiratory complications. There was a set of standardised deep breathing exercises together with the use of an incentive spirometer. Patients were also required to practise coughing. Simple instructions and demonstrations were given during admission.

The standardised deep breathing exercise was instructed to do every hour, and the step includes:-

1) 10 deep inspiration/set x at least three times/day with thoracic cage stretching, followed by huffing/blowing out loudly,
2) Long, slow deep breathing using incentive spirometry,
3) Efficient coughing.

Outcome Measures

The overall outcome of the implementation exercise and its correlation with functional status improvement pre- and post-operation were assessed. In addition, subgroup analysis will be performed on the patient undergoing surgery post-neo-adjuvant therapy, elderly patients (>70years old) and in comparison, on disease stage and type of surgery. The difference between preoperative and postoperative physical performance and functional capacity was assessed using ECOG performance status, walking distance, handgrip strength, and peak flow rate on alternate days. However, ECOG Grade 3, 4 and 5 patients were not included (as not intended for surgery).

The parameters were filled into a standard ERAS assessment form with a duration of 1-2 weeks before surgery. For those who have good functional and nutritional status, the minimal duration of prehabilitation before surgery is 1 week. Clavien Dindo classification (CDC) was originally described in 2004 and is widely used throughout surgery for grading adverse events i.e. post-operative complication (POCs) which occurs as a result of surgical procedures.[32] It has become a standard classification system for many surgical specialities. The grading system is from grade 1 to grade V.

Statistical Analysis

Data were checked and cleaned before being analysed using the Statistical Package for the Social Science (SPSS) version 28. The data distribution before and after the intervention was not equally distributed. The normality test for this study was negative. Wilcoxon Signed-Ranks Test was used to determine the association between the baseline parameter and perioperative parameter (1st week and 2nd weeks after prehabilitation intervention). Furthermore, the relationships between postoperative outcomes after prehabilitation against the prehabilitation period were determined using the Chi-square test.

Ethical Consideration

This study was initiated by the Surgical Department of the National Cancer Institute of Malaysia, and it was self-funded. This study was registered under National Medical Research Registry (NMRR) (NMRR ID-21-1370-60445 (IIR) and approval were granted (21-1370-60445 (2)) by the Medical Research and Ethics Committee (MREC), Ministry of Health Malaysia.

RESULTS

Thirty-one participants were recruited in the study who underwent major upper GI surgery, either gastrectomy and/or esophagectomy, as shown in Table I. The patients' mean age was 59.2 (SD±8.9) years old. The majority of patients who underwent major upper GI surgery due to cancer were males (67.7%) but they had an equal variation of BMI between males (23.8 ± 6.3) and females (22.9 ± 5.7). Meanwhile, most of the participants were SGA B (51.6%), had good ECOG status of 1 (61.3%) and were classified as ASA II (67.7%). Patients with SGA C (32.3%) and mediocre functional status with ECOG performance 2 (16.1%) were another extreme spectra of concern. Twenty-one (67.8%) studies of stomach cancer required gastrectomy and ten (32.3%) studies of cardio-oesophageal/oesophageal cancer required oesophagectomy. Most of the diseases were in stage III (54.9%), followed by stage II (29%), stage IV (9.7%) and last, stage I (6.4%) which is the least and usually benefits from the minimally invasive approach.

Table II shows a comparison of the outcome between baseline and preoperative parameters after a week of prehabilitation interventions. The perioperative parameters have shown a significant improvement (22.4%) on PEFR (p<0.001), 20.9% improvement on hand grip (p<0.001), 5.4% improvement on total body calorie (p<0.001) and 8.5% improvement on total body protein (p=0.004). There is also a positive development in ECOG performance (p<0.001), walking distance (p<0.001), and intensive spirometry (p<0.001).

The remaining patients after 1 week of prehabilitation were only 16 out of 31 patients. There were significant positive strong correlations between pre-intervention and two weeks post-interventions for PEFR (p<0.001), hand grip (p<0.001) and intensive spirometry (p<0.001). Meanwhile, other prehabilitation interventions (total body calorie, total body protein, ECOG performance) were found to have no association after two weeks of the prehabilitation process as shown in Table III.

Table I: Patients characteristics who had undergone gastrectomy or oesophagectomy (n=31)

Varibales	n(%)
Age (years), mean ± SD	59.2 ± 8.9
Gender	
Male, n (%)	21 (67.7)
BMI, mean ± SD	23.5 ± 6.0
Male	23.8 ± 6.3
Female	22.9 ± 5.7
ASA grade, n (%)	
I	8 (25.8)
II	21 (67.7)
III	2 (6.5)
Comorbidities, n (%)	
Diabetes	11 (35.5)
Hypertension	16 (51.6)
Ischaemic heart disease	4 (12.9)
Baseline ECOG performance status, n (%)	
0	7 (22.6)
1	19 (61.3)
2	5 (16.1)
SGA, n (%)	
A	5 (16.1)
B	16 (51.6)
C	10 (32.3)
Albumin, g/dL, mean ± SD	38.7 ± 4.5
TLC, mean ± SD	1.95 ± 0.7
Diagnosis, n (%)	
Stomach cancer	21 (67.8)
Cardio-oesophageal / oesophageal cancer	10 (32.3)
Cancer Stage, n (%)	
I	2 (6.4)
II	9 (29.0)
III	17 (54.9)
IV	3 (9.7)
Neoadjuvant therapy, n (%)	11 (35.5)
Types of surgery, n (%)	
Gastrectomy	21 (67.8)
Oesophagectomy	10 (32.2)
Length of stay (post-operative), days, median (IQR)	9 (6-21)
Gastrectomy	6 (5.5-22.5)
Oesophagectomy	13.5 (8.5-17.2)

SD: Standard deviation; IQR: interquartile range; BMI: body mass index; ASA: American Society of Anaesthesiologists physical status class; ECOG: Eastern Cooperative Oncology Group; SGA: Subjective Global Assessment; TLC: total lymphocyte count.

Table II: Comparison of baseline parameters and perioperative parameters outcome after one week of prehabilitation interventions (n=31)

Variables	Pre-intervention	Post-intervention	Improvement difference (%)	*p* value
PEFR, mean ± SD	322.2 (118.7)	394.5 (116.6)	72.3 (22.4)	<0.001[a]
Hand grip, mean ± SD	20.9 (6.7)	25.4 (6.8)	4.5 (20.9)	<0.001[a]
Calorie, mean ± SD	91.4 (18.6)	96.4 (6.4)	5.0 (5.4)	<0.001[a]
Protein, mean ± SD	89.7 (20.2)	97.4 (9.5)	7.7 (8.5)	0.004[a]
ECOG Performance, n (%)			NA	<0.001[b]
Grade 0	7 (22.6)	10 (32.3)		
Grade 1	19 (61.3)	20 (64.5)		
Grade 2	5 (16.1)	1 (3.2)		
Walking distance			NA	<0.001[b]
<3 meter	1 (3.2)	0 (0.0)		
< 10 meter	2 (3.2)	1 (3.2)		
>10 meter	29 (93.5)	20 (96.8)		
Incentive Spirometry (IS)			NA	<0.001[b]
Level 1	2 (6.5)	0 (0.0)		
Level 2	5 (16.1)	2 (9.7)		
Level 3	24 (77.4)	28 (90.3)		

[a]Wilcoxon Signed Ranks Test
[b]Chi-square Test

Table III: Comparison of baseline and perioperative parameter after two weeks of prehabilitation interventions (n=16)

Variables	Pre-intervention	Post-intervention	Improvement difference (%)	*p* value
PEFR, mean ± SD	304.3 (118.4)	419.3 (132.1)	115 (37.7)	<0.001[a]
Hand grip, mean ± SD	19.1 (7.0)	26.1 (6.3)	7 (36.6)	<0.001[a]
Calorie, mean ± SD	90.9 (22.6)	98.2 (3.5)	7.3 (8.0)	0.173[a]
Protein, mean ± SD	89.8 (23.6)	99.1 (9.8)	9.3 (10.3)	0.173[a]
ECOG Performance, n (%)			NA	0.072[b]
Grade 0	1 (6.3)	3 (18.8)		
Grade 1	11 (61.8)	13 (81.3)		
Grade 2	4 (25.0)	0 (0.0)		
Walking distance			NA	NA
< 10 meter	2 (12.6)	0 (0.0)		
>10 meter	14 (87.5)	16 (100.0)		
Incentive Spirometry (IS)			NA	<0.001[b]
Level 1	2 (12.5)	0 (0.0)		
Level 2	3 (18.8)	2 (12.5)		
Level 3	11 (68.8)	14 (87.5)		

[a]Wilcoxon Signed Ranks Test
[b]Fisher exact test

Table IV: The association between postoperative outcomes and the prehabilitation period

Variables	Prehabilitation weeks, n (%)		*p* value
	1 week	2 weeks	
Length of hospital stay			0.028[a]
< 8 days	11 (78.6)	3 (21.4)	
8 – 14 days	2 (28.6)	5 (71.4)	
15 – 21 days	1 (25.0)	3 (75.0)	
22 – 28 days	1 (50.0)	1 (50.0)	
>28 days	0 (0.0)	4 (100.0)	
Any complications			0.011[a]
Yes	5 (27.8)	13 (72.2)	
No	10 (76.9)	3 (23.1)	
Clavien-Dindo Classification			0.029[a]
No Complication	10 (76.9)	3 (23.1)	
Grade 1	2 (100.0)	0 (0.0)	
Grade 2	1 (14.3)	6 (85.7)	
Grade 3a	0 (0.0)	1 (100.0)	
Grade 3b	1 (33.3)	2 (66.7)	
Grade 4	1 (20.0)	4 (80.0)	
Grade 5	15 (48.4)	16 (51.6)	
Pneumonia			0.220
Yes	2 (25.0)	6 (75.0)	
No	13 (56.5)	10 (43.5)	
Wound infection			0.583
Yes	1 (33.3)	2 (66.7)	
No	14 (50.0)	14 (50.0)	
Anastomosis leak			0.226
Yes	0 (0.0)	3 (100.0)	
No	15 (53.6)	13 (46.4)	
Readmission within 30 days			0.484
Yes	0 (0.0)	2 (100.0)	
No	15 (51.7)	14 (48.3)	
Postoperative Mortality			0.516
Yes	0 (0.0)	1 (3.2)	
No	15 (100)	15 (96.8)	

[a] Chi-square Test

Eleven out of fifteen (73.3%) patients who required one week of prehabilitation interventions stayed in the hospital for less than 8 days of hospital postoperatively. While eight out of sixteen (50%) patients who require two weeks of prehabilitation interventions stayed over 14 days in the hospital. Furthermore, patients who need two weeks of rehabilitation interventions end up with 72.2% complications compared to those who required one week of rehabilitation interventions. In the meantime, post-operative outcomes have a significant association with prehabilitation interventions, especially on length of hospital stay (p=0.028), patient complications post-surgery (p=0.011), and Clavien-Dindo classification (p=0.029) (Table IV). Wound infection incidence was only evident in 9.7% of the sample studies. 90.3% of the participant did not reveal to have any form of wound dehiscence. Anastomotic leak incident was found to be 9.7%.

DISCUSSION

Patients with practice have directly shown improvement in the postoperative upper GI malignancy, experience progressive weight loss over time and usually present with moderate-to-severe malnutrition and impaired functional capacity.[13] In our study, most patients fall in the category of 5-10% weight loss with SGA B or more extreme SGA C and this explains how the initial presentation transforms constructively after the intervention prehabilitation. The aim of this is to determine the effectiveness of a basic bedside exercise programme entailed with a component of cardiorespiratory and muscle strengthening exercises, coupled with adequate nutritional loading in patients who are undergoing major upper GI surgery for esophagogastric cancer. Major abdominal surgeries are associated with significant morbidities despite recent improvements in perioperative care, including the ERAS concept.[20] Optimisation of a patient begins from the initial pre-operative stage itself.

The practice is alongside the growing literature base and with the given clinical recommendation of prehabilitation being increasingly adopted into clinical outcomes.[18,22] In this study, we concluded multimodal prehabilitation before major abdominal surgery improves the functional capacity, substantially reduce the post-operative length of hospital stay and significantly change postoperative complication. However, it does not significantly associate with 30 days of hospital readmissions or postoperative mortality. Nevertheless, this data needed to be delivered with caution, because of the substantial heterogeneity within and across the studies especially complications postoperatively. Based on this study, more than 70% of complications derived from patients required two weeks of prehabilitation. Caution prehabilitation assessment is needed especially for patients who may need longer prehabilitation duration for optimization prior to surgery.[33] Patient willingness to participate must also be considered when interpreting the findings, as consented participation was 100%. However, the compliance level is debatable and may vary from one to another. Improvement in surgical care, including the implementation of enhanced recovery after surgery (ERAS) pathway, has manifested and added complexity to interpreting the efficacy of prehabilitation interventions in the pre-operative period, intraoperative and particularly the postoperative period with early mobilisation and optimised pain management.

In this study, thirty-one patients who underwent gastrectomy and esophagectomy consented to partake in this study. We investigated the effect of short-term prehabilitation intervention has overall shown improvement within the period of two weeks. Prehabilitation usually starts two weeks before major upper GI surgery, which entails a component of cardiorespiratory exercise approximately every hour with deep breathing exercises and spirometry. In addition, muscle-resistant training approximately 3 times a day together with nutritional loading was provided during the hospital stay.[29] Parameters like handgrip assessment are expected to increase the muscle strength because of the other exercise load initiated by the patient ward e.g.: muscle strengthening exercises inward using Thera band, static bicycle in gym or dumbbells other fixed resistance used as a training tool.[9] Our group of patients are majorly the malnourished elderly, accustomed to sarcopenia and frailty. Overall, these patients also show a significant improvement in terms of muscle strength with maximal nutrient loading either via parenteral nutrition or full enteral nutrient inward despite the short prehabilitation intervention.

This study had a few limitations to be highlighted. First, this study has no control group to be compared with, which could be an excellent added value for the outcome of this study. Thus, we only compare patients based on the duration of prehabilitation. Second, this study did not directly reflect on the postoperative complications despite the improvement seen in their functional status before surgery. These outcomes should be evaluated by setting an intervention with a control group in major upper GI surgery. We intend to conduct future studies, including a postoperative outcome evaluation with a control group. However, in conclusion, although our study had limitations and a limited number of participants, it is confirmed with a short period of multimodal rehabilitation over one week significantly improved the patient's condition (functional capacity and nutrient loading) preoperatively and postoperatively.

It will have extraordinary potential if this study could be carried out in a prospective study. We have also intended to add another essential component, which is a psychological questionnaire among consented participants. This component of interventions is aimed at reducing preoperative anxiety as well as a motivational interview focusing on improving compliance with program elements which could be incorporated as part of multimodal prehabilitation programs within these included studies. A trained psychologist, a psychology-trained nurse, and a psychology-trained member of the research team should deliver interventions to reduce preoperative anxiety not reported. The motivational interview should be conducted by a specialised physiotherapist. Adherence to this concept will be beneficial and could give an overview of the whole and propel toward good post-surgical outcomes.

In a retrospective review of our practice, we will extend to prospective to recruit more patients to show any difference in terms of prehabilitation and outcome of surgery, length of stay, detailed complications, readmission and mortality postoperatively. On the other end of the spectrum, much prehabilitation research has widened its horizon and focuses on pre- and post-operative patients. Many still lack research on how these affect the intended oncologic (adjuvant) therapies and ongoing exercise behaviour. This will be great revenue for research in the future. More research and study can be developed on the prehabilitation effects.

CONCLUSION

Prehabilitation interventions significantly increase the functional capacity of cancer patients preoperatively, concurrently reducing hospital stays and complications postoperatively. However, certain cancer patients might require over two weeks of prehabilitation to improve the patient's functional capacity and reduce complications postoperatively.

ACKNOWLEDGEMENTS

The authors would like to offer their appreciation to the Director General of Health Malaysia for permitting this paper to be published. The International Society for Disease of the Oesophagus (ISDE) accepted this research to be presented at the 18th World Congress for Oesophagus Diseases 2022 in Tokyo, Japan.

REFERENCES

1. Siegel RL, Miller KD, Jemal A. Cancer statistics, 2016. CA: A Cancer Journal for Clinicians 2016; 66(1): 7-30.
2. Ghaferi AA, Birkmeyer JD, Dimick JB. Hospital volume and failure to rescue with high-risk surgery. Med Care 2011; 49(12): 1076-81.
3. Reames BN, Ghaferi AA, Birkmeyer JD, Dimick JB. Hospital volume and operative mortality in the modern era. Ann Surg 2014; 260(2): 244-51.
4. Ashok A, Niyogi D, Ranganathan P, Tandon S, Bhaskar M, Karimundackal G, et al. The enhanced recovery after surgery (ERAS) protocol to promote recovery following esophageal cancer resection. Surg Today 2020; 50(4): 323-34.
5. Lee L, Li C, Robert N, Latimer E, Carli F, Mulder DS, et al. Economic impact of an enhanced recovery pathway for oesophagectomy. Br J Surg 2013; 100(10): 1326-34.
6. Lee L, Schwartzman K, Carli F, Zavorsky GS, Li C, Charlebois P, et al. The association of the distance walked in 6 min with pre-operative peak oxygen consumption and complications 1 month after colorectal resection. Anaesthesia 2013; 68(8): 811-6.
7. Tanaka R, Lee SW, Kawai M, Tashiro K, Kawashima S, Kagota S, et al. Protocol for enhanced recovery after surgery improves short-term outcomes for patients with gastric cancer: a randomized clinical trial. Gastric Cancer 2017; 20(5): 861-71.
8. Cruz-Jentoft AJ, Baeyens JP, Bauer JM, Boirie Y, Cederholm T, Landi F, et al. Sarcopenia: European consensus on definition and diagnosis: Report of the European Working Group on Sarcopenia in Older People. Age Ageing 2010; 39(4): 412-23.
9. Mathiowetz V, Weber K, Volland G, Kashman N. Reliability and validity of grip and pinch strength evaluations. J Hand Surg Am 1984; 9(2): 222-6.
10. Jack S, West MA, Raw D, Marwood S, Ambler G, Cope TM, et al. The effect of neoadjuvant chemotherapy on physical fitness and survival in patients undergoing oesophagogastric cancer surgery. Eur J Surg Oncol 2014; 40(10): 1313-20.
11. Hulzebos EH, Smit Y, Helders PP, van Meeteren NL. Preoperative physical therapy for elective cardiac surgery patients. Cochrane Database Syst Rev 2012; 11(11): Cd010118.
12. Hoogeboom TJ, Oosting E, Vriezekolk JE, Veenhof C, Siemonsma PC, de Bie RA, et al. Therapeutic Validity and Effectiveness of Preoperative Exercise on Functional Recovery after Joint Replacement: A Systematic Review and Meta-Analysis. PLoS One 2012; 7(5): e38031.
13. Ryan AM, Power DG, Daly L, Cushen SJ, Ní Bhuachalla Ē, Prado CM. Cancer-associated malnutrition, cachexia and sarcopenia: the skeleton in the hospital closet 40 years later. Proc Nutr Soc 2016; 75(2): 199-211.
14. Doganay E, Moorthy K. Prehabilitation for esophagectomy. J Thorac Dis 2019; 11(Suppl 5): S632-s8.
15. Minnella EM, Awasthi R, Loiselle SE, Agnihotram RV, Ferri LE, Carli F. Effect of Exercise and Nutrition Prehabilitation on Functional Capacity in Esophagogastric Cancer Surgery: A Randomized Clinical Trial. JAMA Surg 2018; 153(12): 1081-9.
16. Banugo P, Amoako D. Prehabilitation. BJA Education 2017; 17(12): 401-5.
17. Santa Mina D, van Rooijen SJ, Minnella EM, Alibhai SMH, Brahmbhatt P, Dalton SO, et al. Multiphasic Prehabilitation Across the Cancer Continuum: A Narrative Review and Conceptual Framework. Front Oncol 2020; 10: 598425.
18. Tew GA, Ayyash R, Durrand J, Danjoux GR. Clinical guideline and recommendations on pre-operative exercise training in patients awaiting major non-cardiac surgery. Anaesthesia 2018; 73(6): 750-68.
19. Pouwels S, Stokmans RA, Willigendael EM, Nienhuijs SW, Rosman C, van Ramshorst B, et al. Preoperative exercise therapy for elective major abdominal surgery: a systematic review. Int J Surg 2014; 12(2): 134-40.
20. Hughes MJ, Hackney RJ, Lamb PJ, Wigmore SJ, Christopher Deans DA, Skipworth RJE. Prehabilitation Before Major Abdominal Surgery: A Systematic Review and Meta-analysis. World J Surg 2019; 43(7): 1661-8.
21. Santa Mina D, Clarke H, Ritvo P, Leung YW, Matthew AG, Katz J, et al. Effect of total-body prehabilitation on postoperative outcomes: a systematic review and meta-analysis. Physiotherapy 2014; 100(3): 196-207.
22. Minnella EM, Bousquet-Dion G, Awasthi R, Scheede-Bergdahl C, Carli F. Multimodal prehabilitation improves functional capacity before and after colorectal surgery for cancer: a five-year research experience. Acta Oncol 2017; 56(2): 295-300.
23. Hara T, Kogure E, Kubo A, Kakuda W. Does pre-operative physical rehabilitation improve the functional outcomes of patients undergoing gastrointestinal cancer surgery? J Phys Ther Sci 2021; 33(3): 299-306.
24. Oken MM, Creech RH, Tormey DC, Horton J, Davis TE, McFadden ET, et al. Toxicity and response criteria of the Eastern Cooperative Oncology Group. Am J Clin Oncol 1982; 5(6): 649-55.
25. McCulloch P, Ward J, Tekkis PP. Mortality and morbidity in gastro-oesophageal cancer surgery: initial results of ASCOT multicentre prospective cohort study. Bmj 2003; 327(7425): 1192-7.
26. Papenfuss WA, Kukar M, Oxenberg J, Attwood K, Nurkin S, Malhotra U, et al. Morbidity and mortality associated with gastrectomy for gastric cancer. Ann Surg Oncol 2014; 21(9): 3008-14.
27. Low DE, Kuppusamy MK, Alderson D, Cecconello I, Chang AC, Darling G, et al. Benchmarking Complications Associated with Esophagectomy. Ann Surg 2019; 269(2): 291-8.
28. Blencowe NS, Strong S, McNair AG, Brookes ST, Crosby T, Griffin SM, et al. Reporting of short-term clinical outcomes after esophagectomy: a systematic review. Ann Surg 2012; 255(4): 658-66.
29. Jordan T, Mastnak DM, Palamar N, Kozjek NR. Nutritional Therapy for Patients with Esophageal Cancer. Nutr Cancer 2018; 70(1): 23-9.
30. Ryu SW, Kim IH. Comparison of different nutritional assessments in detecting malnutrition among gastric cancer patients. World J Gastroenterol 2010; 16(26): 3310-7.
31. Muscaritoli M, Arends J, Bachmann P, Baracos V, Barthelemy N, Bertz H, et al. ESPEN practical guideline: Clinical Nutrition in cancer. Clinical Nutrition 2021; 40(5): 2898-913.
32. Clavien PA, Barkun J, de Oliveira ML, Vauthey JN, Dindo D, Schulick RD, et al. The Clavien-Dindo classification of surgical complications: five-year experience. Ann Surg 2009; 250(2): 187-96.
33. Faithfull S, Turner L, Poole K, Joy M, Manders R, Weprin J, et al. Prehabilitation for adults diagnosed with cancer: A systematic review of long-term physical function, nutrition and patient-reported outcomes. Eur J Cancer Care (Engl) 2019; 28(4): e13023.