Effect of multidisciplinary prehabilitation-rehabilitation on outcomes after colorectal surgery in elderly patients

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ABSTRACT

Objective. To determine the effect of the start-to-finish programme by comparing outcomes of elderly patients who underwent colorectal surgery before and after introduction of the programme.

Methods: Data of consecutive patients aged ≥ 75 years who underwent major colorectal surgery (open, minimally invasive, elective, or emergency) between February 2007 and November 2015 at our institution were collected prospectively. Postoperative outcomes of patients were compared before and after the July 2013 introduction of the start-to-finish programme. Patients were risk-stratified for decision on whether prehabilitation was required, based on frailty syndrome, weighted Charlson Comorbidity Index, and ambulatory status. Frailty was defined as presentation of three or more of the following criteria: unintentional weight loss, self-reported exhaustion, weakness (grip strength), slow walking speed, and low physical activity. Outcome measures included discharge destination, functional decline in terms of a loss of ≥ 10 points in the Barthel Index at postoperative week 6, length of hospital stay, postoperative complication in terms of a Clavien-Dindo score of ≥ 3 , and 30-day mortality.

Results: A total of 121 geriatric patients were recruited and followed up for a mean duration of 36 months. Of whom, 49 (40.1%) were recruited after the introduction of start-to-finish programme in July 2013. 34 (28.1%) of the 121 patients were determined to be frail. In multivariate analysis, frailty was the only predictor of discharge destination (odds ratio [OR]=6.067, $p=0.001$). Patients with a Clavien-Dindo score of ≥ 3 were more likely to have functional decline at postoperative week 6 (OR=83.926, $p=0.003$). The start-to-finish programme (OR=0.067, $p=0.023$) and elective surgery (OR=0.091, $p=0.024$) were associated with maintenance of functional. Frailty was associated with discharge to facilities other than home (OR=6.067, $p=0.001$) and a steeper decline on longer-term follow-up.

Conclusion: The start-to-finish programme had a positive effect on reducing functional decline after colorectal surgery. Frail patients and patients with major complications require special attention to mitigate the steep functional decline.

Key words: Colorectal Surgery; Frailty; Rehabilitation

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INTRODUCTION

In 2016, 4.7% of the Singapore population was aged >75 years. Although age is not an independent predictor of operative risk or surgical outcome,¹ frailty is of greater value in predicting surgical outcome and hospital stay.² Surgical outcomes, functional decline, and discharge destination are important outcome measures of holistic patient care.³

Prehabilitation is the process of enhancing the functional capacity of the patient to enable greater tolerance of a stressful event.⁴ In our institution, a start-to-finish multidisciplinary model of care has improved the surgical outcome of elderly patients who underwent major colorectal surgery.⁵ The regimen involves prehabilitation 2 weeks prior to surgery to improve nutrition, muscle strength, respiratory, and cardiovascular reserves, followed by a coordinated enhanced recovery and rehabilitation after surgery. This study aimed to determine the effect of the start-to-finish programme by comparing outcomes of elderly patients who underwent colorectal surgery before and after introduction of the programme.

METHODS

This study was approved by the Domain Specific Review Board of the National Health Group of Singapore. Data of consecutive patients aged ≥ 75 years who underwent major colorectal surgery (open, minimally invasive, elective, or emergency) between February 2007 and November 2015 at our institution were collected prospectively. Postoperative outcomes of patients were compared before and after the introduction of the start-to-finish programme (since July 2013). Patients were managed through the geriatric surgical service⁶ by a multidisciplinary team.

In the start-to-finish programme, patients were risk-stratified for decision on whether prehabilitation was required, based on frailty syndrome, weighted Charlson Comorbidity Index, and ambulatory status.^{7,8} Patients who underwent emergency operations were included in the postoperative component of coordinated enhanced recovery and rehabilitation.

The start-to-finish programme consisted of a multidisciplinary team with a nurse clinician, a physiotherapist, a geriatrician, an anaesthetist, a dietician, and a surgeon. Components of the

programme included education and ensuring compliance, cardiovascular strengthening, mobilising, muscle strengthening, and attention to nutrition.⁵ Prehabilitation aims to enable the patients to understand the disease and indication for surgery, to avoid a weight loss of >5% over 2 weeks, to achieve 100% of dietary requirements within 1 week, to improve the number of chair-to-stand repetitions by >10%, and to improve the 10-m walk test in terms of the number of steps and time by >3%.⁵ The modified Barthel Index was re-evaluated after 2 weeks. Postoperatively, the enhanced recovery programme aims to achieve early discharge home or to a community hospital.

Patients were evaluated pre-operatively, prior to discharge, at postoperative week 6, and at a mean follow-up of 18 months. Functional status was assessed using the Barthel Index. Discharge destination was stratified based on whether the patients returned to their original accommodation after discharge from the hospital. Other outcome measures included the length of hospital stay, postoperative complication in terms of a Clavien-Dindo score of ≥ 3 ,⁹ and 30-day mortality. Functional decline was defined as a loss of ≥ 10 points in the Barthel Index or mortality at postoperative week 6.⁹ Frailty was defined as presentation of three or more of the following criteria: unintentional weight loss, self-reported exhaustion, weakness (grip strength), slow walking speed, and low physical activity.⁸ A negative event was defined as a functional decline of ≥ 20 points of Barthel Index or death.

Statistical analyses were conducted using SPSS (Windows version 23; IBM Corp, Armonk [NY], US). Continuous variables were analysed using an independent-samples *t* test, whereas categorical variables were analysed using the Chi-squared test or Fisher's exact test. Survival was based on the Kaplan-Meier analysis. A *p* value of <0.05 was considered statistically significant.

RESULTS

A total of 121 geriatric patients were recruited and followed up for a mean duration of 36 (standard deviation, 24) months (**TABLE 1**). Of the 121 patients, 49 (40.1%) were recruited after the introduction of start-to-finish programme in July 2013; and 34 (28.1%) were considered to be frail.

TABLE 1
Patient characteristics (n=121)

Patient characteristic	No. (%) of patients or mean±SD
Male	69 (57.0)
Female	52 (43.0)
Age, y	80.92±74.97
American Society of Anesthesiologists score	
<3	53 (43.8)
≥3	68 (56.2)
Weighted Charlson Comorbidity Index	
<4	82 (67.8)
≥4	39 (32.2)
Frailty	
Yes	34 (28.1)
No	87 (71.9)
Pre-operative Barthel Index	93.66±45.100
Introduction of start-to-finish programme	
Before	72 (59.5)
After	49 (50.5)
Physiological and operative severity score for the enumeration of mortality and morbidity (mean %)	
Predicted mortality	13.8 (0.7-42.3)
Predicted morbidity	48.1 (2.8-73.1)
Predicted mortality (colorectal surgery)	8.29 (4.3-97.9)
Urgency of surgery	
Elective	100 (82.6)
Emergency	21 (17.4)
30-day mortality	
Yes	3 (2.5)
No	118 (97.5)
Postoperative complications	
Clavien-Dindo score of <3	111 (91.7)
Clavien-Dindo score of ≥3	10 (9.3)
Unplanned readmissions within 2 weeks of surgery	
Yes	6 (5.1)
No	109 (94.9)
Functional decline (loss of Barthel Index of ≥10) at postoperative week 6	
Yes	9 (7.4)
No	112 (92.6)
Barthel Index at postoperative week 6	92.7±45.10
Length of hospital stay, d	10.8±3.96

Three (2.5%) patients died within 30 days of surgery; 11 (9.3%) patients had a Clavien-Dindo score of ≥3. The median length of hospital stay was 7 days. Six (5.1%) patients had an unplanned readmission within 2 weeks of discharge.

Of the 121 patients, 98 (81.0%) were discharged home or to their original accommodation. Frail patients were less likely to be discharged home (61.8% vs 88.5%, $p=0.010$, **TABLE 2**). Nine (7.4%) patients had functional decline at postoperative week 6; functional decline was more likely in patients with a Clavien-Dindo score of ≥3 (40.0% vs 4.5%, $p=0.003$) and those with emergency surgery (23.8% vs 4.0%, $p=0.002$).

In multivariate analysis, frailty remained the only predictor of discharge destination (odds ratio [OR]=6.067, $p=0.001$, **TABLE 3**). Patients with a Clavien-Dindo score of ≥3 were more likely to have functional decline at postoperative week 6 (OR=83.926, $p=0.003$). The start-to-finish programme (OR=0.067, $p=0.023$) and elective surgery (OR=0.091, $p=0.024$) were associated with maintenance of function. Frailty was associated with discharge to facilities other than home (OR=6.067, $p=0.001$). Subgroup analysis of frail patients revealed that prehabilitation were associated with being discharged home (90.0% vs 50.0%, $p=0.032$). In Kaplan-Meier analysis, frail patients had a steeper functional decline rate ($p=0.022$, **FIGURE**).

DISCUSSION

Frailty is a clinical syndrome (determined by weight loss, gait speed, grip strength, physical activity, and physical exhaustion) pertinent to postoperative outcomes. In elderly patients, frailty is associated with increased postoperative morbidity and mortality.^{2,10-13} Frail patients recover less quickly from illness/surgery and are characterised by decreased physiological reserve.¹⁴

Patient-centred care has recently become a main goal for health care providers. Patient-centred outcomes address the functional decline, increased care needs, and discharge to a nursing home that results in loss of independence. These outcomes are associated with postoperative readmissions and death after discharge.¹⁵ In a study of critically ill patients aged >60 years and their treatment preferences, a significant proportion of patients would decline treatment if it resulted in functional and cognitive loss.¹⁶ Quality of life is most important to geriatric patients following cancer treatment and should be taken into account when evaluating treatment plans and outcomes.¹⁷

TABLE 2
Variables associated with discharge home and functional decline at postoperative week 6

Variable	Discharge home No. (%) of patients		p Value	Functional decline No. (%) of patients		p Value
	Yes	No		Yes	No	
Total	98 (81.0)	23 (19.0)		9 (7.4)	112 (92.6)	
Gender			0.378			0.544
Male	44 (84.6)	8 (15.4)		3 (5.8)	49 (94.2)	
Female	54 (78.3)	15 (22.7)		6 (4.3)	63 (95.7)	
Frailty			0.010			0.057
Yes	21 (61.8)	13 (38.2)		5 (14.7)	29 (85.3)	
No	77 (88.5)	10 (11.5)		4 (4.6)	83 (95.4)	
Introduction of start-to-finish programme			0.275			0.339
Before	56 (77.8)	16 (22.2)		4 (5.6)	68 (94.4)	
After	42 (85.7)	7 (15.3)		5 (10.2)	44 (89.8)	
Postoperative Clavien-Dindo score			0.095			0.003
<3	92 (82.9)	19 (17.1)		5 (4.5)	106 (95.5)	
≥3	6 (60.0)	4 (40.0)		4 (40.0)	6 (60.0)	
Urgency of surgery			0.066			0.002
Elective	84 (84.0)	16 (16.0)		4 (4.0)	96 (96.0)	
Emergency	14 (66.7)	7 (33.3)		5 (23.8)	16 (76.2)	

TABLE 3
Multivariate analysis for predictors for discharge home and functional decline at postoperative week 6

Variable	Discharge home	p Value	Functional decline	p Value
	Odds ratio (95% confidence interval)		Odds ratio (95% confidence interval)	
Weighted Charlson Comorbidity Index of ≥4	1.322 (0.386-4.521)	0.657	1.132 (0.155-8.250)	0.903
American Society of Anesthesiologists score of ≥3	1.714 (0.562-5.230)	0.344	0.839 (0.133-5.300)	0.852
Frailty	6.067 (2.002-18.383)	0.001	0.199 (0.029-1.353)	0.099
Elective surgery	1.772 (0.510-6.158)	0.368	0.091 (0.011-0.726)	0.024
Introduction of start-to-finish programme	1.270 (0.293-5.506)	0.750	0.067 (0.006-0.690)	0.023
Clavien-Dindo score of ≥3	0.252 (0.49-1.298)	0.099	83.926 (5.573-1263.797)	0.001

Our previous study focused on the short-term surgical outcomes before and after introduction of the start-to-finish programme.⁵ The present study focused on the impact of frailty on the longer term functional outcomes. The results show that frailty was associated with discharge to an institution instead of home after surgery (including elective), consistent with other studies.^{18,19} Health care costs are reduced when patients can return home with satisfactory functional outcome rather than requiring rehabilitation at an institution. Functional decline was associated with emergency surgery and presence of postoperative complications, whereas prehabilitation was associated with better functional outcome. Prehabilitation aims to maximise patients' functional status preoperatively in order to improve recovery. Frailty is a dynamic state that can be improved through interventions such as exercise.²⁰⁻²² A comprehensive geriatric assessment significantly

FIGURE. Kaplan Meier curves of patients with and without pre-operative frailty in terms of functional decline (a loss of Barthel Index of ≥20) or death

reduces medical complications and hospital stay.²³ In our institution, the geriatric surgical service has decreased morbidity and mortality in geriatric patients,⁵ and the prehabilitation programme has shortened the length of hospitalisation.⁶ Currently, there is no protocol to guide prehabilitation, but several randomised controlled trials on prehabilitation are underway.^{24,25} Nonetheless, frailty does not take cognitive aspects into account, and both frailty and cognitive impairment are predictors of postoperative survival.²⁶ Reduced cognitive reserve affects patient judgement of care needs. Preoperative cognitive intervention has been reported to improve postoperative cognitive function.^{25,27}

CONCLUSION

The start-to-finish programme had a positive effect on reducing functional decline after colorectal surgery. Frail patients and patients with major complications require special attention to mitigate the steep functional decline.

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DECLARATION

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