

Assessing the impact of frailty in elderly patients undergoing emergency laparotomies in Singapore

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ABSTRACT

Introduction: The global rise in ageing populations poses challenges for healthcare systems. By 2030, Singapore anticipates a quarter of its population to be aged 65 or older. This study addresses the dearth of research on frailty's impact on emergency laparotomy (EL) outcomes in this demographic, emphasising the growing significance of this surgical intervention.

Method: Conducted at 2 tertiary centres in Singapore from January to December 2019, a retrospective cohort study examined EL outcomes in patients aged 65 or older. Frailty assessment, using the Clinical Frailty Scale (CFS), was integrated into demographic, diagnostic and procedural analyses. Patient data from Tan Tock Seng Hospital and Khoo Teck Puat Hospital provided a comprehensive view of frailty's role in EL.

Results: Among 233 participants, 26% were frail, revealing a higher vulnerability in the geriatric population. Frail individuals exhibited elevated preoperative risk, prolonged ICU stays, and significantly higher 90-day mortality (21.3% versus 6.4%). The study illuminated a nuanced connection between frailty and adverse outcomes, underlining the critical need for robust predictive tools in this context.

Conclusion: Frailty emerged as a pivotal factor influencing the postoperative trajectory of older adults undergoing EL in Singapore. The integration of frailty assessment, particularly when combined with established metrics like P-POSSUM, showcased enhanced predictive accuracy. This finding offers valuable insights for shared decision-making and acute surgical unit practices, emphasising the imperative of considering frailty in the management of older patients undergoing emergency laparotomy.

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Keywords: emergency surgery, frailty, general surgery, geriatric medicine, surgery

CLINICAL IMPACT

What is New

- This study assesses the correlation between frailty and outcomes following emergency laparotomy in older patients in Singapore.
- Frail patients had a 3-fold higher 90-day mortality rate, longer ICU stays, and more postoperative complications.
- Mortality prediction following emergency laparotomies can be enhanced by combining P-POSSUM score with the Clinical Frailty Scale

Clinical Implications

- Integration of P-POSSUM score with Clinical Frailty Scale in acute surgical units can facilitate shared decision-making, assist in guiding preoperative optimisation, postoperative care and rehabilitation planning

INTRODUCTION

The ageing population is a growing global phenomenon. In 2019, 14.4% of the population in Singapore, equivalent to 3.9 million people,

were aged 65 years or older.¹ This percentage is expected to increase to 25% by 2030, primarily due to increased life expectancy and lower fertility rates.¹ Consequently, older patients are more likely to develop age-related physical impairments, frailty, sarcopenia, functional and cognitive impairments.² Emergency laparotomy (EL) is a common procedure for the treatment of acute abdominal catastrophes in Singapore. A significant proportion of these procedures are performed on the geriatric population, who tend to have higher postoperative morbidity, mortality and intensive care unit (ICU) resource utilisation rates.³ Older patients also have longer hospital and ICU stays after EL than younger patients.³ According to the latest patient report from the UK National Emergency Laparotomy Audit (NELA) covering December 2019 to November 2020, 1 in 5 older people undergoing emergency laparotomy was

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frail.⁴ Frailty is associated with greater risks of postoperative mortality and morbidity independent of age. Frailty has also been shown to predict adverse outcomes after emergency general surgery.⁵⁻⁷ The Asian population has been shown to have increased prevalence of frailty compared to the Western population.⁸ Additionally, the physique of Asian patients also differs, with lower muscle mass, higher body fat with central distribution and weaker handgrip strength; hence, it is possible that postoperative outcomes may differ. Thus, the objective of this study is to examine the impact of frailty on morbidity, mortality, length of hospital stay after EL, and to evaluate the performance of the Clinical Frailty Scale (CFS) as a predictor of mortality in a Singaporean population.

METHOD

Ethics approval was obtained from the National Healthcare Group Domain Specific Review Board (Ref: 2018/01227). A retrospective cohort study was conducted to investigate EL outcomes at 2 tertiary centres in Singapore, namely, Tan Tock Seng Hospital and Khoo Teck Puat Hospital, in the period of January 2019 to December 2019. Inclusion criteria were patients 65 years or older who underwent EL. Exclusion criteria were similar to the NELA guidelines and excluded laparotomies for trauma, vascular, gynaecological emergencies, relook laparotomy, appendectomy, cholecystectomy and non-gastrointestinal surgeries.⁴ The 11 key elements of the NELA guidelines—preoperative assessment, timely surgery, intraoperative excellence, postoperative monitoring, ICU and high dependency unit (HDU) care, recovery and ward care, nutrition and hydration, delirium management, physiotherapy and mobility, rehabilitation, and discharge planning—were adopted by both hospitals prior to the study. Postoperative geriatric assessments were recommended for patients aged ≥ 65 years in the hospital workflows.

Patient demographics, diagnoses and preoperative risk assessment using the Portsmouth Physiological and Operative Severity Score for the enumeration of Mortality and Morbidity (P-POSSUM) scores were collected. The physical state of patients before EL was assessed using the American Society of Anesthesiologists (ASA) Physical Status Classification System. The efficiency outcomes were also assessed, which include time from decision of surgery to time in operating theatre, presence of consultant surgeon and anaesthetist, number of geriatric assessment and patients admitted into HD/ICU. The priority (P) accorded to each EL was also recorded. In our

institution, P1 refers to procedures that were performed within 1 hour; P2 for procedures undertaken within 4 hours; and P3 denotes those that took place within 24 hours. The CFS was used to classify patients into either frail (CFS 5–9) or non-frail (CFS 1–4) categories and was calculated by the attending physicians upon admission, as it was found to be a valid and reproducible score that is simple to understand and apply. For the purpose of clarity and comprehension, it is important to note that in this context, the CFS is designated as 5 and above, as opposed to the recently revised classification by Rockwood, which includes CFS 4 for mildly frail individuals. This distinction ensures a clearer understanding of the frailty categorisation in the context of the study. Postoperative complications were defined as incidence of any medical and/or surgical complications postoperatively deviating from the normal postoperative course, and were graded according to the Clavien-Dindo classification system. Postoperative geriatric assessment rates were also compared. Data on length of stay (LOS), 90-day mortality, 30-day readmission and ICU/HDU utilisation were evaluated. Prolonged LOS was defined as >14 days; while there is no standard definition for “prolonged” in existing literature, we used an arbitrary cut-off of 14 days based on the Seventh Patient Report of the NELA,⁴ which showed median LOS of 14 days for patients aged ≥ 65 years and with CFS ≥ 5 , as well as the first United Kingdom report on patient outcomes following EL, with median LOS of 16 days.⁹ Percentages were used for categorical data and means with standard deviations (SD) for continuous data unless otherwise specified. Comparisons between groups for categorical data were made using chi-squared test or Fisher’s Exact test, whereas comparisons between groups for continuous data were made using Student’s t-test for parametric distribution, and Mann-Whitney U test for non-parametric distribution. All *P* values <0.05 were considered statistically significant, and all *P* values were 2-tailed.

We analysed the outcomes of older adults who underwent EL using univariate and multivariate logistic regression, to compare between the frail and non-frail groups. Age ≥ 75 years, P-POSSUM mortality $>10\%$, and lack of geriatrician assessment were used as covariates for multivariate logistic regression. The accuracy of P-POSSUM and CFS in predicting 90-day mortality rates were evaluated using Receiver Operating Characteristic (ROC) curve. *P* <0.05 was considered statistically significant. We performed all statistical analyses using SPSS version 25 (SPSS, SPSS Inc, Chicago, IL, US).

RESULTS

The analysis included a total of 233 participants, 61 (26%) of whom were frail and 172 (74%) were non-frail (Table 1). Within the frail group, 28 (45.9%) of the 61 patients were male with a mean age of 79 years (SD ± 7). Moreover, the frail group tended to have poorer pre-operative physical status, with 56 (91.8%) having a high ASA grade of 3–5,

and the majority of the population being at ASA 3 with 41 patients (67.2%). A total of 40 (65.6%) patients had P-POSSUM mortality risk $\geq 10\%$, and the mean P-POSSUM score was 25.2 ± 25.1 . The most common indications for EL were intestinal obstruction (47.6%), gastric or bowel perforation (29.5%), and bowel ischemia (9.8%), as shown in Table 1.

Table 1. Demographics and characteristics.

Demographics and characteristics	n (%) / mean $\pm$ SD		P value
	CFS 1–4	CFS 5–9	
Total cases (n)	172	61	–
Mean age (years)	75 $\pm$ 7	79 $\pm$ 7	<0.01
Gender			
Male	94 (54.7%)	28 (45.9%)	0.30
Female	78 (45.3%)	33 (54.1%)	
BMI	23.2 $\pm$ 4.8	23.0 $\pm$ 5.4	0.88
ASA			
1	1 (0.6%)	1 (1.6%)	0.46
2	47 (27.3%)	4 (6.6%)	<0.01
3	95 (55.2%)	41 (67.2%)	0.14
4	29 (16.9%)	14 (23.0%)	0.39
5	0	1 (1.6%)	–
3–5	124 (72.1%)	56 (91.8%)	<0.01
P-POSSUM			
P-POSSUM mortality (%)	18.6 $\pm$ 22.9	25.2 $\pm$ 25.1	0.06
Low (<5%)	54 (31.4%)	4 (6.5%)	<0.01
Medium (5–10%)	34 (19.8%)	17 (27.9%)	0.26
High (>10%)	84 (48.8%)	40 (65.6%)	0.04
Indication for surgery			
Intestinal obstruction	90 (52.3%)	29 (47.6%)	0.62
Gastric / bowel perforation	46 (26.7%)	18 (29.5%)	0.80
Bowel ischaemia	16 (9.3%)	6 (9.8%)	0.90
Adhesiolysis	8 (4.7%)	4 (6.6%)	0.52
Bleeding	7 (4.1%)	1 (1.6%)	0.68
Hernia	3 (1.7%)	2 (3.3%)	0.61
Others*	2 (1.2%)	1 (1.6%)	1.00

ASA: American Society of Anesthesiologists; BMI: body mass index; CFS: Clinical Frailty Scale; P-POSSUM: Portsmouth Physiological and Operative Severity Score for the enumeration of Mortality and Morbidity; SD: standard deviation

*Others include anastomotic leak and abdominal infection

When comparing frail versus non-frail groups, there was significant differences in mean age (79 ± 7 versus [vs] 75 ± 7 , $P < 0.01$), ASA status (6.6% ASA 2, 91.8% ASA 3–5 vs 27.3% ASA 2, 72.1% ASA 3–5, $P < 0.01$), and P-POSSUM score 6.5% low ($< 5\%$) vs 31.4% low, $P < 0.01$ and P-POSSUM score 65.5% high ($> 10\%$) vs 48.8% high, with frail older patients having a higher ASA status and P-POSSUM score. However, other characteristics, such as gender, BMI and indications for surgery, were not statistically significant.

In terms of efficiency outcomes (Table 2), postoperative geriatric assessments were low, the frail group having received more assessments than the non-frail group (49.2% vs 27.9%, $P < 0.01$). Other pre-operative (time from decision for surgery to time in operating theatre [OT] at start of surgery), intraoperative (presence of consultant anaesthetists and surgeons in OT), and postoperative (P-POSSUM $> 10\%$ patients admitted to ICU/HDU) efficiency outcomes were not statistically significant.

Concerning clinical outcomes (Table 3), frail patients had longer LOS in ICU/HDU, i.e. 2.0 days (interquartile range [IQR]=1.0–6.5) vs 1.0 day (IQR=0–4.0), $P < 0.01$; and higher 90-day mortality (21.3% vs 6.4%, $P < 0.01$). Other clinical outcomes, such as postoperative complications, unplanned return to OT, overall length of stay, 30-day mortality and 30-day readmission, were higher in frail patients but were not statistically significant.

Multivariate analysis (Table 4) revealed that P-POSSUM mortality $> 10\%$ (OR 10.601, 95% CI 2.363–47.547, $P < 0.01$) and CFS 5–9 (OR 3.238, 95% CI 1.263–8.300, $P = 0.014$) were independent predictors of 90-day mortality. Age > 75 years old was also found to be an independent predictor for prolonged LOS > 14 days (OR 2.848, 95% CI 1.595–5.086, $P < 0.01$), ICU/HDU utilisation (OR 2.502, 95% CI 1.164–5.380, $P = 0.019$), and 30-day readmission (OR 2.845, 95% CI 1.266–6.391, $P = 0.011$). ASA 3–5 (OR 3.708, 95% CI 1.709–8.045, $P = 0.001$), P-POSSUM mortality $> 10\%$ (OR 6.022, 95% CI 2.782–13.036, $P = 0.00$), and lack of postoperative geriatric assessment (OR 3.366, 95% CI 1.579–7.172, $P < 0.01$) were also identified as independent predictors of ICU/HDU utilisation. In addition, frail patients were found to be associated with 3 times more postoperative complications compared to non-frail patients (OR 3.038, 95% CI 1.528–6.039, $P = 0.002$).

A scatter plot of CFS against incidence of 90-day mortality was plotted (Fig. 1). With increasing CFS, incidence of 90-day mortality also increased. However, based on the scatter plot, it appears that the relationship between CFS and 90-day mortality is nonlinear, with a sharp increase in 90-day mortality when CFS was 8 or 9.

The Area Under the Receiver Operating Characteristic (AUROC) and 95% CI for P-POSSUM

Table 2. Efficiency outcomes.

Efficiency outcomes	n (%) / mean $\pm$ SD		
	CFS 1–4	CFS 5–9	P value
Total cases (n)	172	61	
Pre-operative			
Time from decision for surgery to time in OT (min)	159 $\pm$ 177	159 $\pm$ 163	0.99
P1 operations (min) [n=26]	42.2 $\pm$ 23.2	51.2 $\pm$ 19.4	0.40
P2 operations (min) [n=181]	143.3 $\pm$ 116.8	134.7 $\pm$ 110.0	0.65
P3 operations (min) [n=26]	381.5 $\pm$ 344.5	470.0 $\pm$ 260.0	0.57
Intraoperative			
Consultant surgeon presence in OT	160 (93.0%)	58 (95.1%)	0.76
Consultant anaesthetist presence in OT	98 (57.0%)	36 (59.0%)	0.90
Postoperative			
Geriatric assessment	48 (27.9%)	30 (49.2%)	< 0.01
P-POSSUM $> 10\%$ patients admitted to critical care (HD/ICU)	74/84 (88.1%)	37/40 (92.5%)	0.55

CFS: Clinical Frailty Scale; HD: high dependency; ICU: intensive care unit; OT: operating theatre; P1: Priority 1 operations; P2: Priority 2 operations; P3: Priority 3 operations; P-POSSUM: Portsmouth Physiological and Operative Severity Score for the enumeration of Mortality and Morbidity; SD: standard deviation

Table 3. Clinical outcomes.

Clinical outcomes	n (%) / median [IQR]		P value
	CFS 1–4	CFS 5–9	
Total cases	172	61	
Postoperative complications			
Clavien-Dindo III	21 (12.2%)	7 (11.5%)	0.88
Clavien-Dindo IV	9 (5.2%)	4 (6.6%)	0.75
Clavien-Dindo V	10 (5.8%)	6 (9.8%)	0.44
Unplanned return to OT	9 (5.2%)	4 (6.6%)	0.75
Hospital length of stay (days)			
Overall length of stay, median [IQR]	13.0 [8.0–22.8]	16.0 [9.5–25.0]	0.147
Critical care days, median [IQR]	1.0 [0–4.0]	2.0 [1.0–6.5]	<0.01
Mortality			
30-day mortality	8 (4.7%)	8 (13.1%)	0.051
90-day mortality	11 (6.4%)	13 (21.3%)	<0.01
30-day readmission	25 (14.5%)	14 (23.0%)	0.19

CFS: Clinical Frailty Scale; IQR: interquartile range; OT: operating theatre

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mortality >10% and CFS ≥ 5 in predicting 90-day mortality were 0.83 (0.76–0.90) and 0.68 (0.55–0.80), respectively. The AUROC and 95% CI for P-POSSUM in predicting 90-day mortality in frail and non-frail groups were 0.75 (0.61–0.89) and 0.88 (0.82–0.95), respectively (Fig. 2). This result shows that the AUROC of P-POSSUM was better in the non-frail group than in the frail group ($P<0.01$). These results suggest that P-POSSUM mortality >10% is a better discriminator of outcomes in the older population for predicting 90-day mortality. When comparing the use of P-POSSUM mortality >10% vs P-POSSUM mortality >10% + CFS ≥ 5 in predicting the 90-day mortality rate, P-POSSUM + CFS (AUROC=0.83) and P-POSSUM (AUROC=0.83) had comparable AUROC scores. However, P-POSSUM + CFS had a slightly better AUPRC (positive predictive value) of 0.42 against 0.38 for P-POSSUM, $P=0.19$. This indicates that P-POSSUM + CFS is more likely to predict 90-day mortality if both criteria were fulfilled (i.e. P-POSSUM mortality >10% and CFS ≥ 5).

DISCUSSION

Frail older patients typically present with a greater burden of symptoms, including fatigue, medical complexity, and reduced tolerance for medical and surgical interventions such as emergency

laparotomy.¹⁰ The emergency laparotomy and frailty trial in the UK has demonstrated that frailty is associated with higher postoperative mortality and morbidity, independent of age.⁵ Genetic heterogeneity, socio-economic dynamics, cultural paradigms, healthcare accessibility and lifestyle choices collectively contribute to the distinctive portrayal and implications of frailty in Asian societies. These factors may exert influence over the prevalence, phenotypic expression and consequent outcomes associated with frailty. This study adds valuable input to existing literature on the impact of frailty on Asian older patients undergoing EL. Up to 26% of older patients undergoing EL in this study were frail. Frailty was an independent predictor of postoperative mortality and was associated with 3-fold higher mortality compared to the non-frail.

Both 30-day and 90-day mortality rates were higher in the frail as compared to the non-frail but the difference was more pronounced in the latter. The 90-day mortality rate was 1 in 5 (21.3%) for frail patients as compared to 6.4 % in the non-frail. Complications related to functional decline and long-term mortality risk can occur in frail patients during their hospitalisation stay, which may not be captured within the first 30 days after surgery. These complications can manifest later in the postoperative period, such as pneumonia

Table 4. Results of univariate and multivariate analyses of factors associated with outcomes in older adults undergoing emergency laparotomy.

	Univariate				Multivariate			
	OR	95% CI		P value	OR	95% CI		P value
		Lower	Upper			Lower	Upper	
90-day mortality								
Age >75 years old	1.715	0.719	4.093	0.224	0.852	0.326	2.226	0.743
P-POSSUM mortality >10%	11.539	2.646	50.323	0.001	10.601	2.363	47.547	0.002
CFS 5–9	3.964	1.669	9.417	0.002	3.238	1.263	8.300	0.014
Without geriatrician input	0.675	0.285	1.598	0.372	0.834	0.323	2.151	0.707
Prolonged LOS >14 days								
Age >75 years old	3.545	2.065	6.088	0.000	2.848	1.595	5.086	0.000
ASA 3–5	2.585	1.342	4.978	0.005	1.630	0.799	3.324	0.179
P-POSSUM mortality >10%	2.311	1.364	3.916	0.002	1.665	0.943	2.939	0.079
CFS 5–9	1.700	0.943	3.067	0.078	1.223	0.636	2.350	0.546
Without geriatrician input	1.182	0.685	2.041	0.549	1.385	0.761	2.521	0.287
Critical care utilisation								
Age >75 years old	4.098	2.147	7.823	0.000	2.502	1.164	5.380	0.019
ASA 3–5	5.589	2.882	10.837	0.000	3.708	1.709	8.045	0.001
P-POSSUM mortality >10%	7.622	3.767	15.424	0.000	6.022	2.782	13.036	0.000
CFS 5–9	2.951	1.312	6.638	0.009	1.994	0.760	5.231	0.161
Without geriatrician input	2.070	1.134	3.778	0.018	3.366	1.579	7.172	0.002
30-day readmission								
Age >75 years old	2.941	1.386	6.242	0.005	2.845	1.266	6.391	0.011
ASA 3–5	1.759	0.694	4.456	0.234	1,239	0.456	3.367	0.675
P-POSSUM mortality >10%	1.031	0.517	2.055	0.931	0.730	0.348	1.533	0.406
CFS 5–9	1.751	0.842	3.642	0.133	1.380	0.626	3.044	0.425
Without geriatrician input	0.769	0.378	1.568	0.470	0.899	0.425	1.900	0.780

Values in bold indicate where P is <0.05 and of statistical significance.

ASA: American Society of Anesthesiologists; BMI: body mass index; CFS: Clinical Frailty Scale; CI: confidence interval; LOS: length of stay; OR: odds ratio; P-POSSUM: Portsmouth Physiological and Operative Severity Score for the enumeration of Mortality and Morbidity

or thromboembolic events due to prolonged bed rest or hospitalisation. While these complications may not be immediately fatal, they can significantly impact a patient's quality of life and contribute to long-term mortality risk. Therefore, using 90-day mortality as an outcome metric may provide a more representative assessment of a frail patient's postoperative outcome, as it allows for the identification of late complications and the impact of postoperative functional decline on mortality. Of note, incidence of 90-day mortality for CFS 8

and 9 were 50% and 100%, respectively, which is markedly higher compared to that of CFS 1–7. This is apparent from Fig. 1, which shows a nonlinear relationship between increasing CFS and incidence of 90-day mortality. Ideally, subgroup analysis should be performed for patients with CFS 5–7 and CFS 8–9 to ensure results are not falsely skewed by inclusion of more frail patients (i.e. CFS 8–9). However, these patients form only a minority of all frail patients, rendering subgroup analysis impossible due to a small sample size. Additionally,

Fig. 1. Scatter plot of CFS and 90-day mortality in older adults undergoing EL.

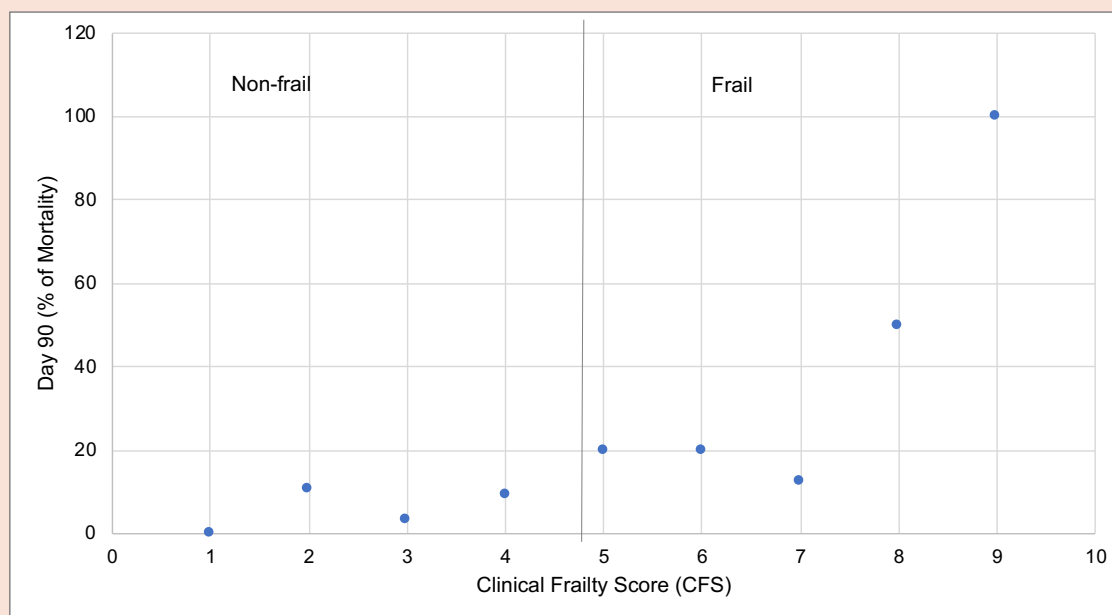
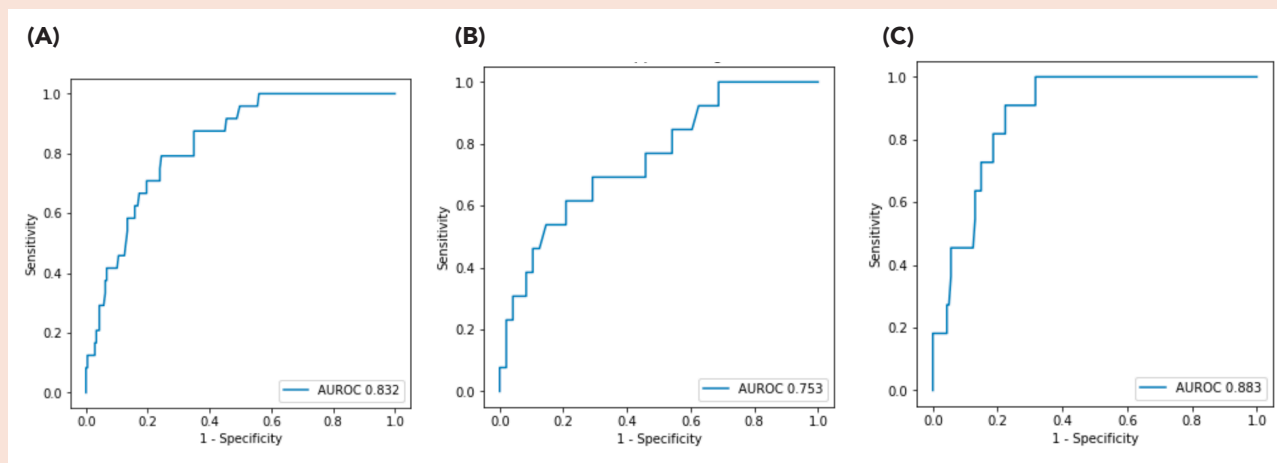


Fig. 2. AUROC of P-POSSUM (A) for all patients (B) for frail patients (C) for non-frail patients.



the use of CFS ≥ 5 has been investigated in existing studies for older patients undergoing EL with similar results as our study.¹¹ The duration of ICU stay was also longer in frail patients and this was associated with higher 90-day mortality. Aggressive treatments commonly administered in the ICU, such as mechanical ventilation and vasopressor support, have been described to be associated with increased risk of complications and mortality in frail patients.¹²

We sought to evaluate the clinical utility of combining the established P-POSSUM score with the CFS in predicting 90-day mortality. Interestingly, the discriminative power of the CFS alone for predicting 90-day mortality was modest, with an AUROC of 0.675 (0.550–0.799). Our findings

suggest that a combination of predictors may be more useful, particularly given that the P-POSSUM score performed better in predicting 90-day mortality in the non-frail group. This highlights the potential contribution of frailty to mortality beyond the components of the P-POSSUM score. Our results support the clinical utility of combining P-POSSUM and CFS scores to improve mortality prediction in older patients undergoing EL. To improve the identification of high-risk patients who may benefit from preoperative optimisation and the involvement of senior clinicians, integrating frailty scoring into acute surgical units could be helpful. This can facilitate shared decision-making and discharge planning, which is crucial for improving patient outcomes and reducing hospital

readmissions. By identifying patients who are at increased risk for complications and poor outcomes, clinicians can provide targeted interventions and individualised care plans to optimise patient outcomes.

This study found that postoperative geriatrician assessment was associated with lower intensive care use, although geriatrician engagement remained low for both frail and non-frail patients (49.2% and 27.9%, respectively). The decision for ICU/HDU admission usually arises preoperatively or immediately postoperatively based on holistic assessment of a patient's co-morbidities, vital parameters, laboratory and radiological investigations. Should patients require postoperative ICU/HDU admission, this usually happens immediately postoperatively due to postoperative events, such as inability to extubate and haemodynamic instability requiring inotropes. Therefore, it is unlikely that the lack of postoperative geriatric assessment will directly predict ICU/HDU utilisation. Instead, it is more likely that postoperative geriatric assessments were carried out in patients who were more frail and had more co-morbidities that required ICU/HDU admission.¹³ Use of comprehensive geriatric care models with pre-operative geriatric assessment, nutritional assessment and interventions, as well as postoperative follow-up have been shown to reduce mortality and major morbidity for older patients undergoing elective colorectal surgery.¹⁴ Hence, the role of postoperative geriatrician assessment may similarly be useful. The American College of Surgeons and the American Geriatrics Society highlighted that older patients are at higher risk of postoperative delirium, functional decline, pulmonary complications and urinary tract infections, and recommended for the implementation of geriatric care models for multidisciplinary and holistic management of older patients.^{15,16} Further studies should evaluate the incidence of specific complications as mentioned above to truly identify the clinical utility of postoperative geriatric assessment.

There were several limitations to our study that should be considered. The length of rehabilitation in community hospitals was not accounted for in our study. To assess the true duration of institutionalisation and loss of independence, the total length of stay in both acute and community hospitals should be evaluated. The meta-analysis by Kennedy et al. showed increased LOS in the frail (n=3 studies, mean difference 3.91 days, 95% CI: 0.18-7.63 days, $p<0.05$).¹⁷ However, our study did not show any statistical significance between frail and non-frail patients (16.0 vs. 13.0 days, $p=0.147$). Kennedy et al. attributed the

increased length of stay among the frail in his study to postoperative complications or discharge to a skilled care facility. Similarly, in the local setting, many frail surgical patients were transferred to community hospitals for further rehabilitation but this was not accounted for in total LOS. Additionally, the variability and heterogeneity of surgical pathology can make accurate comparisons challenging, particularly as certain pathologies are known to be associated with higher morbidity. The sample size was also considerably smaller for the cohort of frail patients, which we attempted to circumvent through inclusion of patient data from 2 institutions. In view of the small sample size, subgroup analysis for specific indications for emergency laparotomy was also not possible as this would further dilute the sample size. In addition, there was incomplete data on patients' co-morbidities such as Charlson Comorbidity Index and specific type of postoperative complications outcomes which may have influenced the prediction of postoperative mortality. Nonetheless, this study was necessary to understand the significance of frailty in patients undergoing EL in Singapore and serves as a springboard for shared decision-making on the ground and development of potential strategies to mitigate frailty.

CONCLUSION

Up to a quarter of the older population who underwent EL were frail. Frail patients were associated with a longer length of stay in the ICU and a 90-day mortality rate more than 3 times that of their non-frail counterparts. The combination of PPOSSUM with CFS was shown to improve the positive predictive value for mortality following EL. Since frailty scoring was a significant predictor of 90-day mortality, integrating it into acute surgical units to facilitate shared decision-making should be considered.

Declaration

The study was not supported by any grant or foundation. The authors declare that they have no affiliations with or involvement in any organisation or entity with any financial interest in the subject matter or materials discussed in this manuscript.

Ethics

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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