

Frailty and Upper Gastrointestinal Surgery: Initial Findings from Thailand's First Surgical Frailty Study

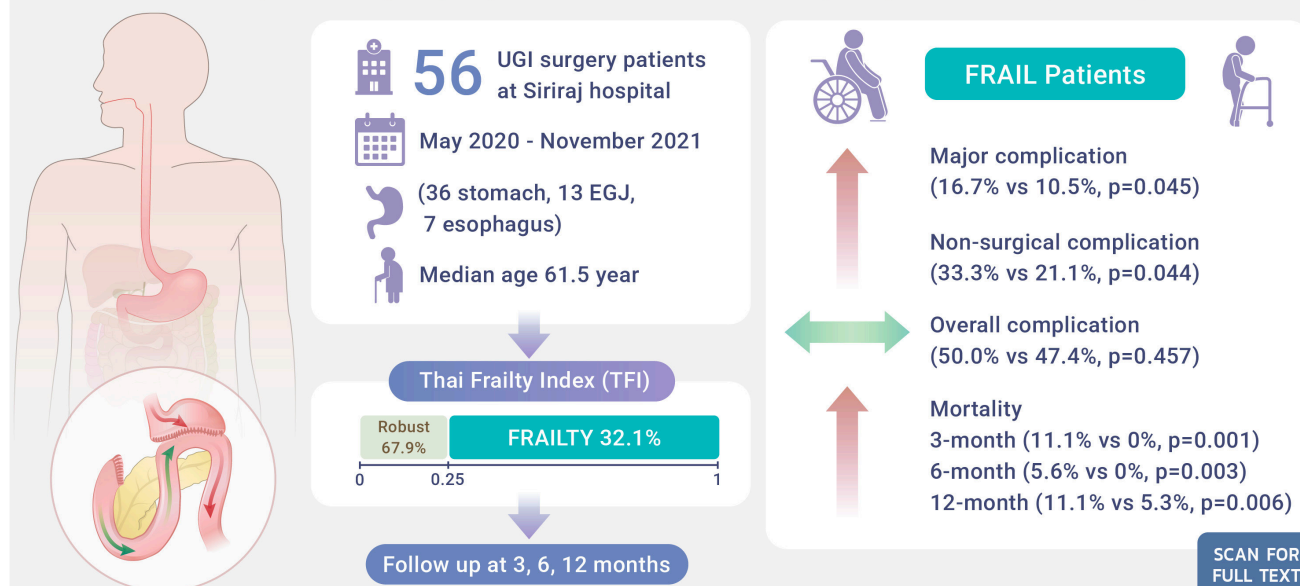
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Prevalence of frailty and its association with short term outcome in upper GI surgery patients

THAILAND'S FIRST SURGICAL FRAILTY STUDY

Frailty is associated with worse short-term outcomes and higher postoperative mortality.
Frailty screening may improve risk stratification and perioperative care planning.



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ABSTRACT

Objective: Thailand's aging population has led to an increase in elderly patients undergoing major surgery. Frailty is a key predictor of adverse surgical outcomes, but its impact in Thai patients remains underreported. This study aimed to determine the prevalence of frailty and its association with short-term postoperative outcomes among patients undergoing upper gastrointestinal (UGI) surgery.

Materials and Methods: This prospective cohort study included all adult patients undergoing elective UGI surgery at Siriraj Hospital between May 2020 and November 2021. Preoperative frailty was assessed using the Thai Frailty Index (TFI), with scores >0.25 indicating frailty. Demographic data, surgical details, and postoperative outcomes — including complications and survival at 3, 6, and 12 months — were compared between frail and robust groups.

Results: Among 56 patients (median age 61.5 years), 18 (32.1%) were classified as frail. Frail patients were significantly older and had poorer functional status and nutritional risk. Frail patients also underwent fewer resection procedures (61.1% vs 84.2%, $p=0.001$). While the overall complication rate did not differ significantly between groups (50.0% vs 47.4%; $p=0.457$), frail patients experienced higher rates of major complications (16.7% vs 10.5%; $p=0.045$) and non-surgical complications (33.3% vs 21.1%; $p=0.044$). Mortality was significantly higher in the frail group at 3, 6, and 12 months postoperatively ($p=0.001$, 0.003, 0.006 respectively).

Conclusion: Frailty is common among Thai patients undergoing UGI surgery and is associated with worse short-term outcomes and higher postoperative mortality. Routine frailty screening using the TFI may improve preoperative risk stratification and perioperative care planning.

Keywords: Frailty; Thai frailty index; Upper gastrointestinal surgery; Postoperative complication; Mortality (Siriraj Med J 2025; 77: 574-582)

INTRODUCTION

At present, Thailand is experiencing a demographic shift towards an aging society, attributed to advancements in medical care. According to data from the National Statistical Office in 2017, approximately 11 million people in Thailand are aged 60 years or older, representing approximately 16% of the total population. However, previous studies have shown that chronological age does not always accurately reflect actual physical fitness or functional performance in elderly individuals.¹ This discrepancy between chronological age and physiological age can significantly influence postoperative recovery and the risk of complications. Frailty, a clinical condition characterized by increased vulnerability due to age-related decline across multiple physiological systems, has gained considerable attention in geriatric medicine.^{2,3} The reduced physiological reserve seen in frail individuals renders them especially susceptible to the adverse effects of surgical stress, leading to unfavorable postoperative outcomes in approximately 25%-50% of patients.⁴ Previous studies have highlighted the impact of frailty on post-surgery outcomes, revealing that elderly patients classified as frail are more likely to experience higher rates of complications, lower quality of life after surgery, and lower survival rates compared to robust patients.⁵⁻¹³ However, no studies to date have examined the relationship between frailty and surgical outcomes in Thailand.

Frailty can be identified and assessed using various tools, such as the Modified Frailty Index¹⁴, Preoperative Modified Frailty Index¹⁵, Clinical Frailty Scale¹⁶, assessments of Sarcopenia¹⁷, the Groningen Frailty Indicator¹⁸, and the Study of Osteoporotic Fractures (SOF).⁶ However, there is currently no universally accepted gold standard for frailty assessment. In Thailand, the Thai Frailty Index (TFI) was developed to predict long-term mortality in the elderly population³. Despite this, surgical patients in Thailand have not yet been evaluated using this tool.

Diseases affecting the upper gastrointestinal (UGI) tract, particularly cancer, continue to pose significant public health challenges. Surgery remains the mainstay treatment modality for most UGI diseases, but it is associated with a high overall complication rate, including procedure-related adverse events and prolonged hospital stays. Adequate preoperative preparation, including nutritional assessment and frailty assessment, is crucial for reducing morbidity.¹⁹⁻²¹ In recent years, the Enhanced Recovery After Surgery (ERAS) program has become increasingly popular,²² including in UGI surgery. The ERAS protocol aims to facilitate faster recovery and minimize surgical stress through a comprehensive approach involving pre-operative optimization, minimally invasive surgical techniques, and postoperative care.²³⁻²⁶ Compared to the era of traditional peri-operative care, ERAS has demonstrated its advantages in promoting faster recovery and reducing

hospital stay.²⁷ The objective of this study is to determine the prevalence of frailty among surgical patients and to evaluate its impact on short-term postoperative outcomes.

MATERIALS AND METHODS

Patient selection

This single-center prospective cohort study was conducted at Siriraj Hospital. We recruited patients aged 18 years and older who underwent elective upper gastrointestinal surgery for either benign or malignant diseases between May 2020 and November 2021. Emergency cases, individuals with limited understanding or inability to answer the questionnaire, and those who were bedridden or unable to perform physical tests were excluded. Frailty was assessed preoperatively using the Thai Frailty Index (TFI), which includes 30 dichotomous variables covering medical comorbidities, functional status, and physical and emotional health. The frailty index was calculated by dividing the number of deficits identified by the total number of items. Patients with a TFI > 0.25 were classified as frail, while those with TFI ≤ 0.25 were considered robust. In this study, the TFI was used to categorize patients as either frail or robust prior to surgery. Subsequent treatment decisions were made through standard counseling between the doctor and patient in the outpatient department, without considering frailty status. Starting in 2020, all surgical patients were managed according to the ERAS protocol, in accordance with our faculty's policy. The details of our protocol were previously published in a separate study.²⁶

Data collection

Clinicopathological characteristics were recorded, including age, gender, body mass index (BMI), the American Society of Anesthesiologists (ASA) classification, Eastern Cooperative Oncology Group (ECOG) scale, Charlson comorbidity index, comorbidities, nutritional status screening and assessment, preoperative diagnosis, disease location, operative approach, and surgical procedure. Cancers of the esophagus, esophagogastric junction (EGJ), and stomach were staged based on the 8th edition of the American Joint Committee on Cancer (AJCC) staging system.²⁸ Nutritional status was assessed using the Nutritional risk screening²⁹ and the Modified Nutrition Alert Form.³⁰

After surgery, we analyzed short-term postoperative outcomes, including length of hospital stay and postoperative complications, graded according to the Clavien-Dindo classification.³¹ Severe complications were defined as grade III or higher. Patients were followed up at 3, 6 and 12 months after hospital discharge. Data were collected during scheduled outpatient clinic visits. In

cases where a patient was unable to attend or did not have an appointment, follow-up data were obtained via telephone. During these follow-up assessments, we collected information on the patient's survival status.

The primary objective of this study was to determine the prevalence of frailty among patients undergoing UGI surgery and to assess its impact on short-term postoperative outcomes, including complication rates and survival. The study protocol was approved by the Institutional Review Board (IRB) of the Faculty of Medicine Siriraj Hospital, Mahidol University (certificate of approval no. Si 249/2020).

Statistical analysis

Continuous variables were presented as means with standard deviations or as medians with interquartile ranges. Group comparisons were conducted using the Student's t-test or the Mann-Whitney U test. Categorical variables were expressed as numbers and percentages, and comparisons were made using the chi-square test or Fisher's exact test. Univariable and multivariable logistic regression analyses were performed to identify factors associated with postoperative complications. Hazard ratios (HRs) and 95% confidence intervals were estimated using multivariate analysis. Variables with a P-value less than 0.05 in the univariate analysis were included in the multivariable model. A two-tailed P-value less than 0.05 was considered statistically significant. All statistical analyses were conducted using SPSS® version 30.0 (IBM, Armonk, New York, USA).

RESULTS

Demographic and baseline characteristics data

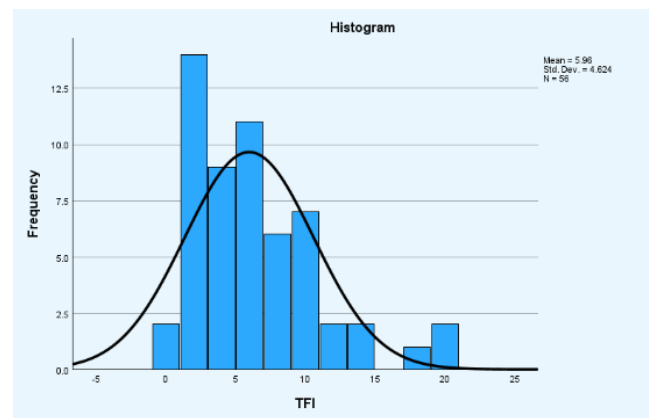
A total of 56 patients were enrolled in this study, comprising 29 male and 27 female patients. The median age was 61.5 years (IQR 56.25-74.75 years). The stomach was the most common primary disease site in this cohort, observed in 36 patients (64.3%), followed by the esophagogastric junction in 13 patients (23.2%), and the esophagus in seven patients (12.5%). Among the study population, 49 patients (87.5%) were diagnosed with malignant conditions, including 32 cases (57.1%) of adenocarcinoma, 13 cases (23.2%) of subepithelial tumor, and four cases (7.1%) cases of squamous cell carcinoma of the esophagus. The remaining seven patients (12.5%) were diagnosed with benign diseases. The median duration of symptoms prior to presentation was 2 months (IQR 1-6 months). In terms of surgical approach, 27 patients (48.2%) underwent open surgery, 15 patients (26.8%) underwent laparoscopic surgery, and 14 patients (25.0%) underwent a robot-assisted procedure.

Based on the Thai Frailty Index evaluation, the mean TFI score in this cohort was 6.0 ± 4.6 . The prevalence of frailty among upper gastrointestinal surgical patients was 18 cases (32.1%) (Fig 1). Patients in the frailty group had significantly higher median age (71.0 years vs 60.0 years, $p=0.042$), and a higher proportion of female patients (66.7 vs 39.5%, $p<0.001$). Frail patients also showed a trend toward lower BMI than robust patients. There were no significant differences between the two groups in terms of ASA classification or age-adjusted Charlson Comorbidity Index. However, the ECOG score was significantly higher in the frailty group ($p=0.003$), indicating worse functional status. Regarding preoperative nutritional status, frail patients were at significantly higher risk of malnutrition ($p<0.001$). Moreover, the Nutrition Alert Form assessment showed a trend toward more severe malnutrition among frail patients (Table 1).

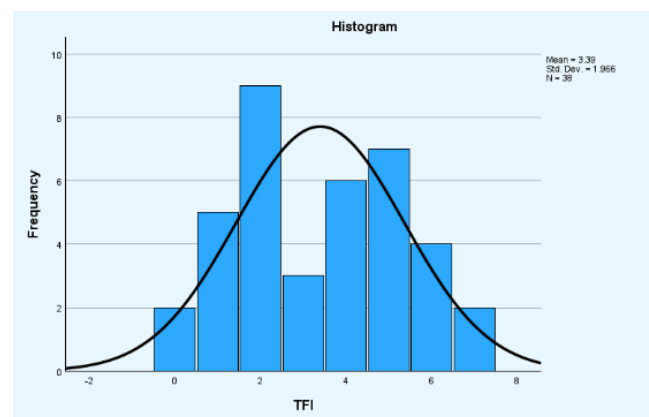
Surgical data and postoperative outcomes

All patients underwent surgical treatment according to standard clinical protocols. The operative approaches, either open or minimally invasive surgery, did not differ significantly between groups. However, a lower proportion of patients in the frailty group underwent resection surgery compared to the robust group (61.1% vs 84.2%, $p=0.001$). There was no significant difference in the overall postoperative complication rate between the frailty and robust groups (50.0% vs 47.4%, $p=0.457$). However, the incidence of major postoperative complications was significantly higher in the frailty group (16.7% vs 10.5%, $p=0.045$), as was the rate of non-surgical complications (33.3% vs 21.1%, $p=0.044$). There were no significant differences between the two groups in total hospital stay or postoperative length of stay.

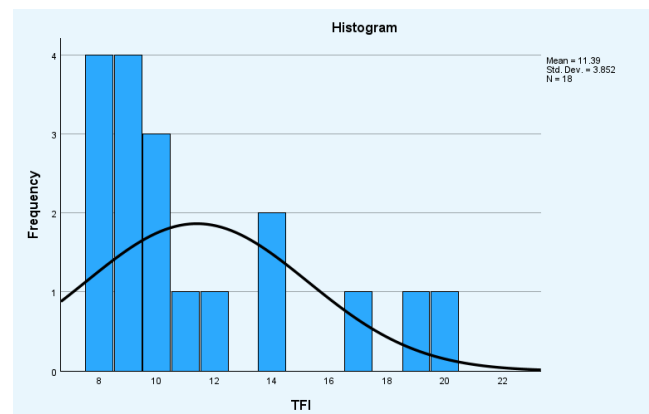
Among the study participants, only one case of in-hospital mortality was observed, occurring in a robust patient with esophageal squamous cell carcinoma who underwent transthoracic esophagectomy with three-field lymphadenectomy. Prior to the operation, this patient exhibited borderline pulmonary function and subsequently experienced postoperative respiratory failure and required intubation. The patient developed hospital-acquired pneumonia and, despite treatment, passed away on postoperative day 30. As a result, the in-hospital mortality rate was slightly higher in the robust group (2.6% vs 0%, $p=0.001$). However, at 3-month, 6-month, and 12-month follow-up, the frailty group showed significantly higher rates of postoperative mortality ($p=0.001$, 0.003, 0.006, respectively) (Table 2).



A. All patients



B. Robust group



C. Frailty group

Fig 1. Thai Frailty Index (TFI) scores among upper gastrointestinal surgical patients

DISCUSSION

Frailty is an emerging topic in the field of geriatric medicine but it remains poorly understood in the surgical context in Thailand. To the best of our knowledge, this study is the first of its kind within the country. In our study, the prevalence of frailty was 32.1%. This finding is comparable to other studies, such as one by Tegels *et al*

TABLE 1. Demographic data.

Characteristics	Robust (N=38)	Frailty (N=18)	P-value
Age (years), median (IQR)	60.0 (54.5-72.5)	71.0 (59.5-77.0)	0.042
Female gender, n (%)	15 (39.5)	12 (66.7)	<0.001
Mean BMI (kg/m ²) (min-max)	23.6 (17.1-35.5)	21.2 (15.6-30.9)	0.067
ASA classification, n (%)			0.474
1-2	30 (78.9)	14 (77.8)	
3-4	8 (21.1)	4 (22.2)	
ECOG scale, n (%)			0.003
0-1	38 (100)	15 (83.3)	
≥2	0	3 (16.7)	
Age-adjusted Charlson comorbidity index, n (%)			0.203
1-2 (mild comorbidity)	5 (13.2%)	1 (5.5)	
3-4 (moderate comorbidity)	13 (34.2)	4 (22.2)	
≥5 (severe comorbidity)	19 (50.0)	13 (72.2)	
Disease localization, n (%)			0.003
Esophagus	6 (15.8)	1 (5.5)	
Esophagogastric junction	10 (26.3)	3 (16.7)	
Stomach	22 (57.9)	14 (77.8)	
Disease pathology			<0.001
Neoplastic diseases, n (%)	34 (89.5)	15 (83.3)	
Esophageal cancer	3 (7.9)	1 (5.5)	
Gastric cancer	21 (55.3)	11 (61.1)	
Subepithelial tumor	10 (26.3)	3 (16.7)	
Non-neoplastic diseases	4 (10.5)	3 (16.7)	
Duration of symptoms (months), median (IQR)	3 (0-12)	1 (0-6)	0.542
Nutrition screening score (SPENT), n (%)			<0.001
0-1	27 (71.1)	5 (27.8)	
2-3	11 (28.9)	13 (72.2)	
Nutrition assessment score (NAF), n (%)			0.177
Normal to mild malnutrition (0-5)	18 (47.4)	4 (22.2)	
Moderate malnutrition (6-10)	13 (34.2)	6 (33.3)	
Severe malnutrition (≥11)	7 (18.4)	8 (44.4)	

Abbreviations: ASA, American Society of Anesthesiologists; BMI, Body mass index; ECOG, Eastern Cooperative Oncology Group; IQR, Interquartile range; NAF, Nutrition alert form; SPENT, Society of Parenteral and Enteral Nutrition of Thailand

TABLE 2. Surgery-related data.

Characteristics	Robust (N=38)	Frailty (N=18)	P-value
Operative approach, n (%)			0.104
Open	17 (44.7)	10 (55.6)	
Laparoscopic or robotic	21 (55.5)	8 (44.4)	
Surgery type, n (%)			0.001
Resection surgery	32 (84.2)	11 (61.1)	
Non-resection surgery	6 (15.8)	7 (38.9)	
Complication, n (%)			
Minor (CD grade I-II)	14 (36.9)	6 (33.3)	0.214
Major (CD grade III-V)	4 (10.5)	3 (16.7)	0.045
Complication category, n (%)			
Surgical related	13 (34.2)	5 (27.8)	0.082
Non-surgical related	8 (21.1)	6 (33.3)	0.044
Length of stay, median (days) (IQR)			
Total	7 (5.5-12)	9 (5-16)	0.565
Post-operative	6 (4-11)	5 (4-12.5)	0.662
Mortality, n (%)			
In-hospital	1 (2.6)	0	0.001
3-month	0	2 (11.1)	0.001
6-month	0	1 (5.6)	0.003
12-month	2 (5.3)	2 (11.1)	0.006

Abbreviation: CD, Clavien-Dindo classification

(2012), which reported a frailty rate of 24% among patients with gastric adenocarcinoma, using the Groningen Frailty Indicator (GFI) and the Short Nutritional Assessment Questionnaire (SNAQ)¹⁸ for evaluation. Similarly, *Mazzola et al's* study (2017) reported a frailty prevalence of 54%¹⁴ in patients with malignant UGI tumors, based on a modified frailty index. Furthermore, a systematic review encompassing 70 studies revealed a wide range in the prevalence of frailty among older patients undergoing general surgery, ranging from 8% to 77.8%.¹² Notably, a previous report focusing on community-dwelling older adults in Thailand using the Thai Frailty Index found a frailty prevalence of 22.1%.³

Consistent with several previous publications,^{13,16,17} our study found no significant difference in overall postoperative morbidity between frail and robust patients. However, the incidence of major complications and non-surgical complications was significantly higher in

the frailty group. Our results align with a recent study by *Chaoyang Gu et al.* (2022) in China, which included 246 patients undergoing gastrointestinal surgery. In that study, 47 patients (19.1%) were classified as frail based on the Frailty Index score. Although overall morbidity did not differ significantly between groups, the frail group had higher rates of ICU admission, mortality, and 30-day postoperative complications (57.1% vs 16.1%) compared to the robust group. A subgroup analysis focusing on minor surgical procedures found no significant association between frailty and intraoperative or postoperative parameters.³² Postoperative morbidity is influenced by several factors, such as age, co-morbidities, and the type of surgery. While many previous studies have primarily focused on screening frailty in elderly patients, our study diverges by assessing the frailty score in all surgical patients regardless of age or surgical type. Furthermore, the variation in diagnostic tools used to assess frailty contributes to the

wide range of reported prevalence rates across studies. It is important to acknowledge that our findings may be limited by the relatively small sample size. Hence, future investigations involving larger cohorts or subgroup analyses may provide more definitive insights.

However, frailty appears to play a significant role in quality-of-life (QoL) outcomes. QoL is a concept that lacks a universally accepted definition and remains a subject of ongoing debate. The World Health Organization (WHO) defines QoL as an individual's perception of their position in life within the context of their culture, societal expectations, personal goals, expectations, standards, and worries.³³ When frailty is present, a decline in various domains of functioning, including psychological, social capabilities, and physical ability, is commonly observed. It is estimated that approximately 20% to 30% of individuals aged 75 years and older are vulnerable to frailty.³⁴ This evaluation will be further demonstrated in our future prospective cohort study.

A key question that arises is whether the implementation of ERAS improves postoperative morbidity and quality of life in both frail and robust patients undergoing UGI surgery. Enhanced recovery is an integrated interdisciplinary perioperative pathway that offers a standardized approach to perioperative care. Its primary goal is to reduce the catabolic stress response to surgery and promote functional recovery through a series of interventions.³⁵ Its implementation has been proven to be suitable despite the advanced age of the patients.³⁶ A study by Wang *et al* in 2010 reported improved QoL scores and Visual Analog Scale (VAS) ratings in the ERAS group.³⁷ In our study, we compared outcomes in frail and robust patients who received perioperative care under an ERAS protocol with those who underwent conventional care. Interestingly, we found no significant difference in immediate postoperative morbidity between the ERAS and conventional care groups in either the frail or robust patients. This lack of significance may be attributed to the limited sample size. Future publications and research may provide additional insights into the potential benefits of implementing ERAS in this patient population.

Clinical implication and future research direction

This study highlights the importance of recognizing and addressing frailty, which was detected in approximately one-third of our patient cohort based on the Thai frailty Index score. Early identification of frailty allows for timely interventions aimed at optimizing overall patient health. Several interventions have been proposed to address the impact of frailty.^{38,39}

1) Adherence to ERAS protocols^{40,41}: Following ERAS protocols can facilitate early recovery and reduce surgical stress, potentially benefiting frail patients.

2) Implementation of a prehabilitation program⁴²: Prehabilitation aims to enhance patients' physical and functional status prior to surgery. Previous studies have shown that prehabilitation can reduce the incidence of postoperative pneumonia and length of hospital stay.

3) Conducting early geriatric interdisciplinary assessments⁴³: Involving a multidisciplinary team of healthcare professionals with expertise in geriatric care can facilitate a comprehensive evaluation of the patient's health status and tailor interventions to their specific needs.

By implementing these interventions, healthcare providers can effectively address frailty and potentially improve outcomes for frail patients undergoing upper gastrointestinal surgery.

Limitations and strengths

Several limitations of this study should be acknowledged. First, the relatively small sample size limits the generalizability of the findings reported in this study. This limitation was primarily due to the short recruitment period, which spanned only one and a half years. Further analysis of the prospective cohort is expected to include a larger patient population, which may yield a more accurate estimate of frailty prevalence and its true impact on short-term surgical outcomes, long-term recovery, and quality of life among patients with upper gastrointestinal diseases. Second, the heterogeneity of included diseases presents a challenge. This study encompassed a broad range of both benign and malignant conditions affecting the esophagus, esophagogastric junction, and gastric diseases. Each disease entity has its own unique prognosis. In future studies with a larger sample size, our aim is to conduct subgroup analyses based on the specific organ involved and the nature of the disease. This approach will allow for a more comprehensive understanding of outcomes associated with each disease and procedure.

CONCLUSION

This study is the first prospective investigation in Thailand to evaluate the impact of frailty on surgical outcomes in patients undergoing upper gastrointestinal surgery. We found that frailty was prevalent in nearly one-third of the study population and was significantly associated with advanced age, poorer performance status, and increased nutritional risk. Although overall complication rates were similar between frail and robust patients, frailty was linked to a higher incidence of major and non-surgical

complications. Furthermore, frail patients demonstrated significantly lower survival rates at 3, 6, and 12 months postoperatively. These findings underscore the importance of preoperative frailty assessment as a valuable tool for identifying high-risk patients and tailoring perioperative care accordingly. Future studies with larger cohorts and multi-center designs are needed to validate these findings and further explore the integration of frailty screening into standard surgical pathways in Thailand.

Data Availability Statement

Data are available upon reasonable request.

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DECLARATION

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Conflict of Interest

The authors declare no conflicts of interest.

Registration Number of Clinical Trial

This research project has been approved by Thai Clinical Trial Registry (ID number TCTR20250731006).

Author Contributions

G.G. was the first author and was responsible for study design, data collection, data analysis and manuscript writing. N.T. analyzed the data and edited the original manuscript. C.N., J.S., A.M. designed the study, collected and analyzed the data, edited and reviewed the manuscript. A.S., O.C., V.S. designed the study, collected the data and reviewed the manuscript. T.P. was the corresponding author and was responsible for conceptualization, study design, study methodology, data collection and analyses, and final manuscript editing. All authors approved the final manuscript.

Use of Artificial Intelligence

None.

Statement of Ethics

This study was reviewed and approved by the Institutional Review Board (IRB) of the Faculty of Medicine Siriraj Hospital, Mahidol University (certificate of approval no. Si 249/2020). All participating patients provided written informed consent prior to enrollment.

REFERENCES

1. Rønning B, Wyller TB, Nesbakken A, Skovlund E, Jordhøy MS, Bakka A, et al. Quality of life in older and frail patients after surgery for colorectal cancer-A follow-up study. *J Geriatr Oncol.* 2016;7(3):195-200.
2. Xue QL. The frailty syndrome: definition and natural history. *Clin Geriatr Med.* 2011;27(1):1-15.
3. Srinonprasert V, Chalerm Sri C, Aekplakorn W. Frailty index to predict all-cause mortality in Thai community-dwelling older population: A result from a National Health Examination Survey cohort. *Arch Gerontol Geriatr.* 2018;77:124-8.
4. McIsaac DI, Jen T, Mookerji N, Patel A, Lalu MM. Interventions to improve the outcomes of frail people having surgery: a systematic review. *PLoS ONE.* 2017;12(12):e0190071.
5. Hodari A, Hammoud ZT, Borgi JF, Tsiouris A, Rubinfeld IS. Assessment of morbidity and mortality after esophagectomy using a modified frailty index. *Ann Thorac Surg.* 2013;96:1240-5.
6. Choe YR, Joh JY, Kim YP. Association between frailty and readmission within one year after gastrectomy in older patients with gastric cancer. *J Geriatr Oncol.* 2017;8(3):185-9.
7. Lu J, Zheng H-L, Li P, Xie J-W, Wang J-B, Lin J-X, et al. High preoperative modified frailty index has a negative impact on short- and long-term outcomes of octogenarians with gastric cancer after laparoscopic gastrectomy. *Surg Endosc.* 2018;32:2193-200.
8. Lin H-S, Watts JN, Peel NM, Hubbard RE. Frailty and post-operative outcomes in older surgical patients: a systematic review. *BMC Geriatr.* 2016;16(1):157.
9. McIsaac DI, Taljaard M, Bryson GL, Beaulé PE, Gagné S, Hamilton G, et al. Frailty as a predictor of death or new disability after surgery: a prospective cohort study. *Ann Surg.* 2020;271(2):283-9.
10. Revenig LM, Canter DJ, Kim S, Liu Y, Sweeney JF, Sarmiento JM, et al. Report of a simplified frailty score predictive of short-term postoperative morbidity and mortality. *J Am Coll Surg.* 2015;220(5):904-11.
11. Buettner S, Wagner D, Kim Y, Margonis GA, Makary MA, Wilson A, et al. Inclusion of sarcopenia outperforms the modified frailty index in predicting 1-year mortality among 1,326 patients undergoing gastrointestinal surgery for a malignant indication. *J Am Coll Surg.* 2016;222(4):397-407.
12. Aucoin SD, Hao M, Sohi R, Shaw J, Bentov I, Walker D, et al. Accuracy and feasibility of clinically applied frailty instruments before surgery: a systematic review and meta-analysis. *Anesthesiology.* 2020;133(1):78-95.
13. Shen Y, Hao Q, Zhou J, Dong B. The impact of frailty and sarcopenia on postoperative outcomes in older patients undergoing gastrectomy surgery: a systematic review and meta-analysis. *BMC Geriatr.* 2017;17:188.
14. Mazzola M, Bertoglio C, Boniardi M, Magistro C, De Martini P, Carnevali P, et al. Frailty in major oncologic surgery of upper

- gastrointestinal tract: How to improve postoperative outcomes. *Eur J Surg Oncol.* 2017;43:1566-71.
15. Lu J, Cao L-L, Zheng C-H, Li P, Xie J-W, Wang J-B, et al. The Preoperative Frailty Versus Inflammation-Based Prognostic Score: Which is Better as an Objective Predictor for Gastric Cancer Patients 80 Years and Older? *Ann Surg Oncol.* 2017; 24:754-62.
 16. Tanaka T, Suda K, Inaba K, Umeki Y, Gotoh A, Ishida Y, et al. Impact of Frailty on Postoperative Outcomes for Laparoscopic Gastrectomy in Patients Older than 80 Years. *Ann Surg Oncol.* 2019;26:4016-26.
 17. Chen FF, Zhang F-Y, Zhou X-Y, Shen X, Yu Z, Zhuang C-L, et al. Role of frailty and nutritional status in predicting complications following total gastrectomy with D2 lymphadenectomy in patients with gastric cancer: a prospective study. *Langenbecks Arch Surg.* 2016;401(6):813-22.
 18. Tegels JJ, Maat MFG, Hulsewe KWE, Hoofwijk AGM, Stoot JHMB. Value of geriatric frailty and nutritional status assessment in predicting postoperative mortality in gastric cancer surgery. *J Gastrointest Surg.* 2014;18:439-46.
 19. Schlitzkus LL, Melin AA, Johanning JM, Schenarts PJ. Perioperative Management of Elderly Patients. *Surg Clin North Am.* 2015;9 5(2):391-415.
 20. Mörgeli R, Scholtz K, Kurth J, Treskatsch S, Neuner B, Koch S, et al. Perioperative Management of Elderly Patients with Gastrointestinal Malignancies: The Contribution of Anesthesia. *Visc Med.* 2017;33(4):267-74.
 21. Sandrucci S, Beets G, Braga M, Dejong K, Demartines N. Perioperative nutrition and enhanced recovery after surgery in gastrointestinal cancer patients. A position paper by the ESSO task force in collaboration with the ERAS society (ERAS coalition). *Eur J Surg Oncol.* 2018;44(4):509-14.
 22. Kehlet H. Multimodal approach to control postoperative pathophysiology and rehabilitation. *Br J Anaesth.* 1997;78(5): 606-17.
 23. Dorcaratto D, Grande L, Pera M. Enhanced recovery in gastrointestinal surgery: upper gastrointestinal surgery. *Dig Surg.* 2013;30:70-78.
 24. Low DE, Allum W, Manzoni G, Ferri L, Immanuel A, Kuppusamy M, et al. Guidelines for Perioperative Care in Esophagectomy: Enhanced Recovery After Surgery (ERAS) Society Recommendations. *World J Surg.* 2019;43:299-330.
 25. Mortensen K, Nilsson M, Slim K, Schafer M, Mariette C, Braga M, et al. Consensus guidelines for enhanced recovery after gastrectomy Enhanced Recovery After Surgery (ERAS) Society recommendations. *BJS.* 2014;101:1209-29.
 26. Parakonthon T, Tawantanakorn T, Swangsri J, Suwatthanarak T, Srisuworanan N, Taweerutchana V, et al. Results of an enhanced recovery after surgery protocol for upper gastrointestinal surgery at a super-tertiary referral hospital in Thailand. *Surgery, Gastroenterology and Oncology.* 2020;25(5):248-59.
 27. Nampoolsuksan C, Parakonthon T, Tawantanakorn T, Mora A, Swangsri J, Akaraviputh T, et al. Short-term Postoperative Outcomes Before and After the Establishment of the Siriraj Upper Gastrointestinal Cancer Center: A Propensity Score Matched Analysis. *Siriraj Med J.* 2020;72(4):215-320.
 28. Amin MB, Greene FL, Edge SB, Compton CC, Gershenwald JE, Brookland RK, et al. The Eighth Edition AJCC Cancer Staging Manual: Continuing to build a bridge from a population-based to a more "personalized" approach to cancer staging. *CA Cancer J Clin.* 2017;67:93-99.
 29. Kondrup J, Rasmussen HH, Hamberg O, Stanga Z, Ad Hoc ESPEN Working Group. Nutritional risk screening (NRS 2002): a new method based on an analysis of controlled clinical trials. *Clin Nutr.* 2003;22:321-36.
 30. Komindr S, Tangsermwong T, Janepanish P. Simplified malnutrition tool for Thai patients. *Asia Pac J Clin Nutr.* 2013;22:516-21.
 31. Dindo D, Demartines N, Clavien P-A. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. *Ann Surg.* 2004;240(2): 205-13.
 32. Gu C, Lu A, Lei C, Wu Q, Zhang X, Wei M, et al. Frailty index is useful for predicting postoperative morbidity in older patients undergoing gastrointestinal surgery: a prospective cohort study. *BMC Surg.* 2022;22(1):57.
 33. WHOQOL Group. Study protocol for the World Health Organization project to develop a Quality of Life assessment instrument (WHOQOL). *Quality of Life Research.* 1993;2(2): 153-9.
 34. Papathanasiou IV, Rsmmoginni A, Papagiannis D, Malli F, Mantzaris DC, Tsaras K, et al. Frailty and Quality of Life Among Community-Dwelling Older Adults. *Cureus.* 2021;13(2):e13049.
 35. Ljungqvist O, Scott M, Fearon KC. Enhanced recovery after surgery: a review. *JAMA Surg.* 2017;152(3):292-8.
 36. Heng G, Lohsiriwat V, Tan K-Y. Suitability of Enhanced Recovery after Surgery (ERAS) Protocols for Elderly Colorectal Cancer Patients. *Siriraj Med J.* 2019;72(1):18-23.
 37. Wang D, Kong Y, Zhong B, Zhou X, Zhou Y. Fast-track surgery improves postoperative recovery in patients with gastric cancer: a randomized comparison with conventional postoperative care. *J Gastrointest Surg.* 2010;14(4):620-7.
 38. Dalton A, Zafirova Z. Preoperative Management of the Geriatric Patient: Frailty and Cognitive Impairment Assessment. *Anesthesiol Clin.* 2018;36:599-614.
 39. Ko FC. Preoperative Frailty Evaluation: A Promising Risk-stratification Tool in Older Adults Undergoing General Surgery. *Clin Ther.* 2019;41:387-99.
 40. Tawantanakorn T, Phibalyart W, Parakonthon T, Nampoolsuksan C, Suwatthanarak T, Srisuworanan N, et al. Changes in Physical Components after Gastrectomy for Adenocarcinoma of Stomach and Esophagogastric Junction. *Siriraj Med J.* 2023;75(4):241-9.
 41. Parakonthon T, Gonggetyai G, Nampoolsuksan C, Suwatthanarak T, Tawantanakorn T, Swangsri J, et al. Higher compliance with the enhanced recovery after surgery protocol improves postoperative recovery and 6-month mortality in upper gastrointestinal surgery. *Surg Pract Sci.* 2024;19:100265.
 42. Hulzebos EH, van Meeteren NL. Making the elderly fit for surgery. *Br J Surg.* 2016;103:e12-e15.
 43. Somnuke P, Pongraweeewan O, Siriussawakul A. Optimizing Perioperative Care for Elderly Surgical Patients: A Review of Strategies and Evidence-Based Practices. *Siriraj Med J.* 2024; 76(7):465-72.