

Frailty and Adverse Outcomes Among Older Patients Undergoing Gastroenterological Surgery in Vietnam

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Purpose: With the ageing population, more older adults undergo surgery, and frailty increases the risk of postoperative complications in older patients. This study aimed to determine the association between frailty and 30-day adverse outcomes in older patients undergoing gastroenterological surgery in Vietnam.

Patients and Methods: A prospective cohort study was conducted in the Gastroenterology Department of the University Medical Center in Ho Chi Minh City. Frailty was determined using Fried's criteria. Adverse outcomes within 30 days of gastroenterological surgery were recorded, including postoperative infections, acute respiratory failure, acute kidney injury, and death. Univariate and multivariate logistic analyses were performed to determine the association between frailty and 30-day postoperative adverse outcomes using Stata 14.0.

Results: Data of 302 elective surgical participants were collected (mean age: 69.8± 8.1 years, 53.3% female), and the prevalence of frailty was 18.5%. Frailty was an independent risk factor for 30-day adverse outcomes (odds ratio=6.56, 95% confidence interval, 2.77–15.53, $p<0.001$), which included postoperative infections, acute respiratory failure, acute kidney injury, and death. Frail participants had a significantly higher risk of postoperative infections (odds ratio=8.21, 95% confidence interval, 3.28–20.54, $p<0.001$), and exhaustion was strongly associated with postoperative adverse outcomes.

Conclusion: Frailty was a predictor of 30-day adverse outcomes in older patients undergoing gastroenterological surgery. Therefore, preoperative frailty should be screened in older patients, and frailty-associated risks should be considered during the decision-making process by physicians, patients, and their families.

Keywords: surgical risk factors, Fried's criteria, postoperative complications, geriatrics, infections

Plain Language Summary

Ageing is a current global phenomenon, with Vietnam being the fast-ageing country in South-Eastern Asia. An increasing number of older people undergo surgical procedures and studies have shown that frailty is a predictive factor of poor outcomes in older patients undergoing surgery. Frailty is a highly common syndrome in older individuals, which is characterized by decreased function in multiple organ systems, causing the body to be vulnerable to stressors such as surgery. However, limited data are available on this relationship in older people in low-middle-income countries such as Vietnam. Therefore, we conducted this study to clarify the impact of frailty on adverse outcomes in older patients within 30 days after surgery in a teaching hospital in Vietnam. We enrolled 302 participants who underwent gastroenterological surgery and followed them up for 30 days after surgery for adverse outcomes, including infections, acute respiratory

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failure, acute kidney injury, and death. We found frailty to have a strong association with adverse outcomes in older Vietnamese patients undergoing surgery. Individuals with frailty had approximately 7 times higher risk of adverse outcomes and approximately 8 times higher risk infections than older patients without frailty. Therefore, surgical teams should consider older people with frailty as individuals who have a very high risk of poor outcomes after surgery, and the substantial frailty-associated risks shown in this study should be considered during the decision-making process by physicians, patients, and their families.

Introduction

Population ageing is a current global phenomenon, and it has been fastest in South-Eastern Asian countries.¹ In Vietnam, the number of people aged 60 years and above was approximately 20 million in 2019, and it is estimated that the number of older people will account for one-third of the population in 2050.² Frailty is a highly prevalent geriatric syndrome, characterized by a decrease in physiological reserve in multiple organ systems and loss of homeostasis when facing stressors.^{3,4} The prevalence of frailty in the older population is 15% in the USA⁵ and 7.4% in Japan,⁶ whereas it is much higher in South-Eastern Asian countries such as Thailand (22.1%) and Vietnam (21.7%).⁷ Frailty affects a significant proportion of older people residing in nursing homes and hospitals (19–75.6%)^{8,9} and increases the risks of falls, disability, prolonged hospital stay, and mortality.^{3,10}

In older individuals undergoing surgery, frailty is a predictive factor for adverse outcomes.^{11,12} A number of mechanisms possibly underline this association. Frail patients tend to be accompanied by multimorbidity;¹³ studies showed that surgical patients with multimorbidity had a much higher risk of death than those without multimorbidity.¹⁴ Surgery is a major physiological stress in patients with frailty who are vulnerable to stressors and have a decreased physiologic reserve.¹⁵ This implies that frail patients have a limited ability to cope with and recover from surgery, and are vulnerable to adverse outcomes.¹⁶ For example, frail patients decrease in responses to hypoxia and hypercapnia, hypovolemia, and hypoxia; thus, they are more likely to have respiratory and circulatory failure intra- and postoperation.¹⁷

Research has shown that frailty increases the risks of postoperative complications and mortality rates within 30 days, 90 days, and 1 year after surgery.^{11,18,19} According to a study on older patients undergoing pancreaticoduodenectomy,²⁰ frailty predicted major complications, longer hospital stays, and surgical intensive care unit admissions. A systematic review and meta-analysis study showed that frailty significantly increased

the risks of postoperative major morbidity, short-term mortality, and long-term mortality; patients with frailty had 2.5 times higher risk of postoperative morbidity and 6 times higher risk of short-term mortality than patients without frailty.²¹

With the ageing population increasing, more older people undergo surgical procedures.^{17,22} In Vietnam, to the best of our knowledge, data of older individuals undergoing surgery are unclear and no study has addressed the association between frailty and postoperative complications among older Vietnamese patients. However, a previous study found that frailty was significantly high in older hospitalized patients (35.4%).²³ Understanding the association between frailty and postoperative outcomes among older patients will help geriatricians and surgeons recognize the importance of preoperative frailty screening and discuss the outcomes with patients and their families.²⁴ In addition, it will help develop preventive strategies for frail patients undergoing surgery. Therefore, this study aimed to determine the association between frailty and adverse outcomes in older individuals within 30 days of undergoing gastroenterological surgery in Vietnam.

Materials and Methods

Study Design

This was an observational cohort study conducted in the Gastroenterology Department, including the gastrointestinal unit and the liver-biliary-pancreatic unit, at Ho Chi Minh City University Medical Center, a teaching hospital located in District 5 in Ho Chi Minh City with 1000 beds. Patients admitted to this hospital are from Ho Chi Minh City and other provinces in South and Central Vietnam. The study was conducted between February and June 2019. Participants were recruited using convenience sampling. The study was approved by the Institution Review Board of the University of Medicine and Pharmacy at Ho Chi Minh City (approval number: 434/ĐHYD-HĐĐĐ), which followed the Declaration of Helsinki.

Participants

The inclusion criteria were: elective surgery patients expected to undergo an operation in the gastrointestinal (GI) system, aged ≥ 60 years, able to walk 4.6 m, and able to perform handgrip measurements. Exclusion criteria included the presence of any of the following symptoms: extreme vomiting, abdominal pain, GI bleeding or unstable vital signs, or not undergoing surgery. A total of

327 eligible patients were recruited for the study. However, 25 subjects were excluded because they did not undergo surgery, and no one refused to participate in the study. The participants were evaluated within 72 hours of admission and were followed up for complications for 30 days after surgery. Written consent forms were obtained from all participants.

Procedures

Frailty Assessment

Frailty was assessed based on Fried's criteria,³ including unintentional weight loss within the last year, exhaustion, weakness, slowness, and low physical activity. Unintentional weight loss was defined as a decrease in weight of ≥ 4.5 kg or $\geq 5\%$ within 1 year. Patients' subjective estimation was acceptable. Exhaustion was defined as a positive answer to one of two statements from the Center for Epidemiological Study Depression scale ("I felt that everything I did require effort during the last week" and "I could not get going during the last week"). Weakness was evaluated based on handgrip strength, using the Jamar hydraulic dynamometer Model 5030J1 (JLW Instruments, Chicago, IL, USA). The average value was calculated based on three repetitions of the task with the dominant hand, and the cut-off values were stratified by sex and body mass index (BMI) (women: ≤ 17 kg for BMI of ≤ 23 kg/m², ≤ 17.3 kg for BMI of 23.1–26 kg/m², ≤ 18 kg for BMI of 26.1–29 kg/m², and ≤ 21 kg for BMI of > 29 kg/m²; men: ≤ 29 kg for BMI of ≤ 24 kg/m², ≤ 30 kg for BMI of 24.1–28 kg/m², and ≤ 32 kg for BMI of > 28 kg/m²). Walking speed was measured over walking a distance of 4.6 m at the participant's usual speed, and the cut-off values were stratified by sex and height (women: ≥ 7 s for a height of ≤ 159 cm and ≥ 6 s for a height of > 159 cm; men: ≥ 7 for a height of ≤ 173 cm and ≥ 6 s for a height of > 173 cm). Low physical activity was evaluated using the Physical Activity Scale for the Elderly (PASE),²⁵ which was scored based on the calculation from weight and frequency values of 12 activities during the previous week, including walking outside the house, light sport, moderate sport, rigorous sport, muscle strength/endurance exercises, light housework, heavy housework, home repair, yard care, outdoor gardening, caring for another person and working for pay or as a volunteer. The cut-off values were stratified by sex (women < 270 Kcal/week; men < 383 Kcal/week). Subjects who met ≥ 3 criteria were classified as frail, and those who met 0–2 criteria were classified as non-frail (including pre-frail and robust).

Other Covariates

Participants' comorbid conditions were collected based on medical records, and the Charlson Comorbidity Index (CCI) was also used in assessing comorbidity.²⁶ Nutritional status was assessed using the Nutrition Risk Screening (NRS) 2002 score²⁷ and those subjects who had a score of ≥ 3 were categorized as having nutritional risk. Information regarding the age, sex, weight, and height of the participants was also collected. We also collected other covariates, including surgical organ, operation procedure, operative duration, and baseline creatinine. In this study, the American Society of Anaesthesiologists (ASA) physical status classification system was used to grade the preoperative health of the surgical patients, as evaluated by anesthesiologists.

Outcome Measures

This study primarily measured adverse outcomes within 30 days after surgery, including postoperative infections, acute respiratory failure, acute kidney injury, reoperation, and death. In our study, postoperative infections comprised infections related to superficial surgical-site infection, intra-abdominal infection, pneumonia, urinary tract infection, or sepsis. These events were collected from the hospital medical records. Patients were followed up for 30 days after their surgery.

Data Analysis

Data were processed using Epidata 3.1, and statistical analyses were performed using Stata version 14 (StataCorp, College Station, TX, USA), with $p < 0.05$ indicating statistical significance. Discrete variables were expressed as counts and percentages, and χ^2 or Fisher's exact tests were used to compare proportions. The association between frailty and adverse outcomes was determined using a logistic regression model adjusted for relevant prognostic variables. To predict the primary outcome, we used items with statistical significance from each of the univariate analyses for our predictive model. After reviewing previous studies, we used patients' demographic data for the model.

Results

Data were collected from 302 participants and made available to all participants at the end of the study. The mean age was 69.8 (standard deviation 8.1, range 60–92) years, and 161 (53.3%) were women; they were not significantly older than men ($p = 0.76$).

There were 246 participants (81.5%) classified as non-frail and 56 (18.5%) as frail. In the study, 51.7% of the participants underwent laparoscopy, and the most frequent surgical indications were mechanical ileus and bleeding that required colon and/or rectal resection, which comprised

31.3% of the cases. Biliary surgery was the second most frequent procedure (25.2%).

Table 1 provides a comparison between the sample of 56 frail patients and 246 non-frail patients. The two groups of patients were similar in several factors, such as high blood pressure, BMI,

Table 1 General Characteristics of the Participants (n = 302)

| Characteristics | Non-Frail (N = 246) | Frail (N = 56) | p value |
|---|---------------------|----------------|---------|
| Age group (years old) | | | |
| 60 – 69 | 162 (65.9) | 10 (17.9) | <0.001 |
| 70 – 79 | 63 (25.6) | 21 (37.5) | |
| ≥80 | 21 (8.5) | 25 (44.6) | |
| Sex (Male) | 119 (48.4) | 22 (39.3) | 0.219 |
| Body mass index (kg/m ²) ^a | | | |
| <18.5 | 26 (10.6) | 14 (25.0) | 0.006 |
| 18.5 – 30 | 211 (85.8) | 38 (67.9) | |
| ≥30 | 9 (3.7) | 4 (7.1) | |
| NRS score ≥3 | 88 (35.8) | 39 (69.6) | <0.001 |
| High blood pressure | 132 (55.7) | 44 (78.6) | 0.001 |
| Diabetes mellitus | 49 (19.9) | 16 (28.6) | 0.155 |
| History of stroke ^b | 3 (1.2) | 8 (14.3) | <0.001 |
| Coronary heart disease | 28 (11.4) | 19 (33.9) | <0.001 |
| Creatinine >1.5 mg/dl ^b | 2 (0.8) | 0 (0) | 1.000 |
| Metastatic cancer | 30 (12.2) | 20 (17.9) | 0.259 |
| CCI score | | | |
| <3 | 170 (69.1) | 27 (48.2) | 0.006 |
| 3 – 4 | 45 (18.3) | 14 (25.0) | |
| ≥5 | 31 (12.6) | 15 (26.8) | |
| ASA grade ≥3 | 71 (28.9) | 38 (67.9) | <0.001 |
| Surgery region | | | |
| Biliary | 64 (26.0) | 12 (21.3) | 0.466 |
| Hepato-pancreatotomy | 45 (18.3) | 7 (12.3) | |
| Gastric or Duodenal | 26 (10.7) | 8 (31.1) | |
| Colorectal | 77 (31.3) | 17 (30.4) | |
| Hernia and Others | 34 (13.8) | 12 (21.4) | |
| Surgical procedure | | | |
| Laparoscopic | 130 (52.9) | 26 (46.4) | 0.386 |
| Open surgery | 116 (47.1) | 30 (53.6) | |
| Operation Duration (minutes) | | | |
| <120 | 117 (47.6) | 21 (37.5) | 0.018 |
| 120–180 | 71 (28.9) | 27 (48.2) | |
| ≥180 | 58 (23.6) | 8 (14.3) | |

Notes: ^aBody mass index was calculated as weight in kilograms divided by height in meters squared. ^bFisher's exact test applied.

Abbreviations: ASA, American Society of Anesthesiologists; CCI, Charlson comorbidity index; NRS, nutritional risk screening.

and NRS score. However, the frail group had higher scores on CCI ($p=0.006$) and ASA classification ($p<0.001$).

During the 30-day follow-up, adverse outcomes were recorded in 16.2% (49 patients) of our sample; 2.7% (8 patients) of the participants died. The most frequent complications were postoperative infections, and pneumonia was the most frequent type of infection. In our study, six

patients underwent reoperation (2.0%). Table 2 shows the summary statistics for all types of complications.

Univariate regression analysis showed that age, BMI, CCI score, state of metastasis, NRS score, and procedure time were predictive factors of 30-day postoperative outcomes. Detailed results of the univariate logistic regression are shown in Table 3.

Table 2 Types of Adverse Outcomes of the Participants

| Adverse Outcomes | Total (n = 302) | Non-Frail (n = 246) | Frail (n = 56) | p value |
|--|-----------------|---------------------|----------------|---------|
| 30-day adverse outcomes | 49 (16.2) | 23 (9.4) | 26 (46.4) | <0.001 |
| Postoperative infection | | | | |
| Superficial surgical site infection ^a | 16 (5.3) | 8 (3.3) | 8 (14.3) | 0.003 |
| Intra-abdominal infection ^a | 7 (2.3) | 5 (2.0) | 2 (3.6) | 0.618 |
| Pneumonia ^a | 22 (7.3) | 5 (2.0) | 17 (30.4) | <0.001 |
| Urinary tract infection ^a | 5 (1.7) | 2 (0.8) | 3 (5.4) | 0.046 |
| Sepsis ^a | 6 (2.0) | 1 (0.4) | 5 (8.9) | 0.001 |
| Acute kidney injury ^a | 9 (3.0) | 0 (0) | 9 (16.1) | <0.001 |
| Respiratory failure ^a | 8 (2.7) | 2 (0.8) | 6 (10.7) | 0.001 |
| Reoperation ^a | 6 (2.0) | 5 (2.0) | 1 (1.8) | 1.000 |
| Death ^a | 8 (2.7) | 1 (0.4) | 7 (12.5) | <0.001 |

Notes: Data are presented as counts (%). ^aFisher's exact test was used.

Table 3 Results of Univariate Logistic Regressions for Different Pre- and Intraoperative Variables of 30-Day Postoperative Complication and Postoperative Infections

| Pre-/Intraoperative Variables | 30-Day Adverse Outcomes | | Postoperative Infection | |
|---|-------------------------|-----------|-------------------------|-----------|
| | OR | 95% CI | OR | 95% CI |
| Age (per 1 year increased) | 1.08 ^c | 1.04–1.11 | 1.08 ^c | 1.04–1.12 |
| Sex | | | | |
| Female | 1 (ref) | | 1 (ref) | |
| Male | 0.92 | 0.50–1.69 | 0.89 | 0.46–1.70 |
| Body mass index (per 1 kg/m ² increased) | 1.02 | 0.94–1.10 | 0.99 | 0.90–1.07 |
| CCI score (per 1 point increased) | 1.33 ^c | 1.15–1.53 | 1.40 ^c | 1.21–1.62 |
| Metastasis | | | | |
| Absent | 1 (ref) | | 1 (ref) | |
| Present | 2.60 ^a | 1.22–5.57 | 3.19 ^b | 1.47–6.92 |
| Surgical procedure | | | | |
| Laparoscopic | 1 (ref) | | 1 (ref) | |
| Open | 2.56 ^b | 1.34–4.88 | 2.51 ^b | 1.27–4.98 |
| Operation duration (per 30 minutes increased) | 1.13 ^a | 1.03–1.25 | 1.12 ^a | 1.01–1.24 |
| NRS score | | | | |
| <3 | 1 (ref) | | 1 (ref) | |
| ≥3 | 2.53 ^b | 1.36–4.76 | 3.02 | 1.54–6.93 |

Notes: The 30-day postoperative complications included postoperative infections, acute kidney injury, respiratory failure, reoperation, and death. Postoperative infections included superficial surgical site or intra-abdominal infections, pneumonia, urinary tract infection, and sepsis. ^a $p < 0.05$, ^b $p < 0.01$, ^c $p < 0.001$.

Abbreviations: CCI, Charlson comorbidity index; OR, odds ratio; 95% CI, 95% confidence interval; NRS, Nutrition Risk Screening.

Table 4 shows the association between frailty and 30-day adverse outcomes, as revealed by multiple logistic regression analyses. The adjusted odds ratio (OR) of having an adverse outcome or postoperative infections within 30 days was 6.56 (95% confidence interval [CI]: 2.77–15.53, $p < 0.001$) and 8.21 (95% CI: 3.28–20.54, $p < 0.001$), respectively, in frail participants compared with those in non-frail participants. This association was found regardless of age, BMI, or surgery-related variables such as type of surgery and surgery duration.

Table 5 presents the association of five components of Fried's criteria and 30-day postoperative adverse outcomes. The results showed that the exhaustion criterion had the most impact on 30-day postoperative adverse outcomes (OR=22.43, 95% CI: 6.07–82.90, $p < 0.001$) and postoperative infections (OR=24.92, 95% CI: 6.67–93.19, $p < 0.001$) whereas the weakness criterion had the least impact.

Discussion

This study addressed the association between frailty and 30-day adverse outcomes in older Vietnamese patients undergoing gastroenterological surgery. The results

showed that 18.5% of older patients undergoing surgery met frailty, and the rate of 30-day adverse outcomes in individuals with frailty was 5 times higher than that in individuals without frailty. We found that frailty had a significant association with postoperative adverse outcomes; older patients with frailty had approximately 7 times higher risk of 30-day postoperative complications and approximately 8 times higher risk of postoperative infection than older patients without frailty. Moreover, the mortality rate in the frail group was significantly higher than that in the non-frail group (7% vs 0.4%, $p < 0.001$). The data indicated frailty was a predictive risk factor for 30-day adverse outcomes among older Vietnamese patients undergoing gastroenterological surgery.

These results are in line with those of previously reported studies.^{28–30} In a study of colorectal cancer resection, Tan et al found that frailty significantly increased the risk of major adverse outcomes (OR=4.08; 95% CI, 1.93–11.63),¹⁹ and similar results were observed by Myrick et al, who showed that frailty was associated with a higher risk of 30-day mortality in older postoperative patients.³¹ This can be explained

Table 4 Odds Ratios Comparing Frail and Non-Frail Patients on 30-Day Postoperative Complications and Postoperative Infections by Multivariable Logistic Regressions

| | Number of Events (%) | Unadjusted OR (95% CI) | Adjusted OR (95% CI) |
|---------------------------------------|----------------------|---------------------------------|--------------------------------|
| 30-day postoperative adverse outcomes | 49 (16.2) | 8.40 [†] (4.26–16.56) | 6.56 [†] (2.77–15.53) |
| Postoperative infections | 43 (14.2) | 10.22 [†] (5.01–20.83) | 8.21 [†] (3.28–20.54) |

Notes: The 30-day adverse outcomes included postoperative infection, acute kidney injury, respiratory failure, reoperation, and death. Postoperative infections included superficial surgical site infection, intra-abdominal infection, pneumonia, urinary tract infection, and sepsis. Adjusted models included age (years), body mass index (kg/m²), Charlson score, metastasis (yes vs no), surgical procedure (open vs laparoscopic), NRS score (≥ 3 vs < 3), and operation duration (minutes). [†] $p < 0.001$.

Abbreviations: OR, Odds ratio; CI, confidence interval.

Table 5 The Association of Five Components of Fried's Criteria and 30-Day Postoperative Adverse Outcomes and Postoperative Infections by Multivariable Logistic Regressions

| Components of Fried Criteria | Number of Patients with Positive Criteria (%) | 30-Day Postoperative Adverse Outcomes Adjusted OR (95% CI) | Postoperative Infections Adjusted OR (95% CI) |
|--|---|--|---|
| Unintentional weight loss over the last year | 64 (21.2) | 2.86 ^a (1.25–6.53) | 2.85 ^a (1.21–6.73) |
| Weakness | 161 (53.3) | 1.38 (0.62–3.10) | 1.57 (0.65–3.76) |
| Exhaustion | 19 (6.29) | 22.43 ^c (6.07–82.90) | 24.92 ^c (6.67–93.19) |
| Slowness | 59 (19.5) | 4.41 ^c (1.96–9.94) | 5.49 ^c (2.32–13.01) |
| Low physical activity | 119 (39.4) | 3.10 ^b (1.43–6.75) | 3.55 ^b (1.53–8.25) |

Notes: The 30-day adverse outcomes included postoperative infections, acute kidney injury, respiratory failure, reoperation, and death. Postoperative infections included superficial surgical site infection, intra-abdominal infection, pneumonia, urinary tract infection, and sepsis. Adjusted models included age (years), body mass index (kg/m²), Charlson score, metastasis (yes vs no), surgical procedure (open vs laparoscopic), NRS score (≥ 3 vs < 3 score), and operation duration (minutes). ^a $p < 0.05$, ^b $p < 0.01$, ^c $p < 0.001$.

Abbreviations: OR, Odds ratio; CI, confidence interval.

by the decreased functional reserve across multiple physiological systems and an increased vulnerability to poor resolution of homeostasis when coping with surgery. As surgery is an essential stressor, it puts frail patients at a high risk of postoperative adverse outcomes such as postoperative infection, acute respiratory failure, and acute kidney injury.³ Moreover, frail individuals tend to have multimorbidity.^{13,32} In our study, a higher rate of comorbidity was observed in frail patients, of whom 26.8% had a high CCI score, compared with 12.6% in non-frail patients ($p=0.006$). This contributed to higher rates of poor outcomes in frail individuals. Similarly, according to a study on patients undergoing emergent cholecystectomy,³³ frailty was independently associated with mortality, which coincides with our study. In another study in China, Binru et al reported that frailty was an independent risk factor for postoperative complications in older Chinese patients undergoing major thoracic and abdominal surgery (OR= 16.59, 95% CI: 4.56–60.40, $p<0.001$).³⁴ This result is relatively higher than the finding of our study. It may be due to the differences in the study populations. The participants in Binru's study underwent major thoracic and abdominal surgery, whereas those in our study merely underwent abdominal surgery. Major thoracic surgery is a high-risk procedure, thus the probability of postoperative complications was higher.³⁵ Furthermore, the prevalence of frailty in Binru's study was also higher than the result of our study (26.1% vs 18.5%).

An interesting finding of our study is that in the five components of Fried criteria, exhaustion had the highest impact on 30-day postoperative adverse outcomes, and weakness (handgrip strength) had the least impact. This can be because exhaustion was evaluated based on patients' self-reports, and as it is a subjective criterion, it may be more sensitive than other objective criteria in frailty.³ Meanwhile, in a study on cardiac surgery, Chung et al found that handgrip strength was a predictive factor of postoperative complications in patients with heart failure,³⁶ and another study reported that walking speed was a predictor of postoperative morbidities in older patients undergoing gastrectomy.³⁷ However, the authors only chose one component and did not compare other components in Fried's criteria.

Our findings suggest that gastroenterological surgery may be considered high risk for frail people, and frailty was a predictive risk factor for 30-day adverse outcomes, including postoperative infections, acute respiratory failure, acute kidney injury, and death. Therefore, older patients considering gastroenterological surgery should be screened for frailty. Regardless of the surgical

indication, the substantial frailty-associated risks shown here should be considered during the decision-making process shared by physicians, patients, and their families. Furthermore, preventive strategies need to be well-prepared to ensure perioperative safety for frail patients in clinical practice in a fast-ageing country such as Vietnam.

Strengths and Limitations

In our study, frailty was assessed using Fried's criteria, which is considered a reference standard in frailty diagnosis. To the best of our knowledge, this is the first study to evaluate the association of frailty and postoperative complications in older patients in Vietnam, adding a clearer understanding of the impact of frailty on postoperative adverse outcomes in a South-Eastern Asian country. However, this study has several limitations. First, information regarding adverse outcomes was collected based on medical records, and there is a possibility that the diagnoses were not consistent among physicians. Second, this is a single-center study and the patient enrollment was performed by convenience sampling; thus, our results may not be nationally representative. Furthermore, older patients requiring emergency surgery were not recruited in our study, and there is a possibility that we underestimated the effect of frailty on poor outcomes.

Conclusion

This study found that frailty was an independent risk factor for 30-day adverse outcomes in older patients undergoing gastroenterological surgery in Vietnam. The rate of postoperative infections was approximately 8 times greater in frail patients, and the rate of 30-day adverse outcomes was approximately 7 times higher. Exhaustion was the most significant associated factor with 30-day adverse outcomes compared with other components in Fried's criteria. Therefore, frailty should be assessed before surgery in older patients to prevent poor postoperative outcomes. Furthermore, surgeons, anesthesiologists, and other physicians may wish to consider strategies to optimize outcomes for frail patients.

Abbreviations

ASA, American Society of Anesthesiologists; BMI, Body mass index; CCI, Charlson comorbidity index; CI, confidence interval; GI, gastrointestinal; NRS, Nutrition risk screening; OR, odds ratio.

Data Sharing Statement

The data supporting the findings of this study are available from the corresponding author upon a reasonable request.

Ethics Approval and Informed Consent

The study was approved by the Institution's Reviewed Board (IRB) of the University of Medicine and Pharmacy at Ho Chi Minh City, Vietnam (approval number: 434/DHYD-HĐĐĐ), according to the Declaration of Helsinki.

Consent for Publication

Written informed consent for publication of their details was obtained from the study participants.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis, and interpretation, or in all these areas; took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted, and agree to be accountable for all aspects of the work.

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