

Preoperative Frailty Index as a Predictor of Perioperative Outcomes in Elderly Surgical Patients: An Observational Study

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Abstract

Background: Frailty reflects diminished physiological reserve and increased vulnerability to physiological stress. Surgical stress may therefore produce disproportionate morbidity and mortality in frail older adults. Identification of frailty during preoperative assessment may facilitate risk stratification and perioperative planning.

Objective: To evaluate the clinical utility of preoperative frailty assessment and determine the association between Frailty Index and perioperative morbidity and mortality among elderly patients undergoing surgery.

Materials and Methods: This observational study included 238 patients aged >65 years undergoing surgery at a tertiary-care teaching hospital between October 2022 and August 2024. Patients were assessed

preoperatively using a Frailty Index based on comorbidities and functional status. Perioperative outcomes included mortality, intraoperative hypotension and hypertension, excessive blood loss, delayed recovery, hypothermia, bradycardia, tachycardia, postoperative intensive care unit (ICU) requirement, blood transfusion, vasopressor support, elective ventilation, tracheostomy, dyselectrolytemia, uncontrolled blood glucose, delirium, re-exploration, and hospital stay. Statistical analysis was performed using SPSS version 26.0. Mann-Whitney U test, Spearman correlation, and chi-square test were used as appropriate, with $p < 0.05$ considered statistically significant.

Results: The mean age of the 238 participants was 69.85 ± 4.30 years, and 61.8% were male. The mean Frailty Index score was 2.00 ± 0.91 . Overall mortality was 3.8%. Frailty Index values were significantly higher

among patients who died than among survivors (mean rank 180.11 vs 117.12; $p=0.004$). Higher frailty was also significantly associated with intraoperative hypotension ($p=0.002$), excessive blood loss ($p=0.016$), postoperative ICU requirement ($p=0.022$), vasopressor requirement ($p=0.031$), dyselectrolytemia ($p=0.001$), uncontrolled blood glucose ($p=0.004$), and postoperative delirium ($p<0.001$). No significant association was observed between Frailty Index and hospital stay >14 days ($p=0.930$), hypertension, bradycardia, tachycardia, delayed recovery, hypothermia, blood transfusion, elective ventilation, tracheostomy, or re-exploration.

Conclusion: Higher preoperative frailty was significantly associated with mortality and several clinically important perioperative complications in elderly surgical patients. Incorporating frailty assessment into routine preoperative evaluation may improve identification of high-risk older adults and facilitate individualized perioperative planning.

Keywords: Frailty, Frailty Index, Elderly, Perioperative Outcomes, Postoperative Complications, Mortality, Surgery, Preoperative Assessment

Introduction

Population ageing has resulted in an increasing number of older adults undergoing surgical procedures. Although chronological age has traditionally been used during surgical risk assessment, patients of similar age may demonstrate substantial differences in physiological reserve and ability to tolerate operative stress. Frailty provides a clinically relevant framework for characterizing this vulnerability.^{1,2}

Frailty is a multidimensional state characterized by reduced physiological reserve and increased susceptibility to adverse outcomes following relatively minor stressors.¹ It results from cumulative deterioration

across multiple physiological systems rather than dysfunction of a single organ system. Frail individuals are consequently more vulnerable to hospitalization, disability, institutionalization, and death³.

Two principal approaches to frailty assessment are widely recognized: the physical frailty phenotype described by Fried et al. and the deficit-accumulation approach underlying the Frailty Index^{4,5}. The latter quantifies the accumulation of comorbidities, functional deficits, cognitive impairment, and other health-related deficits and can be adapted to clinical datasets⁵.

Frailty has particular relevance in the perioperative setting. Surgery and anesthesia constitute major physiological stressors, and patients with limited reserve may be unable to maintain homeostasis during the perioperative period. Previous studies have associated frailty with postoperative complications, prolonged hospitalization, non-home discharge, disability, and mortality.^{6,7}

Frailty may also provide prognostic information not adequately captured by chronological age or conventional perioperative risk scores. Systematic review evidence suggests that frail surgical patients experience significantly poorer postoperative outcomes than non-frail patients^{7,8}. The present study was therefore undertaken to determine the clinical utility of preoperative frailty assessment among elderly surgical patients and to evaluate the relationship between Frailty Index and perioperative morbidity and mortality.

Aim and Objectives

Aim

To determine the clinical utility of frailty as a component of preoperative assessment.

Primary Objective

To correlate Frailty Index among patients older than 65 years with perioperative morbidity and mortality.

Secondary Objectives

1. To evaluate the relationship between frailty and intraoperative complications.
2. To evaluate the relationship between frailty and postoperative complications.
3. To assess the requirement for intensive care among frail patients.
4. To assess mortality in relation to Frailty Index.
5. To evaluate the relationship between frailty and duration of postoperative hospital stay.

Materials and Methods

Study Design

This was a hospital-based observational study.

Study Setting

The original study was conducted at Command Hospital (Eastern Command), Kolkata, a tertiary-care teaching hospital.

Study Period

The study was conducted from October 2022 to August 2024.

Study Population

Patients older than 65 years undergoing surgical procedures were considered for participation.

Sample Size

A total of 238 patients were included in the final analysis.

Inclusion Criteria

- Age >65 years.
- Undergoing surgery.
- ASA physical status II or higher.
- Postoperative follow-up during hospitalization for up to two weeks.

Exclusion Criteria

- Age <65 years.
- ASA physical status I.
- Cataract surgery.
- Minor procedures performed under local anesthesia.

Note: The final dataset contained one participant classified as ASA I despite the stated exclusion criterion; the manuscript retains the source dataset as reported.

Preoperative Frailty Assessment

After informed consent and application of the eligibility criteria, patients underwent pre-anesthetic evaluation. A Frailty Index was calculated before surgery. The components documented for Frailty Index assessment included diabetes mellitus; congestive heart failure; transient ischemic attack or cerebrovascular accident; dementia; myocardial infarction; peripheral vascular disease or rest pain; cerebrovascular accident with neurological deficit; chronic obstructive pulmonary disease or pneumonia; previous percutaneous coronary intervention or angina; hypertension requiring medication; and activities of daily living. Other frailty assessments described in the thesis included the Clinical Frailty Scale (CFS), hand-grip strength assessment, and quadriceps assessment.

Perioperative Outcomes

The predefined intraoperative outcomes included hypotension, hypertension, delayed recovery from anesthesia, difficult extubation/reintubation, severe hemodynamic compromise, hypothermia, tachyarrhythmia or bradyarrhythmia, and excessive blood loss. Postoperative outcomes included ICU admission, postoperative elective ventilation, hospital-acquired infection, dyselectrolytemia, uncontrolled blood glucose, delirium, and duration of hospital stay. Additional outcomes documented in the results included

vasopressor requirement, blood transfusion, tracheostomy, re-exploration, and mortality.

Statistical Analysis

Statistical analysis was performed using SPSS version 26.0. Categorical variables were summarized using frequencies and percentages. Continuous variables were reported using mean and standard deviation and/or median and interquartile range. Frailty Index and CFS were not normally distributed. Consequently, the Mann-Whitney U test was used to evaluate associations between these measures and categorical outcomes. Spearman correlation was used to evaluate relationships with continuous variables. Associations between categorical variables were evaluated using the chi-square test. A p-value <0.05 was considered statistically significant.

Ethical Considerations

Institutional Ethics Committee approval was obtained before commencement of the study, and written informed consent was obtained from enrolled participants.

Results

Demographic and Baseline Characteristics

A total of 238 elderly surgical patients were analyzed. The mean age was 69.85 ± 4.30 years, with a median age of 69 years. Mean body weight was 66.47 ± 7.11 kg. Males constituted 147 patients (61.8%), while 91 (38.2%) were female. Most patients were classified as ASA II (63.9%), followed by ASA III (32.4%).

Characteristic	Value
Total participants	238
Age, years, mean $\pm$ SD	69.85 ± 4.30
Age, median (IQR)	69 (67-71)
Weight, kg, mean $\pm$ SD	66.47 ± 7.11
Male	147 (61.8%)

Female	91 (38.2%)
ASA I	1 (0.4%)
ASA II	152 (63.9%)
ASA III	77 (32.4%)
ASA IIIE	1 (0.4%)
ASA IV	7 (2.9%)

Frailty Index Distribution

The mean and median Frailty Index score were both 2.0, with a standard deviation of 0.91 and an IQR of 1-3. The most common score was 2, present in 95 patients (39.9%), followed by score 1 in 79 (33.2%) and score 3 in 52 (21.8%).

Frailty Index score	n (%)
1	79 (33.2%)
2	95 (39.9%)
3	52 (21.8%)
4	10 (4.2%)
5	1 (0.4%)
6	1 (0.4%)
Total	238 (100%)

Perioperative Outcomes

Intraoperative hypotension was the most frequent recorded complication, occurring in 75 patients (31.5%). Excessive blood loss occurred in 24 patients (10.1%). Forty-six patients (19.3%) required postoperative ICU care, 34 (14.3%) required vasopressor support, and 20 (8.4%) required blood transfusion. Overall mortality was 3.8% (9/238).

Outcome	n (%)
Intraoperative hypotension	75 (31.5%)
Intraoperative hypertension	6 (2.5%)
Excessive blood loss	24 (10.1%)
Bradycardia	4 (1.7%)
Tachycardia	4 (1.7%)

Delayed recovery	9 (3.8%)
Hypothermia	7 (2.9%)
ICU care	46 (19.3%)
Blood transfusion	20 (8.4%)
Vasopressor support	34 (14.3%)
Elective ventilation	10 (4.2%)
Tracheostomy	2 (0.8%)
Dyselectrolytemia	8 (3.4%)
Uncontrolled blood glucose	6 (2.5%)
Delirium	6 (2.5%)
Re-exploration	2 (0.8%)
Hospital stay >14 days	15 (6.3%)
Mortality	9 (3.8%)

Association Between Frailty Index and Mortality

Frailty Index was significantly higher among the nine patients who died than among survivors. Mean rank for Frailty Index was 180.11 among patients who died compared with 117.12 among survivors ($p=0.004$).

Mortality	n	Mean rank	Sum of ranks	p-value
Yes	9	180.11	1621.00	0.004
No	229	117.12	26820.00	
Total	238			

Association with Intraoperative Complications

Frailty Index was significantly higher among patients developing intraoperative hypotension ($p=0.002$) and excessive blood loss ($p=0.016$). No statistically significant associations were identified for intraoperative hypertension, bradycardia, tachycardia, delayed recovery, or hypothermia.

Outcome	Mean rank: present	Mean rank: absent	p-value
Hypotension	138.93	110.56	0.002
Hypertension	149.25	118.73	0.256
Excessive	149.85	116.10	0.016

Outcome	Mean rank: present	Mean rank: absent	p-value
blood loss			
Bradycardia	149.75	118.98	0.347
Tachycardia	145.38	119.06	0.421
Delayed recovery	145.28	118.49	0.225
Hypothermia	152.43	118.50	0.173

Association with Postoperative Outcomes

Frailty Index was significantly higher among patients requiring ICU care ($p=0.022$) and vasopressor support ($p=0.031$). Strong associations were also observed for dyselectrolytemia ($p=0.001$), uncontrolled blood glucose ($p=0.004$), and postoperative delirium ($p<0.001$). Blood transfusion showed a trend toward higher frailty but did not reach statistical significance ($p=0.061$).

Outcome	Mean rank: present	Mean rank: absent	p-value
ICU care	139.25	114.77	0.022
Blood transfusion	145.53	117.11	0.061
Vasopressor support	141.69	115.80	0.031
Elective ventilation	145.20	118.37	0.201
Tracheostomy	83.50	119.81	0.431
Dyselectrolytemia	193.81	116.92	0.001
Uncontrolled blood glucose	194.50	117.56	0.004
Delirium	216.08	117.00	<0.001
Re-exploration	127.00	119.44	0.870

Frailty and Duration of Hospital Stay

Most participants, 223/238 (93.7%), remained hospitalized for fewer than 14 days, whereas 15 (6.3%) stayed longer than 14 days. Frailty Index was not significantly associated with a hospital stay exceeding 14 days (mean rank 120.93 vs 119.40; $p=0.930$).

Discussion

The present observational study evaluated the relationship between preoperative frailty and perioperative outcomes among 238 surgical patients older than 65 years. The findings demonstrate that increasing Frailty Index was associated with mortality and several clinically important intraoperative and postoperative complications.

The mean age of the study population was 69.85 years, and nearly two-thirds of participants were men. Frailty was common across the different frailty assessment methods used in the thesis. Frailty has consistently been associated with poor surgical outcomes. Makary et al. demonstrated that preoperative frailty predicts postoperative complications, length of stay, and discharge disposition among older surgical patients⁹. Similarly, systematic reviews have shown that frailty is independently associated with postoperative morbidity and mortality^{7,8}.

Frailty and Mortality

The overall mortality rate in the present cohort was 3.8%. Frailty Index values were significantly higher among patients who died, with a p-value of 0.004. This is consistent with the large cohort reported by Shinall et al., in which increasing frailty and operative stress were associated with postoperative mortality¹⁰. Frailty likely identifies patients with reduced multisystem physiological reserve who are less capable of compensating for the metabolic, inflammatory, cardiovascular, and respiratory stresses associated with surgery. Fehlmann et al. also reported substantially increased 30-day mortality among frail patients undergoing emergency general surgery¹¹.

Intraoperative Complications

Higher Frailty Index was associated with intraoperative hypotension and excessive blood loss. These observations suggest that frailty may influence perioperative vulnerability even before the postoperative period. Reduced cardiovascular reserve, diminished autonomic responsiveness, comorbidity burden, and impaired homeostatic capacity may contribute to hemodynamic instability in frail patients.

Critical Care and Vasopressor Requirement

Approximately one-fifth of participants required ICU care. Frailty Index was significantly higher among those requiring ICU admission. A similar association was seen for vasopressor requirement. Gleason et al. demonstrated that higher frailty among geriatric fracture patients was associated with greater postoperative complications and longer hospitalization¹². Differences in underlying surgical populations may explain variation in ICU-related findings between studies.

Metabolic Complications

Strong associations were observed between Frailty Index and dyselectrolytemia as well as uncontrolled postoperative blood glucose. These findings may reflect diminished homeostatic capacity and greater vulnerability to perioperative metabolic stress among frail individuals.

Postoperative Delirium

The strongest statistical association in the study was observed between Frailty Index and postoperative delirium ($p < 0.001$). Mahanna-Gabrielli et al. similarly demonstrated that frail and prefrail older adults were at increased risk of postoperative delirium after major noncardiac surgery¹³. Delirium is itself associated with poor postoperative recovery, prolonged hospitalization, functional decline, and adverse long-term outcomes¹⁴.

Length of Hospital Stay

Although frailty has frequently been associated with prolonged hospitalization in previous studies^{7,9,12}, no significant relationship between Frailty Index and hospital stay >14 days was observed in the present study. One explanation may be that 93.7% of participants were discharged within 14 days, leaving relatively few prolonged-stay events and limiting statistical power for this outcome.

Clinical Implications

1. More comprehensive preoperative assessment.
2. Optimization of comorbid conditions.
3. Nutritional and functional prehabilitation.
4. Individualized anesthetic planning.
5. Enhanced hemodynamic monitoring.
6. Appropriate postoperative icu or high-dependency planning.
7. Delirium-prevention measures.
8. More detailed shared decision-making regarding perioperative risk.

Frailty assessment should complement rather than replace established measures such as ASA physical status and procedure-specific risk assessment.

Strengths

The study evaluated a broad surgical population rather than a single procedure-specific cohort. A relatively large sample of 238 elderly surgical patients was prospectively evaluated, and a wide range of intraoperative and postoperative outcomes was recorded. Frailty was assessed before surgery, permitting temporal evaluation of its association with subsequent perioperative outcomes.

Limitations

The study has several important limitations. First, it was conducted at a single institution, limiting

generalizability. Second, the number of less-frail or non-frail patients was comparatively small, reducing the ability to make balanced comparisons between frailty groups. Third, longer-term mortality was not evaluated separately at 30, 60, and 90 days. Fourth, several complications occurred in relatively small numbers of patients, limiting precision of individual associations. Fifth, the analysis primarily used unadjusted nonparametric comparisons, and potential confounding by age, ASA status, comorbidities, surgical category, and operative severity was not controlled using multivariable regression.

Conclusion

Preoperative frailty was significantly associated with adverse perioperative outcomes among elderly surgical patients. Patients with higher Frailty Index values experienced significantly greater mortality, intraoperative hypotension, excessive blood loss, postoperative ICU requirement, vasopressor requirement, dyselectrolytemia, uncontrolled blood glucose, and delirium. The strongest associations were observed for postoperative delirium and metabolic complications. In contrast, Frailty Index was not significantly associated with prolonged hospital stay, bradycardia, tachycardia, delayed recovery, hypothermia, blood transfusion, elective ventilation, tracheostomy, or re-exploration. Routine incorporation of a practical frailty assessment into preoperative evaluation may improve identification of elderly patients at increased perioperative risk and permit more individualized surgical, anesthetic, and postoperative planning.

Declarations

Ethical Approval: Institutional Ethics Committee approval was obtained before commencement of the original study.

Informed Consent: Written informed consent was obtained from all study participants.

Data Availability: Data supporting the findings of this study are available from the corresponding author subject to institutional and ethical requirements.

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