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Original Research Article

Impact of Preoperative Frailty Assessment on Postoperative Complications Following Major Abdominal Surgery: A Prospective Cohort Study

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Abstract

Background: Morbidity after major abdominal surgery is still high, especially in older patients, which are not adequately represented by chronological age or traditional anaesthetic risk scores. This prospective cohort study aimed to determine whether a structured pre-operative frailty assessment is able to predict 30-day postoperative complications following elective major abdominal surgery.

Method: 214 elderly patients (60 years and older) scheduled for elective gastrectomy, colorectal resection, hepatobiliary surgery or major abdominal wall reconstruction were enrolled. The Clinical Frailty Scale and Fried phenotype were used to assess frailty within 7 days prior to surgery. Patients were classified as non-frail (n=116), pre-frail (n=63), or frail (n=35). The main outcome was a Clavien-Dindo grade II or greater complication within 30 days. Secondary outcomes were major complications, length of stay, admission to the intensive care unit, destination at discharge, and readmission.

Results: 31.3% of patients had overall 30-day complications. The complication rate rose with increasing frailty strata, with 20.7% in non-frail, 36.5% in pre-frail and 57.1% in frail patients ($p<0.001$). Frail patients had longer hospital stay (11.8 +/- 5.6 vs. 7.2 +/- 3.4 days, $p<0.001$), higher ICU admission (31.4% vs. 9.5%, $p=0.002$), and more non-home discharge (28.6% vs. 4.3%, $p<0.001$) than non-frail patients. Frailty was independently associated with complications after adjusting for age, sex, ASA class, comorbidity index, surgical complexity, and operative duration (adjusted OR 3.18, 95% CI 1.42-7.09; $p=0.005$). The AUC increased from 0.71 to 0.80 when frailty was added to the baseline risk model.

Conclusion: Preoperative frailty assessment was independently associated with postoperative complications and was superior to risk discrimination following major abdominal surgery. Routine frailty screening could assist with individual counselling, optimization and planning for post-operative management.

Keywords: Frailty; Abdominal Surgery; Postoperative Complications; Clinical Frailty Scale; Prospective Cohort; Perioperative Risk.

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Introduction

Older adults often undergo major abdominal surgery, and the outcomes of surgery are affected by more than just the success of the surgery. After surgical stress, age, comorbidity, nutritional depletion, functional limitation, cognitive vulnerability and inflammatory burden all play a role in determining resilience.

Chronological age, American Society of Anesthesiologists (ASA) physical status, cardiac risk models and organ-specific investigations are all used in traditional preoperative assessment, but these may not be sufficient to identify patients with diminished physiological reserve. Frailty is a multidimensional concept of reduced resilience and increased vulnerability to stressors, which was initially defined as a phenotype of weakness, exhaustion, weight loss, low physical activity and slow gait speed [1].

The Clinical Frailty Scale (CFS) was created as a pragmatic global assessment of fitness and frailty, combining aspects of function, comorbidity and dependence, and is a bedside score that can be quickly applied in routine clinical practice [2]. The significance of frailty as a surgical risk factor for

postoperative complications, longer hospital stays, and institutional discharge was observed in prospective studies, even after controlling for traditional risk factors, and this led to a greater interest in frailty as a surgical risk factor [3]. Later systematic reviews found that frailty is a significant predictor of mortality, morbidity and long hospital stays in older surgical patients [4]. Meta-analytic evidence shows that frailty is significantly linked to major morbidity and short and long-term mortality in major abdominal surgery [5].

Even with this evidence, frailty assessment is not consistently applied prior to abdominal surgery, particularly in low resource settings, where many surgeons may be more interested in anaesthetic clearance than functional reserve. In recent prospective studies in Asian populations, frailty has been found to enhance the predictive value of ASA, POSSUM and E-PASS scores in older patients undergoing thoracic and abdominal surgery [6]. The results are significant because large abdominal operations are often associated with long anaesthetic times, fluid shifts, postoperative pain management, early mobilization and recovery from nutritional deficits, which can be challenging for elderly patients.

The clinical value of frailty screening is not only based on statistical association, but also on the ability to provide additional risk discrimination beyond age and comorbidity. Preoperative assessment of frailty may lead to targeted prehabilitation, nutritional support, geriatric consultation, shared decision making, postoperative ICU triage, delirium prevention and discharge planning. However, future institutional studies of frailty in mixed populations of major abdominal surgery are limited. The aim of the present study was to evaluate the relationship between frailty and 30-day postoperative complications after elective major abdominal surgery and to ascertain whether frailty is an additional factor to the usual perioperative risk factors in predicting complications.

Materials and Methods

Study design and setting: Prospective cohort study in the departments of general surgery, gastrointestinal surgery and anaesthesiology of a tertiary teaching hospital. Patients were screened in the pre-anaesthesia evaluation clinic, with consecutive patients being screened.

Eligibility: Adults (60 years or older) who were scheduled for elective major abdominal surgery under general anaesthetic. Major abdominal surgery was defined as surgery that was likely to last longer than 90 minutes and involve either an intra-abdominal dissection or complex abdominal wall reconstruction. The procedures performed were colorectal resection, gastrectomy, hepatobiliary surgery, pancreaticobiliary bypass or resection, small bowel resection and open ventral hernia repair with component separation. The exclusion criteria included emergency surgery, minor laparoscopic surgery, not being able to walk before the index disease, advanced dementia that prevented evaluation, refusal of consent, preoperative admission to the intensive care unit and failure to follow up after surgery.

Frailty Assessment: Trained research staff, not involved in outcome adjudication, assessed frailty within 7 days prior to surgery. The CFS was measured following interview and review of functional status, and ranged from 1 to 9. Fried phenotype components were evaluated based on unintentional weight loss, self-reported exhaustion, handgrip weakness (using a dynamometer), slow gait speed (over 4 metres) and low physical activity. Those who had 0 components were classified as non-frail, 1 to 2 components as pre-frail and 3 or more components as frail. Primary analysis was done using Fried category and sensitivity analysis was done using CFS.

Perioperative variables: These included baseline variables such as age, sex, body mass index, smoking, diabetes, hypertension, chronic kidney disease, chronic pulmonary disease, malignancy, serum albumin, haemoglobin, ASA class, Charlson comorbidity index, and surgical procedure type. Operative variables were approach, duration of surgery, estimated blood loss, transfusion, intraoperative hypotension and surgical complexity (moderate or high) based on the extent of resection and the need for postoperative care.

Primary outcome: Any complication of Clavien-Dindo grade II or greater within 30 days of surgery. Major complications were considered to be grade III or above. Data collected included surgical site infection, pneumonia, ileus, acute kidney injury, delirium, anastomotic leak, venous thromboembolism, unplanned admission to the intensive care unit, readmission, mortality, length of hospital stay, and destination at discharge. Two investigators blinded to frailty status made the outcomes adjudication based on predefined criteria.

Data analysis: Continuous variables were expressed as mean ± standard deviation or median (interquartile range) as appropriate. Categorical variables were described in terms of numbers and percentages. ANOVA, Kruskal-Wallis test, chi-square test or Fisher exact test were used to assess group differences as appropriate. The relationship between frailty and postoperative complications was assessed by multivariable logistic regression, which controlled for clinically relevant covariates. The area under the receiver operating characteristic curve (AUC) was used to measure model

discrimination. The p value was calculated on both sides and was considered statistically significant if < 0.05.

Results

A total of 236 patients were screened, of whom 214 met eligibility criteria and completed 30-day follow-up. The cohort included 116 non-frail patients (54.2%), 63 pre-frail patients (29.4%), and 35 frail patients (16.4%). Frail patients were older, had lower albumin, higher comorbidity burden, and a greater proportion of ASA III status. The distribution of surgical procedure type was broadly comparable across groups, although high-complexity operations were slightly more common among frail patients.

Table 1: Baseline and perioperative characteristics according to frailty category

Variable	Non-frail (n=116)	Pre-frail (n=63)	Frail (n=35)	p-value
Age, years	66.4 +/- 4.8	69.2 +/- 5.7	72.8 +/- 6.1	<0.001
Male sex, n (%)	66 (56.9)	35 (55.6)	18 (51.4)	0.84
BMI, kg/m2	25.1 +/- 3.9	24.3 +/- 4.1	23.6 +/- 4.2	0.08
Charlson comorbidity index	3.1 +/- 1.4	4.0 +/- 1.7	5.1 +/- 1.9	<0.001
ASA class III, n (%)	27 (23.3)	24 (38.1)	21 (60.0)	<0.001
Serum albumin, g/dL	3.9 +/- 0.4	3.6 +/- 0.5	3.3 +/- 0.5	<0.001
High-complexity surgery, n (%)	45 (38.8)	29 (46.0)	19 (54.3)	0.17
Operative duration, min	154.6 +/- 48.5	164.2 +/- 54.7	176.8 +/- 62.4	0.06

Table 2: Thirty-day postoperative outcomes by frailty category

Outcome	Non-frail	Pre-frail	Frail	p-value
Any complication, n (%)	24 (20.7)	23 (36.5)	20 (57.1)	<0.001
Major complication, n (%)	8 (6.9)	8 (12.7)	9 (25.7)	0.006
Surgical site infection, n (%)	10 (8.6)	9 (14.3)	8 (22.9)	0.046
Pneumonia, n (%)	4 (3.4)	5 (7.9)	6 (17.1)	0.012
Delirium, n (%)	3 (2.6)	6 (9.5)	7 (20.0)	0.002
ICU admission, n (%)	11 (9.5)	11 (17.5)	11 (31.4)	0.002
Length of stay, days	7.2 +/- 3.4	9.1 +/- 4.3	11.8 +/- 5.6	<0.001
Readmission, n (%)	5 (4.3)	5 (7.9)	6 (17.1)	0.026

Table 3: Multivariable logistic regression for any 30-day postoperative complication

Predictor	Adjusted OR	95% CI	p-value
Pre-frail vs. non-frail	1.82	0.92-3.61	0.084
Frail vs. non-frail	3.18	1.42-7.09	0.005
Age per year	1.03	0.98-1.08	0.23
ASA III vs. I-II	1.66	0.88-3.12	0.12
Charlson index per point	1.18	1.01-1.38	0.039
High-complexity surgery	2.04	1.10-3.80	0.024
Operative duration per 30 min	1.17	1.01-1.36	0.041

The baseline model including age, sex, ASA class, Charlson comorbidity index, surgical complexity, operative duration, albumin, and haemoglobin had an AUC of 0.71 for predicting 30-day complications. Addition of frailty category increased the AUC to 0.80 and improved calibration across low-, intermediate-, and high-risk groups. In sensitivity analysis, CFS score of 5 or higher was associated with increased complications (adjusted OR 2.74, 95% CI 1.31-5.72; p=0.007). No deaths occurred in the non-frail group, while 30-day mortality was 1.6% in pre-frail and 5.7% in frail patients.

Discussion

This prospective cohort study showed that frailty prior to surgery is a powerful and independent risk factor for postoperative morbidity following elective major abdominal surgery. The risk of complications rose in a step-wise fashion across the non-frail, pre-frail and frail groups and frailty was independently associated after adjusting for age, ASA class, comorbidity, serum markers, surgical complexity and operative duration. The loss of significance of chronological age after adjustment is consistent with the notion that vulnerability to postoperative stress is not just chronological age. Our findings are similar to those of Makary and colleagues, who found that frailty was an independent predictor of surgical complications, longer hospital stay, and institutional discharge in older patients [3]. They are also consistent with systematic review evidence that frailty is a predictor of mortality, complications and longer hospital stays in older surgical populations [4]. For abdominal surgery, Sandini et al. found

significantly higher morbidity and mortality rates in frail patients following large abdominal surgeries [5]. The current cohort builds on these results by demonstrating clinically relevant incremental discrimination when frailty is incorporated with the standard preoperative variables.

The complications profile seen in frail patients is biologically plausible. Frailty is a manifestation of sarcopenia, poor nutritional reserve, impaired immunity, cardiopulmonary reserve, and ability to withstand inflammation and immobility. The mechanisms behind these may account for the increased incidence of pneumonia, delirium, surgical site infection, admission to an intensive care unit, and not being discharged home. The frailty can also be linked to postoperative pain, opioid use, sleep disturbance and catabolic stress, which can lead to delayed mobilization and longer hospital stays.

It is important to remember the clinical relevance of pre-frailty. While the adjusted association for pre-frailty was not statistically significant, pre-frail patients had intermediate complication rates and longer hospital stay than non-frail patients. This group may be especially appropriate for prevention measures as functional decline may still be preventable. Resistance training, protein supplementation, glycaemic control, correcting anaemia, smoking cessation and respiratory training may be beneficial for prehabilitation to minimise vulnerability prior to elective surgery, but there is a lack of high-quality procedure-specific trials.

The study has implications for the preoperative pathways. Frailty assessment can be done in a short time, with little equipment and can be incorporated into anaesthetic assessment. A positive frailty screen does not mean that surgery is contraindicated but rather should be a platform for a comprehensive discussion of risks, alternatives, likely recovery, rescue preferences, and discharge planning.

The large registry data and emergency abdominal surgery cohorts also suggest that frailty is a prognostic factor in both lower stress and high-risk emergency laparotomy surgery [6,7,8]. It should also promote collaboration between the surgeon, anaesthesist, geriatrician, nutritionist, physiotherapist and nursing staff. Planned postoperative monitoring may be safer than reactive escalation after complications occur, in high-risk frail patients.

There are some limitations to this study. It was carried out in one tertiary centre and surgical case mix may not be representative of all centres. The measurement of frailty was done preoperatively by trained personnel and may vary depending on clinical teams. Adjustment was done for major confounders, but there may be residual confounding. Follow-up was only for 30 days and long-term functional recovery, quality of life and survival were not evaluated. Lastly, the number of subjects was not large enough to allow for detailed analysis of subgroups according to procedure type. Further multicentre trials with larger numbers of patients are needed to determine if frailty-driven interventions can prevent complications, rather than just predict them.

However, the graded risk pattern, independent association, and enhanced AUC indicate that the frailty assessment offers useful information in addition to the traditional risk assessment tools. Preoperative frailty screening could be a useful tool to match the surgical decision with patient reserve and optimize perioperative resource utilization.

Conclusion

Preoperative frailty was independently associated with 30-day postoperative complications, major morbidity, admission to an intensive care unit, length of hospital stay, and discharge to a location other than home following elective major abdominal surgery. The use of frailty assessment in the standard pre-operative assessment process enhanced the risk prediction over the traditional clinical parameters and could help in personalized counselling, optimization, post-operative monitoring and discharge planning.

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