ISSN (P&E): 1996-7195, (O): 2957-899X DOI: https://doi.org/10.53350/pjmhs02025197.6

ORIGINAL ARTICLE

Impact of Patient Frailty on Intensive Care Unit Outcomes after Coronary Artery Bypass Grafting

SALIK AHMED CHEEMA[1], MUHAMMAD MOHSIN MAHMOOD[2], BENAZEER MIKRANI[3], ANEELA JUMADIN[4], MUHAMMAD YASIR[5], ATTAULLAH KHAN NIAZI[6]

[1]Registrar Cardiac Surgery, Department of Cardiac Surgery, King Edward Medical University, Lahore
[2]Senior Registrar Cardiac Surgery, Department of Cardiac Surgery, King Edward Medical University, Lahore
[3]Post Graduate Resident (PGR), Cardiac Surgery, Department of Cardiac Surgery, King Edward Medical University, Lahore
[4]Post Graduate Resident (PGR), Cardiac Surgery, Department of Cardiac Surgery, King Edward Medical University, Lahore
[5]Post Graduate Resident (PGR), Cardiac Surgery, Department of Cardiac Surgery, Mayo Hospital, Lahore
[6]Associate Professor, Cardiac Surgery, Department of Cardiac Surgery, King Edward Medical University, Lahore
Correspondence to: Salik Ahmed Cheema, **E-mail:** Salikahmedcheema93@gmail.com, **Cell:** 0336-5764999

This article may be cited as: Cheema SA, Mahmood MM, Mikrani B, Jumadin A, Yasir M, Niazi AK; Impact of Patient Frailty on Intensive Care Unit Outcomes after Coronary Artery Bypass Grafting. Pak J Med Health Sci, 2025; 19(07): 27-32.

Received: 03-05-2025
Accepted: 24-06-2025
Published: 05-08-2025

Check for updates

© The Author(s) 2025. This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author(s) and source are credited.

ABSTRACT

Background: Preoperative evaluation of frailty has typically relied on subjective measures and has evolved towards objective, standardized scales and tests. Patient frailty is one of the most important predictors for postoperative outcome, including mortality and morbidity. We sought to investigate whether patient frailty influences intensive care unit (ICU) outcomes following coronary artery bypass grafting (CABG). Findings from this study may provide important clinical implications in regard to the potential role of individualized preoperative evaluations and interventions for frail patients recovering from CABG in the ICU.

Methods: 100 patients scheduled for elective isolated CABG between November 2024 and April 2025 were recruited in this observational study. Participants were divided into frail (n=50) and non-frail (n=50) according to the Essential Frailty Toolset (EFT). Preoperative, Intraoperative and Postoperative data was collected including parameters of 30-day mortality, duration of ICU stay, time on mechanical ventilation and postoperative arrhythmia.

Result: Frail patients had a longer ICU stay (median 3.5 days vs 2 days, p=0.002), duration of mechanical ventilation (18 hours vs 11 hours, p<0.001) and postoperative arrhythmia (40% vs 20%, p=0.03) rate compared to non-frail patients. Furthermore, 5 frail patients developed postoperative stroke and none in the non-frail group did (p=0.02). The 30-day mortality was more common in frail patients (14% vs 2%, p=0.03). Frail patients were more commonly associated with surgical site infection, delirium and reoperation for bleeding, but these were not statistically significant.

Conclusion: Frailty is a strong marker of poor ICU outcomes after CABG, correlated with more morbidity and higher incidence of 30-days mortality. Frail patients develop more complications during postoperative recovery, resulting in longer ICU length of stay and higher mortality rate.

Keywords: Frailty, Coronary Artery Bypass Grafting (CABG), ICU Outcomes, Postoperative Complications, Essential Frailty Toolset (EFT).

INTRODUCTION

Frailty is a clinical syndrome of reduced strength, endurance and overall function that is multicausal and multifactorial. This condition exponentially increases the risk of higher dependency and mortality[(1)]. Frailty has becoming increasingly recognized as an important marker of poor outcomes in patients undergoing cardiopulmonary

bypass (CPB), particularly in older populations[2]. Recent studies indicate that frailty prevalence in these patients ranges between 15% and 25%, depending on the frailty assessment tool used[3][4]. Frailty exacerbates postoperative complications, prolongs Intensive Care Unit (ICU) stays, and increases mortality risks[5]. Cardiopulmonary bypass induces an inflammatory response that worsens frailty-related vulnerabilities, including the need for extended mechanical ventilation and ICU care[6]. Despite these risks, preoperative frailty assessments are not yet consistently integrated into surgical planning[7][8].

A meta-analysis by Sepehri et al. in 2019 observed worse outcomes after CPB in frail patients with significantly longer stay in ICU, mechanical ventilation time and higher mortality in the postoperative period[9]. Similarly, Robinson et al. (2020) found frail patients having a 70 percent increased risk of longer length of hospital stay when compared to patients categorized as non-frail[10]. Further, Martin et al. (2020) found that frailty was associated with increased mortality and prolonged ICU treatment, particularly elderly cardiac surgery patients[11].

Although the role of frailty in predicting adverse postoperative outcomes is well-documented, there is a lack of standardized preoperative frailty screening protocols for patients undergoing CPB. The specific impact of frailty on ICU outcomes, such as time on mechanical ventilation, 30-day mortality, and ICU readmission rates, has not been sufficiently addressed in recent literature[12].

The objective is to investigate the impact of frailty on ICU parameters post CABG. Findings of this study will provide clinical evidence concerning the significance of personalized preoperative evaluation and intervention in frail CABG patients within the ICU.

MATERIAL AND METHOD

Study Design

This prospective cohort study was conducted at Department of Cardiac Surgery, King Edward Medical University/ Mayo Hospital Lahore between November 2024 and April 2025, encompassing a duration of 6 months. Patients were enrolled for study after approval from the Institutional Review Board (IRB 178/RC/KEMU 2025).

Inclusion and Exclusion Criteria

Inclusion criteria were adult patients above the age of 60 undergoing elective on-pump Coronary Artery Bypass Grafting (CABG). Patients were excluded if preoperative inotropic support was required, any concomitant cardiac procedure such as valve replacement was planned, history of chronic kidney disease, chronic obstructive pulmonary disease or stroke, there was > 70 % stenosis in either carotid artery, and if they had severe cognitive impairment, delirium or dementia Sample size was calculated with G*Power (version 3.1.9.7). Assuming a medium size effect (Cohen's d = 0.5), alpha = 0.05, and a power of 80%, a sample of at least 88 patients (44 in each group) was estimated to be required to observe a significant difference between frail and non-frail classes. The frail group consisted of 50 patients and the non-frail 50 patients.

Intervention

All Patients were grouped as per their score on the Essential Frailty Toolset (EFT) Table 1. Patients with the score of 0 to 2 were grouped into non- frail whereas those with a score of 3 to 5 were grouped as frail.

All patients underwent a standardized preoperative workup with baselines (Complete Blood Count, Coagulation Profile, Liver Function Tests, Renal Function Tests) along with a Chest Xray, Electrocardiogram (ECG), Arterial Blood Gases (ABGs), in addition to a transthoracic echocardiogram (TTE). Patient's demographic details with their smoking and insulin use status was noted.

All patients underwent median sternotomy and were placed on cardiopulmonary bypass via aortocaval cannulation (ascending aorta and right atrium) for the distal and proximal coronary anastomoses.

Mechanical Ventilation was defined as the total duration of invasive ventilation, noted from the placement of the endotracheal tube (ETT) to extubation, measured in hours. ICU stay was the total duration of patient stay in the ICU, starting from shifting of patient from Operation Theatre (OT) to eventual shifting to Step down unit, measured in days. 30 Day Mortality was any death occurring up to the 30th postoperative day.

Presence of Atelectasis was a subjective assessment on postoperative CXR. Arrhythmia was any irregular rhythm that necessitated intervention in the form of chemical or electrical cardioversion. Reopening for bleeding was determined as per increased mediastinal drain output or per surgeon assessment. Surgical Site Infection was any discharge from median sternotomy skin incision site associated with fever or raised total leukocyte count above 14 x 103/uL.

Statistical Analysis

The data was analysed in IBM SPSS Statistics version 27.0. Continuous measurements such as age, ejection fraction, duration of mechanical ventilation, and ICU stay were assessed for normal distribution. Data were summarized using mean ± standard deviation (SD) for normally followed variables and as median (interquartile range (IQR)) for non-normally followed variables, which were

obtained based on distribution. Between-group differences were assessed using independent sample t test or Mann–Whitney U test for continuous variables and chi squared or Fisher's exact test for categorical variables. Independent risk factors for prolong mechanical ventilation, ICU stay, arrhythmia and 30-day mortality were identified by multivariate logistic regression analyses adjusting for age, sex, Left main disease and ejection fraction. A p-value < 0.05 was considered statistically significant.

Table 1. Essential Frailty Toolset

Parameter	Criteria	Points	Patient Score
Muscle Weakness	Five chair rises in <15 seconds	0	
	Five chair rises in ≥15 seconds	1	
	Unable to complete	2	
Cognitive Impairment	No cognitive impairment	0	
	Cognitive impairment	1	
Anaemia	Men: ≥ 13.0 g/dL, Women: ≥12.0 g/dL	0	
	Men: < 13.0 g/dL, Women: <12.0 g/dL	1	
Hypoalbuminemia	≥ 3.5 g/dL	0	
	<3.5 g/dL	1	
Total Score			

RESULTS

One hundred patients undergoing isolated CABG were included in the study, of which 50 were frail and 50 were not frail. Demographic data and comorbid conditions of the patients are given in Table 2.

Frail patients were older as compared to not frail patients (70.4 ± 5.2 vs. 63.7 ± 6.8 years, p<0.001). There were also no differences between groups in terms of male patients -62% of frail patients vs. 68% of non-frail patients were male (p=0.52). Preoperative Ejection Fraction was marginally lower in frail patients (48.5 ± 8.2% vs 51.3 ± 7.4%, p=0.06). The percentage of patients with left main coronary artery disease was higher in frail patients (46% versus 30%) but this difference was not statistically significant (p=0.09).

Table 3 presents a comparison of postoperative ICU outcomes between frail and non-frail patients. The median mechanical ventilation time was significantly longer in frail patients (18 hours [IQR 14–26]) compared to non-frail patients (11 hours [IQR 9–16], p<0.001). Additionally, the length of ICU stay was significantly greater for frail patients (3.5 days [IQR 2.5–5.0]) compared to non-frail patients (2.0 days [IQR 1.5–3.0], p=0.002).

Frail patients also showed a higher rate of intra-aortic balloon pump (IABP) usage (18% vs. 6%, p=0.05), postoperative arrhythmias (40% vs. 20%, p=0.03), and stroke (10% vs. 0%, p=0.02). Furthermore, frail patients experienced higher 30-day mortality (14% vs. 2%, p=0.03). No statistically significant differences were found between the groups regarding surgical site infections (SSI), delirium, or the need for reopening due to bleeding.

On logistic regression analysis adjusting for age, gender, left main disease, ejection fraction, and insulin-dependent diabetes, frailty remained an independent predictor of prolonged mechanical ventilation (>24 hours) Figure 1 (OR 3.86, 95% CI 1.52–9.78, p=0.005) and increased ICU stay (>3 days) Figure 2 (OR 3.29, 95% CI 1.31–8.27, p=0.011) Table 4. Frailty was associated with a significantly higher odds of postoperative arrhythmia (OR 2.72, 95% CI 1.09–6.76, p=0.032) and 30-day mortality (OR 5.62, 95% CI 1.01–31.3, p=0.048).

Table 2: Basic Characteristics of the Study Population

Variable	Frail (n=50)	Non-Frail (n=50)	p-value
Age (years, mean ± SD)	70.4 ± 5.2	63.7 ± 6.8	<0.001
Male Gender, n (%)	31 (62)	34 (68)	0.52
Pre Operative Ejection Fraction (% mean ± SD)	48.5 ± 8.2	51.3 ± 7.4	0.06
Left Main Disease, n (%)	23 (46)	15 (30)	0.09
Diabetes on Insulin, n (%)	12 (24)	10 (20)	0.63
Smoker, n (%)	20 (40)	22 (44)	0.68

Table 3: ICU and Postoperative Outcomes

Outcome	Frail (n=50)	Non-Frail (n=50)	p-value
Mechanical Ventilation (hours, median [IQR])	18 [14–26]	11 [9–16]	<0.001
ICU Stay (days, median [IQR])	3.5 [2.5–5.0]	2.0 [1.5–3.0]	0.002
IABP Use, n (%)	9 (18)	3 (6)	0.05
Atelectasis, n (%)	7 (14)	5 (10)	0.54
Arrhythmia, n (%)	20 (40)	10 (20)	0.03
Stroke, n (%)	5 (10)	0 (0)	0.02
Delirium, n (%)	3 (6)	2 (4)	0.65
Surgical Site Infection, n (%)	4 (8)	3 (6)	0.69
Reopening for Bleeding, n (%)	3 (6)	2 (4)	0.65
30-Day Mortality, n (%)	7 (14)	1 (2)	0.03

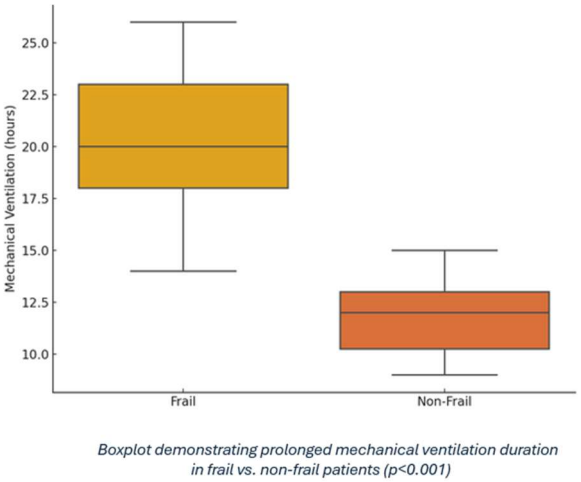

Figure 1. Duration of Mechanical Ventilation by Frailty Status

Table 4: Multivariate Analysis for Key Outcomes

Outcome	Adjusted OR (95% CI)	p-value
Prolonged Mechanical Ventilation (>24 hrs)	3.86 (1.52–9.78)	0.005
ICU Stay >3 Days	3.29 (1.31–8.27)	0.011
Postoperative Arrhythmia	2.72 (1.09–6.76)	0.032
30-Day Mortality	5.62 (1.01–31.3)	0.048

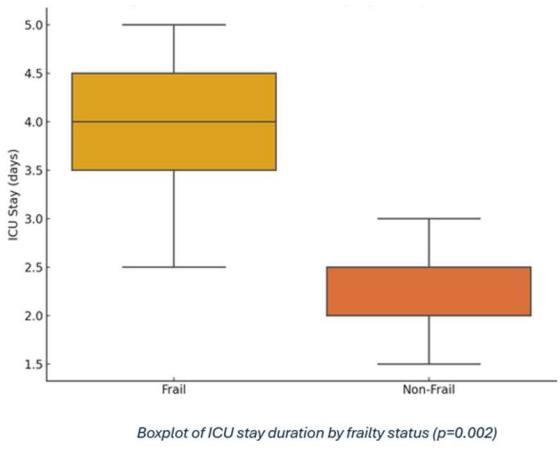

Figure 2. Duration of ICU Stay by Frailty Status

DISCUSSION

Frail patients had inferior postoperative outcomes compared with non-frail patients in our cohort of 100 patients undergoing isolated CABG. Adjusted for independent variables of age, gender, left main disease, ejection fraction and diabetes, frail patients required significantly longer duration of mechanical ventilation and ICU stay with increased 30-day mortality and higher rates of postoperative complications (notably arrhythmias and stroke). These findings are consistent with the growing literature on frailty in cardiac surgery and its profound impact on outcomes after CABG[13][14].

Frailty is a multifaceted variable which lends itself to different measures for its objective assessment. A study by Kim et al at Seoul National University Hospital employed the Laboratory Frailty Index (FI-L) in which laboratory data and vital signs, calculated as the ratio of variables outside the normal range for 32 preoperative parameters, was used to assign a value with a cutoff of 32% determined to predict all-cause mortality after CABG[15]. A retrospective cohort study of 46,928 cardiac surgery patients in Australia and New Zealand grouped patients per the Clinical Frailty Scale into frail (6.7%/3122) and non- frail (93.3%/43,806), finding raw mortality to be 4.2% for frail and 1.05% for non-frail after multivariate adjustment[16]. The fourfold increased risk of mortality is a good indicator of the influence of frailty on cardiac surgical decision making

Our results are consistent with previous research that demonstrated that frail patients were more likely to develop new postoperative arrhythmias and new stroke. Krivoshapova et al. reported that frail patients had higher rates of postoperative arrhythmias (19.5 vs 10.5%, p = 0.025) and strokes (5.7 vs 1.3%, p = 0.031) after CABG[17]. Similarly, the finding of prolonged ICU stay was corroborated by Lim et al which found frail patients staying 0.89 days longer than non-frail patients[18]. While we limited pulmonary complications to atelectasis alone, studies of pulmonary complications after cardiac surgery include pneumonia and respiratory failure, seen as

ventilation > 48 hours or re-intubation[19]. While our cohort of frail patients had longer duration of mechanical ventilation as reported elsewhere in literature, we did not encounter any patient requiring > 48 hours in this study[20].

An important target of research has been to create more sophisticated tools for assessing frailty, which could predict surgical outcomes more precisely. A predictive model that included both frailty as well as geriatric syndromes and proposed that frailty is a strong predictor for complications after cardiac surgery such as extended hospital length of stay, readmission, and higher mortality. Authors had highlighted the importance of early detection of frailty in elderly patients, with the use of performance-based, comprehensive assessment tools, for eg, Geriatric Risk Assessment Tool (GRAT)21 and frailty index (FI):[21]. Moreover, research has consistently defined frailty as an independent predictor of major postoperative complications. A study by Ogawa et al. (2022) verified that patients who are frail undergoing CABG are more prone to new onset postoperative arrhythmias and cerebrovascular events. They also discovered that frail patients were more likely to have a prolonged course of mechanical ventilation and an increased prevalence of AKI, potentially complicating their recovery[22].

The effect of frailty on death and long-term survival after CABG has also been investigated in a number of studies. In a study result in frail and frailty-less patients. The research concluded frailty was associated independently with an increased long-term mortality rate indicating that frailty not only affects short-term postoperative outcomes but also has a long-term effect on survival[23]. Additionally, there have also been recently studies that have sought to investigate possible interventions that can enhance the outcomes of frail patients post CABG. A study by Pozzi et al. (2024) investigated the impact of prehabilitation, an individualised exercise regimen to enhance physical function and minimise frailty in cardiac surgical candidates. They found that frail patients that undertook preoperative physical exercise had fewer postoperative complications, including decreased days in ICU and infections. These findings are consistent with the emerging evidence that preoperative interventions can modify many of the adverse consequences of frailty[24].

Knowledge of the cost-effectiveness of interventions in the management of frail patients, such as prehabilitation programs, would be useful in prioritizing allocation of healthcare resources, as well as potentially improving patient outcomes within this vulnerable cohort.

CONLUSION

Our study adds to mounting evidence that frailty is a powerful, independent predictor of adverse ICU outcomes after CABG therefore supporting the integration of frailty screening into surgical risk assessment. This would help to guide informed consent discussions, allocate ICU resources appropriately, and target interventions to mitigate risk.

DECLARATION

Limitation

This study has limitations that merit discussion. Our sample size (100 patients) was relatively small, so subgroup analyses and the precision of our estimates are constrained. As an observational study, there is potential for unmeasured confounding variables despite statistical adjustment. For instance, frailty may be associated with factors we did not measure (nutritional status, undiagnosed disease) that could influence outcomes.

Recommendations

1. Frailty screening should be universally carried out for all patients scheduled for CABG. Tools such as the Clinical Frailty Scale, Lab Frailty Index (FI-L), or Geriatric Risk Assessment Tool (GRAT) should be included in the surgical screening process to evaluate and classify 'at-risk' frail patients from 'fit' patients as early as possible, prior to surgery.
2. Frail older patients should be considered for prehabilitation programs using exercise and nutrition. A number of reports have proven that the preoperative exercise program enhances functional capacity, decreases frailty and is associated with lower rates of postoperative complications, such as respiratory failure, pneumonia, and extended mechanical ventilation after the operation.
3. A multidisciplinary treatment approach is essential for the management of frail patients receiving CABG. The role of geriatricians, cardiologists, anesthesiologists, and rehabilitation physicians in perioperative care may be the key to success.
4. Close monitoring is recommended for frail individuals in the postoperative period in order to recognize complications such as arrhythmia, stroke, and respiratory compromise early. Advanced monitoring in the ICU, including continuous electrocardiogram monitoring, brain natriuretic peptide (BNP) levels, and neurological assessments, can aid in the early detection of complications.
5. It is critical to educate health care providers, including surgeons, anesthesiologists, and critical care providers, about frailty. Education measures raising awareness of the implications of frailty for the outcome of a surgical procedure and methods of and need for preoperative and postoperative treatment may increase the quality of the management of frail patients after CABG.

REFERENCES

1. Morley JE, Vellas B, van Kan GA, Anker SD, Bauer JM, Bernabei R, et al. Frailty consensus: a call to action. J Am Med Dir Assoc. 2013 Jun;14(6):392–7.
2. Sepehri A, Beggs T, Hassan A, Rigatto C, Shaw-Daigle C, Tangri N, et al. The impact of frailty on outcomes after cardiac surgery: A systematic review. J Thorac Cardiovasc Surg. 2014 Dec 1;148(6):3110–7.

3. Afilalo J, Lauck S, Kim DH, Lefèvre T, Piazza N, Lachapelle K, et al. Frailty in Older Adults Undergoing Aortic Valve Replacement: The FRAILTY-AVR Study. J Am Coll Cardiol. 2017 Aug 8;70(6):689–700.
4. Robinson TN, Walston JD, Brummel NE, Deiner S, Brown CHI, Kennedy M, et al. Frailty for Surgeons: Review of a National Institute on Aging Conference on Frailty for Specialists. J Am Coll Surg. 2015 Dec;221(6):1083.
5. Nguyen TN, Cumming RG, Hilmer SN. The Impact of Frailty on Mortality, Length of Stay and Re-hospitalisation in Older Patients with Atrial Fibrillation. Heart Lung Circ. 2016 Jun 1;25(6):551–7.
6. Makary MA, Segev DL, Pronovost PJ, Syin D, Bandeen-Roche K, Patel P, et al. Frailty as a Predictor of Surgical Outcomes in Older Patients. J Am Coll Surg. 2010 Jun;210(6):901.
7. Lee DH, Buth KJ, Martin BJ, Yip AM, Hirsch GM. Frail Patients Are at Increased Risk for Mortality and Prolonged Institutional Care After Cardiac Surgery. Circulation. 2010 Mar 2;121(8):973–8.
8. Afilalo J, Alexander KP, Mack MJ, Maurer MS, Green P, Allen LA, et al. Frailty Assessment in the Cardiovascular Care of Older Adults. J Am Coll Cardiol. 2014 Mar 4;63(8):747–62.
9. Sepehri A, Beggs T, Hassan A, Rigatto C, Shaw-Daigle C, Tangri N, et al. The impact of frailty on outcomes after cardiac surgery: A systematic review. J Thorac Cardiovasc Surg. 2014 Dec 1;148(6):3110–7.
10. Robinson TN, Wu DS, Pointer L, Dunn CL, Cleveland JC, Moss M. Simple frailty score predicts postoperative complications across surgical specialties. Am J Surg. 2013 Oct 1;206(4):544–50.
11. Spiliopoulos K, Bagiatis V, Deutsch O, Kemkes BM, Antonopoulos N, Karangelis D, et al. Performance of EuroSCORE II compared to EuroSCORE I in predicting operative and mid-term mortality of patients from a single center after combined coronary artery bypass grafting and aortic valve replacement. Gen Thorac Cardiovasc Surg. 2014 Feb 1;62(2):103–11.
12. Collard RM, Boter H, Schoevers RA, Oude Voshaar RC. Prevalence of frailty in community-dwelling older persons: a systematic review. J Am Geriatr Soc. 2012 Aug;60(8):1487–92.
13. Chandiramani A, Ali JM. Frailty in Cardiac Surgery—Assessment Tools, Impact on Outcomes, and Optimisation Strategies: A Narrative Review. J Cardiovasc Dev Dis. 2025 Mar 31;12(4):127.
14. Lee JA, Yanagawa B, An KR, Arora RC, Verma S, Friedrich JO, et al. Frailty and pre-frailty in cardiac surgery: a systematic review and meta-analysis of 66,448 patients. J Cardiothorac Surg. 2021 Jun 25;16(1):184.
15. Kim CH, Kang Y, Kim JS, Sohn SH, Hwang HY. Association Between the Frailty Index and Clinical Outcomes after Coronary Artery Bypass Grafting. J Chest Surg. 2022 Jun 5;55(3):189–96.
16. Ahuja A, Baker T, Ramanan M. Impact of frailty on outcomes after cardiac surgery. J Thorac Cardiovasc Surg [Internet]. 2024 Jun 11 [cited 2025 May 25];0(0). Available from: https://www.jtcvs.org/article/S0022-5223(24)00511-7/abstract
17. Krivoshapova K, Tsygankova D, Bazdyrev E, Barbarash O. Frailty as an Independent Predictor of Adverse Outcomes in Patients Undergoing Direct Myocardial Revascularization. Diagn Basel Switz. 2024 Jul 3;14(13):1419.
18. Lim A, Choi M, Jang Y, Lee H. Preoperative frailty based on laboratory data and postoperative health outcomes in patients undergoing coronary artery bypass graft surgery. Heart Lung. 2022 Nov 1;56:1–7.
19. Ji Q, Mei Y, Wang X, Feng J, Cai J, Ding W. Risk Factors for Pulmonary Complications Following Cardiac Surgery with Cardiopulmonary Bypass. Int J Med Sci. 2013 Sep 10;10(11):1578–83.
20. Henry L, Halpin L, Barnett SD, Pritchard G, Sarin E, Speir AM. Frailty in the Cardiac Surgical Patient: Comparison of Frailty Tools and Associated Outcomes. Ann Thorac Surg. 2019 Jul 1;108(1):16–22.
21. Guasti L, Fumagalli S, Afilalo J, Geisler T, Abreu A, Ambrosetti M, Gevaert S, Christodorescu R, Richter D, Aboyans V, Chastaingt L. Cardiovascular diseases, prevention, and management of complications in older adults and frail patients treated for elective or post-traumatic hip orthopaedic interventions: a clinical consensus statement of the ESC Council for Cardiology Practice (CCP), the European Association of Preventive Cardiology (EAPC), the Association for Acute CardioVascular Care (ACVC), the Association of Cardiovascular Nursing & Allied Professions of the ESC (ACNAP), the ESC Working Group on Aorta and Peripheral Vascular .... European Journal of Preventive Cardiology. 2025 Jan 15:zwaf010.
22. Ogawa M, Satomi-Kobayashi S, Yoshida N, Komaki K, Izawa KP, Hamaguchi M, Inoue T, Sakai Y, Hirata KI, Okada K. Impact of frailty on postoperative dysphagia in patients undergoing elective cardiovascular surgery. JACC: Asia. 2022 Feb 1;2(1):104-13.
23. Bakhtiari M, Shaker F, Shirmard FO, Jalali A, Vakili-Basir A, Balabandian M, Khamene SS, Mohammadkhawajah I, Shafiee A, Badrkhahan SZ, Hosseini K. Frailty efficacy as a predictor of clinical and cognitive complications in patients undergoing coronary artery bypass grafting: a prospective cohort study. BMC Cardiovascular Disorders. 2024 Feb 16;24(1):110.
24. Pozzi M, Mariani S, Scanziani M, Passolunghi D, Bruni A, Finazzi A, Lettino M, Foti G, Bellelli G, Marchetto G. The frail patient undergoing cardiac surgery: lessons learned and future perspectives. Frontiers in Cardiovascular Medicine. 2023 Dec 6;10:1295108.

Publisher's Note:
Pakistan Journal of Medical & Health Sciences (Pak J Med Health Sci) remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.