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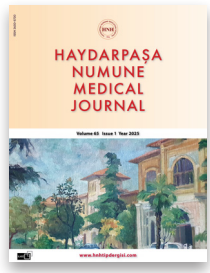

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ORIGINAL ARTICLE

Impact of Edmonton Frailty Score and Vitamin D Levels on Postoperative Outcomes of CABG in Older Adults

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Abstract

Introduction: To evaluate the impact of preoperative frailty, assessed by the Edmonton Frailty Score (EFS), and serum vitamin D and B12 levels on postoperative outcomes in elderly patients undergoing elective coronary artery bypass grafting (CABG).

Methods: This retrospective cohort study included 62 patients aged ≥65 years who underwent elective CABG between June 2023 and December 2024. Demographic data, comorbidities, EFS, serum vitamin D (25-hydroxyvitamin D), and B12 levels were recorded. Postoperative outcomes included duration of mechanical ventilation, intensive care unit (ICU) stay, sternal dehiscence, wound infection, atrial fibrillation, pneumonia, and mortality. Associations among variables were analyzed using parametric and nonparametric tests and correspondence analysis.

Results: The cohort consisted of 44 males (71%) with a mean age of 71.6±3.8 years. Vitamin D deficiency (<20ng/mL) was observed in 75% of males and 72% of females, while vitamin B12 deficiency (<200pg/mL) was identified in 18% of males and 22% of females. Lower vitamin D levels were significantly associated with prolonged mechanical ventilation and an increased risk of postoperative atrial fibrillation (p=0.013). No significant correlation was found for vitamin B12 levels. Higher EFS scores correlated positively with ICU stay, sternal dehiscence, wound infection, pneumonia, mortality, and longer mechanical ventilation times. Two in-hospital deaths occurred, both in patients with EFS ≥7 and vitamin D deficiency.

Discussion and Conclusion: Preoperative frailty and vitamin D deficiency are strong predictors of adverse postoperative outcomes in elderly patients undergoing CABG. Incorporating frailty and vitamin D assessment into preoperative evaluation may improve risk stratification and perioperative management, potentially reducing complications and improving outcomes.

Keywords: CABG; Edmonton score; frailty; vitamin D insufficiency.

With increasing life expectancy, the number of cardiac surgical procedures performed in patients over 65 years of age has risen significantly. Elderly patients often present with comorbidities and reduced physiological reserve, which increases their risk of postoperative complications. Preoperative frailty assessment and evaluation of nutritional deficiencies, including vitamins D and B12, have emerged as potential predictors of adverse outcomes in this population [1].

Frailty, a multidimensional syndrome characterized by reduced strength, endurance, and physiological reserve, has been shown to correlate with postoperative morbidity and mortality. It represents a significant risk factor for postoperative complications and serves as an independent predictor of in-hospital mortality, discharge to institutional care, and decreased mid-term survival.

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The Edmonton Frailty Scale (EFS) is a validated tool that assesses frailty using cognitive, functional, and clinical parameters. The EFS samples 10 domains such as cognition, functional independence, and medication use; scores range from 0 (not frail) to 17. The maximum score is 17 and represents the highest level of frailty [2].

Similarly, vitamin D deficiency has been linked to impaired muscle function, immune dysregulation, and prolonged recovery after surgery, while vitamin B12 deficiency can affect hematologic and neurologic function.

We hypothesized that preoperative frailty and vitamin D deficiency are independently associated with adverse postoperative outcomes in elderly patients undergoing CABG.

Materials and Methods

This retrospective cohort study included patients aged 65 years and older who underwent elective CABG at Mehmet Akif Ersoy Chest, Heart and Vascular Surgery Hospital between June 2023 and December 2024. Ethical approval was obtained from the Institutional Review Board of Istanbul Mehmet Akif Ersoy Chest, Heart and Vascular Surgery Hospital (Approval No: 2025.02-18, Date: 04/03/2025). All procedures were performed in compliance with the ethical standards of the responsible committee on human experimentation and with the 1964 Helsinki Declaration and its later amendments. Patients were eligible for inclusion if they were older than 65 years, scheduled for elective surgery, diagnosed with isolated coronary artery disease, had available preoperative measurements of serum vitamin D (25-hydroxyvitamin D) and vitamin B12 levels, and had completed the Edmonton Frailty Scale assessment. Blood samples were obtained within 7 days prior to surgery and analyzed using a chemiluminescent immunoassay. According to the Edmonton Frailty Scale, scores of 0–4 indicate no frailty, 5–6 indicate vulnerability, 7–8 mild frailty, 9–10 moderate frailty, and 11–17 severe frailty. Patients undergoing emergency surgery, those presenting with poor preoperative condition, requiring additional surgical procedures, or necessitating perioperative mechanical support devices were excluded from the study.

Demographic and preoperative variables, including age, sex, diabetes mellitus, hypertension, chronic obstructive pulmonary disease (COPD), chronic kidney disease (CKD), peripheral vascular disease, smoking status, and left ventricular ejection fraction, were recorded. COPD was defined as a forced expiratory volume in 1 second (FEV_1) to forced vital capacity (FVC) ratio of <80%, and CKD was defined as a glomerular filtration rate (GFR)<30 mL/min/1.73 m^2 or the need for dialysis. Serum 25-hydroxyvitamin D levels <20 ng/mL were considered indicative of vitamin D deficiency, while vitamin B12 deficiency was defined as levels <200 pg/mL. Postoperative outcomes evaluated included duration of mechanical ventilation, intensive care unit (ICU) length of stay, sternal dehiscence, wound infection, atrial fibrillation, pneumonia, and mortality.

All included patients underwent elective coronary artery bypass grafting. Operations were performed through median sternotomy using ascending aorta–right atrial two-stage cannulation and isothermic blood cardioplegia. In all patients, the left internal mammary artery (LIMA) was anastomosed to the left anterior descending artery (LAD), while saphenous vein grafts were used for revascularization of other coronary lesions.

Statistical Analysis

Continuous variables were expressed as mean±standard deviation, and categorical variables as frequencies and percentages. Correlations between vitamin levels, Edmonton frailty scores, and postoperative outcomes were assessed using appropriate parametric or nonparametric tests. Due to the limited sample size, the number of events affected the results within a narrow confidence interval; in addition, correspondence analysis was applied to examine the relationships among variables using multidimensional cross-tabulations. A p-value <0.05 was considered statistically significant.

Results

A total of 62 patients met the inclusion criteria, including 44 males (71%). The mean age was 71.6 (standard deviation 3.8) years. The mean EuroSCORE-II was 1.21. Preoperative comorbidities, including diabetes, hypertension, COPD, CKD, peripheral vascular disease, smoking status, and ejection fraction, did not differ significantly across the cohort. The demographics of the cohort are summarized in Table 1.

When evaluated in terms of vitamin deficiencies, vitamin D deficiency (<20 ng/mL) was observed at notably high rates—75% in males and 72% in females—whereas vitamin B12 deficiency (<200 pg/mL) was identified in 18% of males and 22% of females (Table 1).

Vitamin B12 levels demonstrated variability but showed no significant correlation with other preoperative or postoperative parameters. In contrast, vitamin D levels were inversely associated with mechanical ventilation duration, indicating shorter ventilation times in patients with higher vitamin D levels (Fig. 1). Additionally, lower vitamin D levels were associated with an increased risk of postoperative atrial fibrillation (AF) (p=0.013).

As a result of correspondence analysis, higher Edmonton Frailty Scores were positively correlated with ICU length of

Table 1. Demographics of the cohort

	Mean (± SD)	Count (n=62)
Age		
Male	71.45±3.8	44 (71%)
Female	71.89±3.6	18 (29%)
DM		39 (62.9%)
HT		30 (48.3%)
COPD		5 (8.6%)
CRF		11 (17.7%)
PvD		13 (20.9%)
Smoker		25 (40.3%)
EF (%)		
>50%		36 (58%)
40%-50%		20 (32.2%)
<40%		6 (9.6%)
Vit. D deficiency		
Male		33 (75%)
Female		13 (72%)
Vit. B12 deficiency		
Male		8 (18%)
Female		4 (22%)

DM: Diabetes mellitus; HT: Hypertension; COPD: Chronic obstructive pulmonary disease; CRF: Chronic renal failure; PvD: Peripheral vascular disease; EF: Ejection fraction; SD: Standard deviation.

Table 2. Correspondence analysis

	Dimension	
	1	2
Hospital Stay	-0.175	0.035
MV Time	-0.195	0.743
ICU Stay	-0.204	-0.008
Sternal Dehiscence	-0.224	-0.047
Wound Infection	-0.223	-0.047
Pneumonia	-0.223	-0.046
Mortality	-0.225	-0.047
EdmontonScore	-0.202	-0.044
Vit D levels	-0.131	-0.552
B12 levels	1.802	0.015

MV: Mechanic ventilator; ICU: Intensive care unit. Edmonton Scores were positively correlated with ICU length of stay, sternal dehiscence, wound infection, pneumonia, and mortality. Vitamin D levels were inversely associated with mechanical ventilation duration.

stay, sternal dehiscence, wound infection, pneumonia, and mortality, suggesting that frailer patients were at higher risk for multiple postoperative complications (Table 2). Additionally, an increase in the Edmonton Frailty Score was associated with longer durations of mechanical ventilation in patients (Fig. 2).

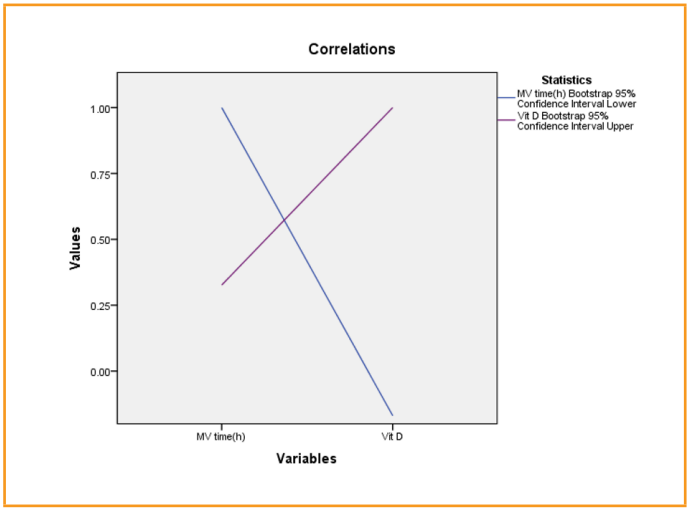

Figure 1. Mechanic ventilation duration and vitamin D levels.

In-hospital mortality occurred in two patients, whose Edmonton Frailty Scores were 7 and 8, respectively. Both patients were found to have vitamin D deficiency. The first patient died on postoperative day 7 due to severely impaired cardiac function, whereas the second patient developed pneumonia that progressed to sepsis, resulting in death on postoperative day 27.

Discussion

This study demonstrates that preoperative frailty and vitamin D status can serve as significant predictors of postoperative outcomes in elderly CABG patients. The negative correlation between vitamin D levels and mechanical ventilation duration aligns with prior research suggesting that vitamin D supports muscle function and immune competence, facilitating recovery. Our study is consistent with the meta-analysis conducted by Zhang et al., [3] demonstrating that preoperative vitamin D deficiency is associated with poor prognosis. Furthermore, in line with the study published by Cerit L. et al., [4] low vitamin D levels were found to be associated with an increased risk of postoperative atrial fibrillation.

In our cohort, vitamin D deficiency was observed in 75% of males and 72% of females, a rate considerably higher than those reported in some previous studies, where the prevalence among cardiac surgery candidates ranged from 40% to 90% depending on population and cutoff values. Several studies have demonstrated that preoperative vitamin D deficiency is associated with increased postoperative morbidity, higher inotropic requirements, and a greater incidence of atrial fibrillation and infectious complications [4,5].

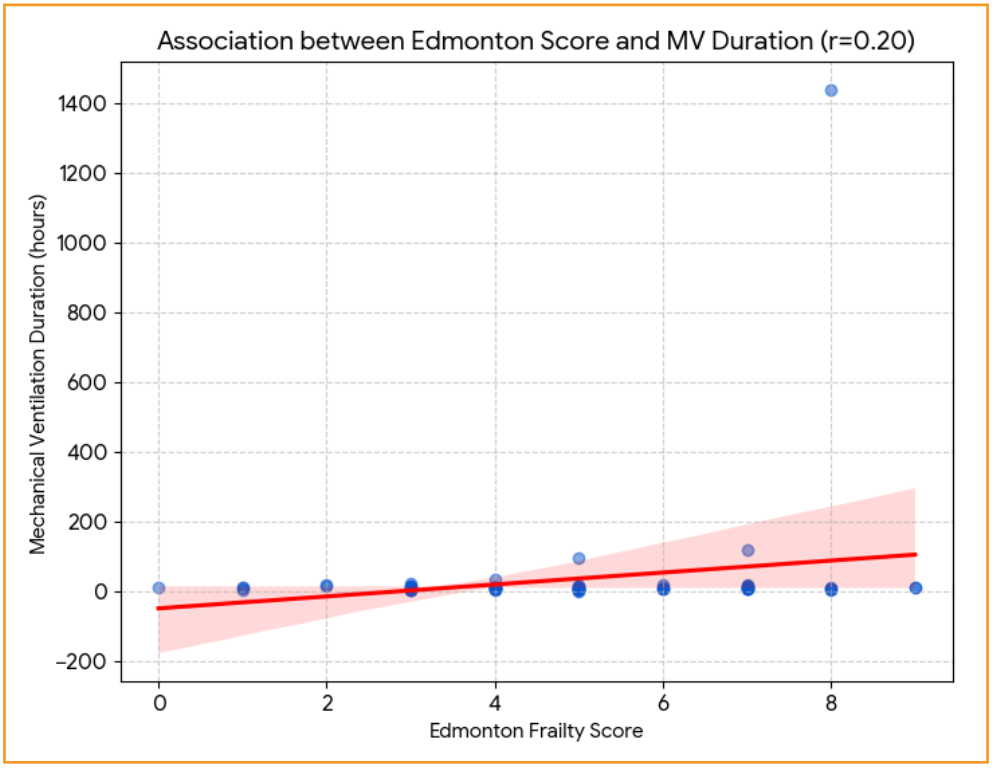

Figure 2. Scatter plot (r=0.196, p=0.127).

Similarly, vitamin B_{12} deficiency was detected in 18% of males and 22% of females in our study. These findings are comparable to the approximately 20% prevalence reported among community-dwelling older adults, though institutionalized populations may demonstrate higher rates (30–40%). Taken together, these results highlight the importance of routine preoperative assessment and correction of vitamin D and B_{12} deficiencies in elderly patients undergoing cardiac surgery. Considering their high prevalence and the potential impact on surgical outcomes, early detection and supplementation may provide a cost-effective strategy to improve recovery and reduce adverse events.

Meta-analyses have shown that vitamin D deficiency (<20 ng/mL) increases the risk of AF by approximately 23%, whereas each 10ng/mL increase in serum vitamin D is associated with a 12–22% reduction in relative risk. Similar findings have been reported in the context of postoperative atrial fibrillation (POAF) after CABG, where a 10ng/mL increase in vitamin D was linked to up to a 56% reduction in POAF risk [5]. Mechanistically, vitamin D is thought to exert protective effects against AF through its anti-inflammatory properties and regulatory role in the renin–angiotensin–aldosterone system (RAAS) [6,7]. Supporting these observations, a large randomized controlled trial from Finland reported that daily supplementation with high doses of vitamin D_3 (1,600 and 3,200IU/day) reduced the incidence of AF by 27% and 32%, respectively, over a five-year follow-up period [7]. These results are in line with the findings of our study, in which vitamin D deficiency was significantly associated with the occurrence of AF. Taken together, current evidence suggests that vitamin D may play an important modulatory role in the development of AF, and deficiency may contribute to increased susceptibility through inflammatory and neurohormonal pathways.

Incorporating frailty screening into preoperative evaluation enhances risk stratification in cardiac surgery and may help identify patients who could benefit from tailored or innovative perioperative management strategies [8]. Such an approach not only provides additional prognostic information beyond conventional risk scores but also allows for early recognition of vulnerable subgroups who may require closer perioperative monitoring, nutritional optimization, or rehabilitation interventions. Furthermore, integrating frailty assessment into clinical decision-making facilitates individualized treatment planning, potentially improving both short- and long-term outcomes. The Edmonton Frailty Score was strongly associated with multiple adverse outcomes, reinforcing the importance of frailty assessment in preoperative planning. This tool has been shown to correlate with increased morbidity, prolonged hospital stay, higher rates of postoperative complications, and even mortality, making it a valuable and practical instrument for routine clinical use in cardiac surgery patients.

Limitations

The retrospective design and single-center setting limit the generalizability of these findings. Further prospective studies with larger sample sizes are warranted to confirm these associations and to explore interventional strategies.

Conclusion

Preoperative Edmonton Frailty Score and vitamin D levels are valuable predictors of postoperative outcomes in elderly patients undergoing elective CABG. Higher vitamin D levels are associated with shorter mechanical ventilation duration, whereas higher frailty scores predict increased postoperative complications and longer ICU stay. Incorporating frailty and nutritional assessment into standard preoperative evaluation may improve risk stratification and patient management in this population.

Ethics Committee Approval: The study was approved by Istanbul Mehmet Akif Ersoy Chest, Heart and Vascular Surgery Hospital Ethics Committee (No: 2025.02-18, Date: 04/03/2025).

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