

Osmangazi Journal of Medicine

e-ISSN: 2587-1579

Impact of Physiological Reserve on Overall Survival in Middle-Old (75–84 Years) Patients Undergoing Pancreaticoduodenectomy: A Single-Center Retrospective Analysis

Pankreatikoduodenektomi Geçiren Orta Yaşlı (75-84 Yaş) Hastalarda Fizyolojik Rezervin Genel Sağkalım Üzerindeki Etkisi: Tek Merkezli Retrospektif Analiz

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Received : 11.11.2025

Accepted : 25.12.2025

Ethics Committee Approval: The study was obtained from the Basaksehir Cam and Sakura City Hospital Scientific Research Ethics Committee No. 2 (Approval Code: 2025-253, Approval Date: July 21, 2025).

Informed Consent: The authors declared that it was not considered necessary to get consent from the patients because the study was a retrospective data analysis.

Authorship Contributions: Conceptualization & Study Design: FG, EK, Data Collection: YYK, MFA, TS, Statistical Analysis: FG, TS

Literature Review & Data Interpretation: IK, YYK, Drafting of Manuscript: FG, YYK, Critical Revision for Important Intellectual Content: OB, EK, Supervision & Project Administration: OB, EK

Copyright Transfer Form: Copyright Transfer Form was signed by all authors.

Peer-review: Internally peer-reviewed.

Conflict of Interest: The authors declare that there is no conflict of interest.

Financial Disclosure: The authors declared that this study received no financial support.

Abstract: With increasing life expectancy, the number of elderly patients undergoing pancreaticoduodenectomy (PD) due to pancreatic cancer is increasing. However, physiological markers affecting overall survival (OS) in this age group have not been clearly defined. This study aims to evaluate the factors affecting OS in middle-old patients aged 75–84 years who underwent PD. In this retrospective study, middle-old patients who underwent PD were examined and divided into two groups according to OS status. Performance status, nutritional status, and frailty level were assessed with clinical and laboratory-based scales. A total of 34 patients were included (median age, 77.5 years [76–79.2]; 58.8% male). ECOG 2 was significantly higher in the non-survivor group (62.5% vs. 22.2%; $p=0.017$). GNRI ≥ 98 was observed more frequently in the survival group (72.2% vs. 31.3%; $p=0.017$). FI-Lab ≥ 0.25 was higher in the non-survival group (56.3% vs. 11.1%; $p=0.005$). Adjuvant chemotherapy treatment was higher in the survival group (88.9% vs. 43.8%; $p=0.005$). In Kaplan–Meier analysis, median survival was significantly longer in patients with GNRI ≥ 98 , ECOG 1, and FI-Lab < 0.25 ($p < 0.01$ for all). In univariate analysis, ECOG 2 (HR=0.11; $p=0.001$), GNRI < 98 (HR=0.21; $p=0.011$), and FI-Lab ≥ 0.25 (HR=0.14; $p=0.002$) were associated with a higher risk of mortality. However, in multivariate analysis, none of these parameters were identified as independent and statistically significant prognostic risk factors for OS. This study demonstrates that performance status, nutritional status, and frailty level are not independently associated with OS in middle-old patients undergoing PD.

Keywords: Pancreaticoduodenectomy; Middle-old; Overall survival; ECOG performance score; Frailty; Geriatric nutritional risk index

Özet: Artan yaşam beklentisiyle birlikte, pankreas kanseri nedeniyle pankreatikoduodenektomi (PD) uygulanan yaşlı hastaların sayısı artmaktadır. Ancak, bu yaş grubunda genel sağkalımı (GS) etkileyen fizyolojik belirteçler net bir şekilde tanımlanmamıştır. Bu çalışma, PD geçiren 75-84 yaş arası orta yaşlı hastalarda GS etkileyen faktörleri değerlendirmeyi amaçlamaktadır. Bu retrospektif çalışmada, PD geçiren orta yaşlı hastalar incelenmiş ve GS durumlarına göre iki gruba ayrılmıştır. Performans durumu, beslenme durumu ve kırılabilirlik düzeyi klinik ve laboratuvar tabanlı ölççeklerle değerlendirilmiştir. Toplam 34 hasta çalışmaya dahil edilmiştir (ortanca yaş 77,5 yıl [76-79,2]; %58,8 erkek). ECOG 2, sağ kalamayan grupta anlamlı derecede daha yüksekti (%62,5'e karşı %22,2; $p=0,017$). GNRI ≥ 98 sağ kalım grubunda daha sık gözlemlendi (%72,2'ye karşı %31,3; $p=0,017$). FI-Lab $\geq 0,25$ sağ kalamayan grupta daha yüksekti (%56,3'e karşı %11,1; $p=0,005$). Adjuvan kemoterapi tedavisi sağ kalım grubunda daha yüksekti (%88,9'a karşı %43,8; $p=0,005$). Kaplan-Meier analizinde, GNRI ≥ 98 , ECOG 1 ve FI-Lab $< 0,25$ olan hastalarda medyan sağ kalım anlamlı derecede daha uzundu (hepsi için $p < 0,01$). Tek değişkenli analizde, ECOG 2 (HR=0,11; $p=0,001$), GNRI < 98 (HR=0,21; $p=0,011$) ve FI-Lab $\geq 0,25$ (HR=0,14; $p=0,002$) daha yüksek mortalite riski ile ilişkiliydi. Ancak, çok değişkenli analizde bu parametrelerden hiçbirisi GS için bağımsız ve istatistiksel olarak anlamlı bir prognostik risk faktörü olarak tanımlanmamıştır. Bu çalışma, PD geçiren orta yaşlı hastalarda performans durumu, beslenme durumu ve kırılabilirlik düzeyinin genel sağkalım ile bağımsız bir ilişki göstermediğini ortaya koymuştur.

Anahtar Kelimeler: Pankreatikoduodenektomi; Orta yaşlı; Genel sağkalım; ECOG performans skoru; Kırılabilirlik; Geriatrik beslenme risk indeksi

How to cite/ Atıf için: Gungor F, Korkmaz YY, Arslan MF, Sarigoz T, Kudas İ, Bostancı Ö, Kinaci E. Impact of Physiological Reserve on Overall Survival in Middle-Old (75–84 Years) Patients Undergoing Pancreaticoduodenectomy: A Single-Center Retrospective Analysis, Osmangazi Journal of Medicine, 2026;48(2):252-260

1. Introduction

Improvements in life expectancy over the last century have led to a significant increase in the geriatric population. According to UK data, the number of people aged 100 and over increased approximately fivefold between 1980 and 2010 (1). In the United States, it is predicted that this age group will constitute 5% of the population by 2050 (2). This demographic change indicates that there will be an increase in elderly patients requiring major surgery.

Pancreatic cancer is an aggressive malignancy with an incidence that increases with age and a five-year survival rate of approximately 13% (3). In recent years, technological advances and increased access to healthcare have improved early diagnosis rates. However, it is reported that only 15–20% of patients diagnosed with pancreatic cancer are suitable for potentially curative surgery (4). The increasing incidence of pancreatic cancer with age and the growing geriatric population lead to an increase in patients undergoing pancreaticoduodenectomy (PD) in this age group (5). Therefore, understanding surgical outcomes in the elderly population is crucial to contribute to the surgical decision-making process.

PD is a surgical procedure performed primarily for pathologies of the pancreatic head and periampullary region and is considered one of the most challenging procedures in surgical practice. Although technological and medical advances have significantly reduced postoperative mortality rates, complications associated with this surgery still significantly impact patient prognosis (6,7). Although some researchers advocate performing pancreaticoduodenectomy after thorough preoperative preparation in elderly patients, debate continues regarding the impact of advanced age on postoperative complications, mortality rates, and long-term survival (5,8-11). In addition, most of the current studies focus on comparing elderly and young patients, and studies isolating the elderly patient group and evaluating surgical techniques and factors affecting survival in this population are limited (5,8,9,11). The fact that there are differences in the literature regarding the definition of "elderly" patients and the sub-classification of this group makes the issue even more complex.

In our study, we aimed to analyze the factors affecting overall survival in middle-aged patients aged 75–84 who underwent

pancreaticoduodenectomy in light of current literature findings.

2. Materials and Methods

This retrospective study included patients aged 75–84 years who underwent PD at the General Surgery Clinic of Basaksehir Cam and Sakura City Hospital between May 1, 2020, and May 1, 2025.

Ethical approval for the study was obtained from the Basaksehir Cam and Sakura City Hospital Scientific Research Ethics Committee No. 2 (Approval Code: 2025-253, Approval Date: July 21, 2025).

The study was conducted in accordance with the ethical principles stated in the Declaration of Helsinki. Although the study employed a retrospective design, informed consent was routinely obtained from patients within the framework of an institutional protocol that allowed for the use of patient data for scientific purposes.

Inclusion criteria for the study:

- Patients aged 75–84 who underwent PD
- Patients with a final histopathological diagnosis of malignancy
- Patients whose data can be entirely accessed from the hospital database or clinical records

Exclusion criteria for the study:

- Patients who have undergone other pancreatic surgery techniques
- Patients who underwent palliative surgery
- Patients who underwent additional organ resection during the PD procedure

It was determined that 231 patients over the age of 65 underwent pancreatic surgery during the study period. These patients were classified according to age groups as youngest-old (65–74 years old), middle-old (75–84 years old), and oldest-old (over 85 years old) (12). In the middle-old group, 45 patients underwent pancreatic surgery, and 37 of them (82.2%) underwent PD. Thirty-four patients who met the inclusion criteria were included in the final analysis (Figure 1).

In the study, demographic, clinical, and surgical characteristics of the patients were evaluated comprehensively. In this context, age, gender, and comorbidities (diabetes mellitus, hypertension, pulmonary diseases, cardiac diseases, renal diseases, neurological diseases, and anticoagulant/antiplatelet use) were recorded. Functional status was assessed using the Eastern Cooperative Oncology Group Performance Status (ECOG PS), the Charlson Comorbidity Index (CCI), and the American Society of Anesthesiologists Physical Status Classification System (ASA). Additionally, sarcopenia, geriatric nutritional risk index (GNRI), frailty index based on laboratory tests (FI-lab) score, and cancer antigen 19-9 (CA 19-9) levels were examined.

In the preoperative period, hospital stay and preoperative biliary drainage (BBD) status were evaluated. Surgical variables included the technique used, operative time, and intraoperative characteristics. Postoperative hospital stay, complication grades according to Clavien–Dindo classification (CDC), histopathological diagnosis, tumor stage, adjuvant chemotherapy (AC) status, and follow-up duration were analyzed. Patients were divided into two groups based on overall survival (OS) status, and analyses were performed between these two groups.

Sarcopenia was assessed by the ratio of the total psoas muscle area measured at the L3 vertebra level to the square of the height, and sarcopenia was defined as a ratio of $<4.0 \text{ cm}^2/\text{m}^2$ in females and $<5.5 \text{ cm}^2/\text{m}^2$ in males. GNRI was calculated with the formula $[1.489 \times \text{serum albumin (g/L)} + 41.7 \times (\text{actual weight} / \text{ideal weight})]$. A GNRI value above 98 was considered as no risk of malnutrition (13). In patients in whom malnutrition or sarcopenia was identified, a preoperative nutritional approach focusing on increased protein and energy intake was implemented according to routine clinical practice.

The first blood parameters of the patients at hospital admission were evaluated, and FI-Lab was calculated as the ratio of the number of abnormal parameters to the total number of parameters. The laboratory parameters included in the FI-Lab calculation were white blood cell count, hemoglobin, platelet count, international normalized ratio, C-reactive protein, glucose, creatinine, sodium, potassium, albumin, total bilirubin, direct bilirubin, aspartate aminotransferase, alanine aminotransferase, alkaline phosphatase, and gamma-glutamyl transferase. In our study, FI-Lab ≥ 0.25 was considered as frailty (14). According to the CDC, grade ≥ 3 complications were considered major complications.

Management of Patients

All patients were evaluated clinically, laboratory, and radiologically by the multidisciplinary hepatopancreaticobiliary council. In the preoperative period, due to the need for nutritional support, treatment of cholangitis, and/or the requirement for biliary drainage, the surgical preparation process was carried out during inpatient hospitalization. All surgical procedures were performed by a surgical team specialized in hepatopancreaticobiliary surgery. All patients underwent conventional open surgery. The choice between classical PD and pylorus-preserving PD was determined intraoperatively by the surgical team based on anatomical considerations and oncological suitability. Postoperative management of patients was provided in accordance with the standard protocols of the hepatopancreaticobiliary surgery unit, which included antibiotic prophylaxis, pain control, antithrombotic therapy, and oral feeding programs. Complications were evaluated according to the CDC and treated with interventional radiologic or surgical interventions when necessary.

In line with the follow-up protocol, unless any problems developed, patients were followed up with outpatient clinic check-ups once a week for the first month, once a month for the second and third months, then once every three months for the first year, once every six months for the second year, and once a year from the third year onwards.

Statistical Analysis

All statistical analyses were conducted using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). The normality of continuous variables was evaluated through the Kolmogorov–Smirnov test. Variables with normal distribution were summarized as mean \pm standard deviation, whereas those without normal distribution were presented as median and interquartile range. For comparisons between two independent groups, either the Student's t-test or Mann–Whitney U test was applied, based on data distribution characteristics. Categorical variables were shown as frequencies and percentages, and group comparisons were performed using the Pearson chi-square test or Fisher's exact test when appropriate. Survival outcomes were assessed using the Kaplan–Meier method, with differences between curves examined by the Log-rank test. To determine factors independently associated with survival, Cox proportional hazards regression analysis was performed, and results were expressed as hazard ratios with corresponding 95% confidence intervals.

A two-tailed p-value of <0.05 was considered to indicate statistical significance.

3. Results

In total, 34 middle-old patients were analyzed (median age 77.5 [76–79.2], 58.8% male), of whom 18 (52.9%) were classified in the survival group. When performance status was evaluated, patients with an ECOG PS of 2 were significantly more prevalent in the non-survival group (62.5% vs. 22.2%; $p=0.017$). When classified based on nutritional status, patients with GNRI ≥ 98 were more frequently represented in the survival group, and this distribution showed a statistically significant difference (72.2% vs. 31.3%; $p = 0.017$). It was found that patients with FI-Lab ≥ 0.25 , which reflects the level of frailty, were significantly more prevalent in the non-survival group (56.3% vs. 11.1%; $p=0.005$). Vascular resection was required in two patients, and according to the International Study Group of Pancreatic Surgery (ISGPS) classification, Type 1 portal vein resection was performed in both cases; both patients were in the non-survival group. Additionally, those who completed adjuvant chemotherapy treatment had a significantly higher survival rate in the treatment group (88.9% vs 43.8%; $p=0.005$). No significant difference was found between the groups in terms of major complication rate (CDC grade ≥ 3 ; 27.8% vs. 18.8%; $p=0.536$). Grade B postoperative pancreatic fistula developed in 5 patients (14.7%), all of whom were managed with percutaneous drainage (CDC grade 3a). Wound revision due to evisceration was performed in two patients (CDC grade 3b). In addition, in-hospital mortality occurred in one patient (2.9%) due to a cardiac complication (CDC grade 5). No significant difference was found

between the groups in terms of other clinical and demographic parameters (Table 1).

According to Kaplan–Meier survival analysis, the median survival was calculated as 1425 days in patients with GNRI ≥ 98 and 340 days in patients with GNRI < 98 (Log-rank $\chi^2 = 7.82$; $p = 0.005$). Median survival was found to be 1425 days in patients with ECOG PS 1 and 330 days in patients with ECOG PS 2 (Log-rank $\chi^2=15.40$; $p<0.001$). Similarly, the median survival of patients with FI-Lab < 0.25 was 1425 days, and 330 days for those with FI-Lab ≥ 0.25 (Log-rank $\chi^2 = 13.09$; $p < 0.001$). Although the survival curve was longer in patients who completed adjuvant chemotherapy, the difference in median survival was not statistically significant (1425 vs 330 days; Log-rank $\chi^2=2.18$; $p=0.140$) (Figure 2).

In the univariate Cox regression model, ECOG PS 2, GNRI < 98 , and FI-Lab ≥ 0.25 were identified as variables significantly influencing mortality risk (ECOG PS 2: HR=0.11; 95% CI: 0.03–0.41; $p=0.001$; GNRI < 98 : HR=0.21; 95% CI: 0.06–0.70; $p=0.011$; FI-Lab ≥ 0.25 : HR=0.14; 95% CI: 0.04–0.47; $p=0.002$). The association between completion of adjuvant chemotherapy treatment and mortality did not reach the statistical limit (HR=2.09; 95% CI: 0.76–5.80; $p=0.156$), and the presence of sarcopenia was also not statistically significant (HR=1.56; 95% CI: 0.55–4.42; $p=0.396$). When ECOG PS, GNRI, and FI-Lab were evaluated together in the multivariate model, the effect of all three variables on survival continued but did not reach significance (GNRI ≥ 98 : HR=0.33; $p=0.103$; ECOG PS 1: HR=0.31; $p=0.173$; FI-Lab < 0.25 : HR=0.31; $p=0.139$) (Table 2).

Table 1. Comparison of Clinical Features of Survivors and Non-Survivors Groups

	Survivors (n=18)	Non-survivors (n=16)	p-value
Age ^a	77 (75-80.25)	77.5 (76-79)	0.612
Sex ^b (Male)	11 (61.11)	9 (56.25)	0.774
Comorbidities ^b			
Diabetes mellitus (Yes)	6 (33.33)	10 (62.5)	0.089
Hypertension (Yes)	11 (61.11)	12 (75)	0.388
Pulmonary diseases (Yes)	4 (22.22)	1 (6.25)	0.189
Cardiac diseases (Yes)	6 (33.33)	7 (43.75)	0.533
Renal diseases (Yes)	1 (5.55)	1 (6.25)	0.932
Neurological diseases (Yes)	5 (27.77)	4 (25)	0.855
Anticoagulant & Antiplatelet (Yes)	5 (27.77)	4 (25)	0.855
ECOG ^b (PS 2)	4 (22.22)	10 (62.5)	0.017
CCI ^a	7 (5.75-7)	7 (6-7)	0.451
ASA ^b (ASA III)	12 (66.66)	14 (87.5)	0.153
Sarcopenia ^b (Yes)	6 (33.33)	10 (62.5)	0.089

GNRI ^b (No risk)	13 (72.22)	5 (31.25)	0.017
FI-lab ^b (Frail)	2 (11.11)	9 (56.25)	0.005
Ca 19-9 ^a	69.4 (36-234)	307 (22.52-660)	0.262
Preop. HS ^a	13 (8-14.25)	12.5 (8.25-16.5)	0.876
PBD ^b (Yes)	10 (55.55)	12 (75)	0.236
Surgical technique ^b (Classic PD)	12 (66.66)	9 (56.25)	0.533
Surgery duration ^a	425 (371.25-531.25)	460 (373.75-485)	0.072
CDC ^b (3and above)	5 (27.77)	3 (18.75)	0.536
Postop. HS ^a	18 (12-22.5)	15.5 (11.25-17.75)	0.144
Histopathology ^b (PDAC)	15 (83.33)	13 (81.25)	0.874
T stage ^b (T3)	13 (72.22)	9 (56.25)	0.331
N stage ^b (N2)	7 (38.88)	8 (50)	0.515
Adjuvant CT ^b (Yes)	16 (88.88)	7 (43.75)	0.005
Follow-up period ^a (/days)	371.5 (131.25-561.25)	294 (97.5-410)	0.398

^a: median (Q1-Q3), ^b: n(%), ECOG PS: Eastern Cooperative Oncology Group Performance Status, CCI: Charlson Comorbidity Index, ASA: American Society of Anesthesiologists, GNRI: Geriatric Nutritional Risk Index, FI-lab: Frailty Index – laboratory based, Ca 19-9: Cancer Antigen 19-9, HS: hospital stay, PBD: Preoperative biliary drainage, PD: Pancreaticoduodenectomy, CDC: Clavien–Dindo Classification, PDAC: Pancreatic Ductal Adenocarcinoma, CT: Chemotherapy

Table 2. Results of Univariate and Multivariate Cox Regression Analyses

	HR (95% CI) - Univariate	p value Univariate	HR (95% CI) - Multivariate	p value Multivariate
GNRI <98	0.21 (0.064 – 0.700)	0.011	3.01 (0.80–11.37)	0.103
ECOG PS=2	9.01 (2.41 – 33.3)	0.001	3.18 (0.60–16.80)	0.173
FI-Lab ≥ 0.25	7.24 (2.11 – 24.9)	0.002	0.31 (0.065–1.46)	0.139
Sarcopenia (Yes)	1.56 (0.55 – 4.42)	0.396		
Adjuvant CT (Yes)	0.48 (0.17 – 1.32)	0.156		

ECOG PS: Eastern Cooperative Oncology Group Performance Status, GNRI: Geriatric Nutritional Risk Index, FI-lab: Frailty Index – laboratory based, CT: Chemotherapy

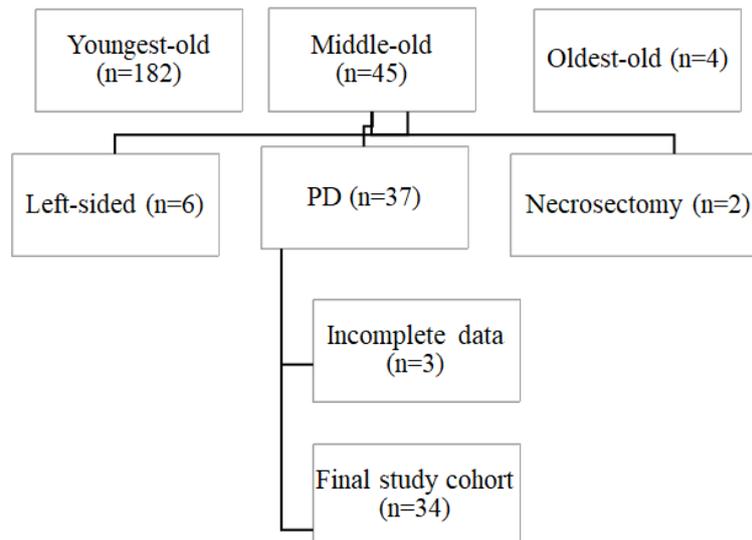
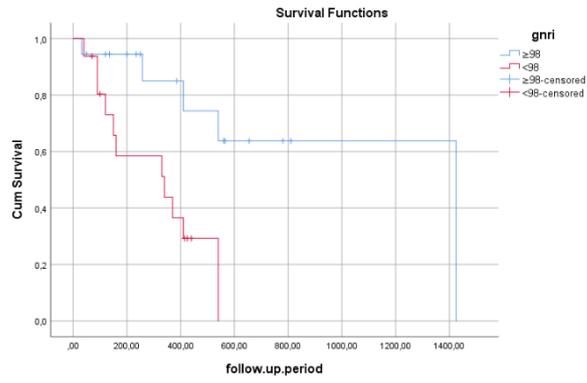
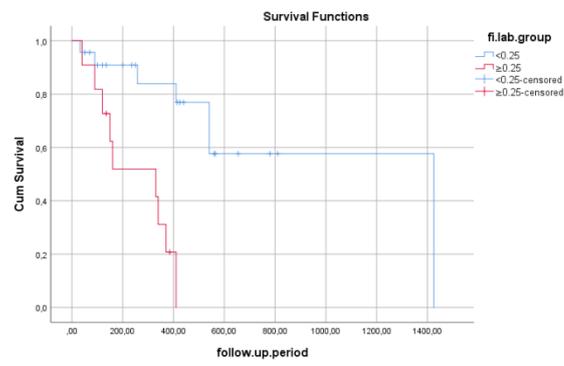


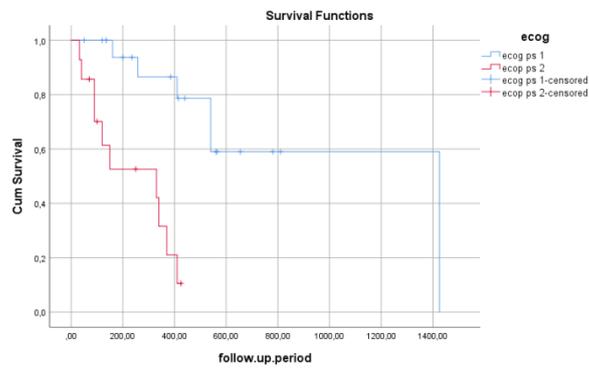
Figure 1. Flowchart of patient selection process



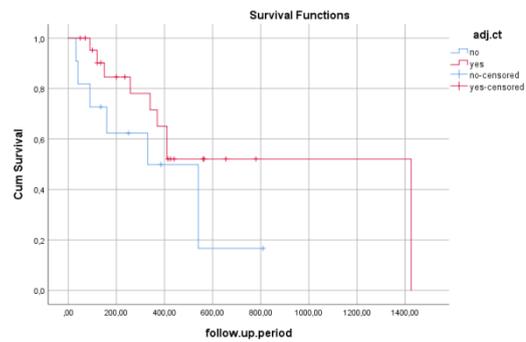
a



b



c



d

Figure 2. Kaplan–Meier overall survival curves stratified by (A) GNRI, (B) FI-Lab, (C) ECOG Performance Status, and (D)

Adjuvant Chemotherapy

4. Discussion

Pancreatic cancer is increasing worldwide, and the number of studies examining the clinical outcomes of elderly patients undergoing PD is also increasing. In this context, our study is one of the rare studies that evaluates the factors affecting OS by focusing only on a homogeneous "middle-old" patient group. In multivariate Cox regression analysis, ECOG PS, GNRI, and FI-Lab were evaluated in terms of OS, but none of these parameters were identified as independent risk factors. Therefore, none of the parameters evaluated in this study are independent prognostic risk factors for OS in middle-old patients undergoing PD.

When we compare our findings with the literature, it is seen that existing studies mostly focus on comparing elderly and young patients, which makes the interpretation of the results difficult by ignoring the heterogeneity of the elderly population (15,16). Our study differs from the others in that it focuses solely on a homogeneous "middle-old" group and is one of the rare studies that evaluates the factors affecting overall survival in this age range. In addition, there is no clear consensus in previous studies on how old age should be defined among patients undergoing PD (16,17). For more accurate clinical decisions in the face of the increasing elderly population, a standard definition of old age and standardized subgroup classifications need to be developed. We believe that the subgrouping used in our study is both applicable and the approach that most appropriately reflects the physiology that changes with age.

The failure of variables to reach statistical significance in the multivariate Cox model is thought to be related to the limited sample size and the fact that these three parameters represent the same biological phenotype from different perspectives. While ECOG PS reflects functional capacity, GNRI represents nutritional reserve and FI-Lab represents systemic physiological frailty. This situation may have led to a natural collinearity between the variables.

GNRI objectively reveals the nutritional status and physiological reserve in elderly individuals by evaluating weight and serum albumin levels together. Although the rate of patients without malnutrition risk was higher among survivors, this variable did not emerge as an independent predictor in the multivariable Cox regression model. There are limited studies in the literature evaluating GNRI in

patients undergoing PD. In the study by Liu et al., which included patients older than 65 years undergoing PD, low GNRI levels were identified as an independent determinant of major morbidity (18). Similarly, Funamizu et al. reported low GNRI values as independent risk factors for morbidity in two separate studies (19,20). However, most of these studies focused on early postoperative morbidity and mortality. Our study has a unique contribution by evaluating GNRI in terms of in a homogeneous middle-aged population, unlike studies in the literature. Our study is the first to evaluate preoperative GNRI in terms of OS in a middle-old population.

FI-Lab is an objective and practical biomarker based on deviations in routine laboratory parameters to assess frailty in elderly individuals. In our study, FI-Lab was calculated using laboratory values at hospital admission, and it was found that the rate of frail patients was significantly higher in the non-survival group. However, this difference lost statistical significance as an independent predictor in multivariate Cox regression analysis. Although various clinical scales have been used in the literature for frailty assessment in patients undergoing surgical resection for pancreatic cancer, an FI-Lab-based analysis has not been reported. Kim et al. reported that in elderly cancer patients, the group assessed as frail using FI-Lab was associated with longer hospital stays, longer intensive care unit stays, increased risk of unplanned readmission within 30 days, and increased mortality risk after surgery (21). In another study, Funamizu et al. used the Modified Frailty Index-6 to assess frailty in patients treated surgically for pancreatic cancer and showed that patients who completed adjuvant chemotherapy were less frail (22).

The ECOG PS is one of the most widely used clinical parameters in the field of oncology and surgery, evaluating the patient's functional capacity and ability to maintain daily living activities independently. In our study, it was determined that patients with poor ECOG PS were significantly more numerous in the non-survival group; however, like other parameters, it was not identified as an independent risk factor for OS in the multivariate Cox regression analysis. In the literature, Ergenç et al.'s retrospective study of 155 cases comparing patients over and under 75 years of age reported that patients with ECOG PS 2–3 had lower OS (23). In another multicenter study, patients aged 80 years

and older were compared with a younger patient group, and it was reported that the ECOG PS were poorer and mortality was higher in the elderly group (24). Although it was not detected as an independent risk factor in our study, when evaluated together with the literature, we think that the ECOG PS is a critical determinant in predicting survival in elderly patients who underwent PD and should not be ignored in the surgical decision-making process.

Finally, although not statistically significant in our study, the more frequent occurrence of sarcopenia in the non-survival group suggests that decreased muscle mass in this middle-old patient group may be an indicator of limited physiological reserve and increased fragility. In a meta-analysis by He et al. involving 30 studies and 5323 patients across heterogeneous age groups, sarcopenia was reported to be associated with decreased OS (25). Similarly, the higher survival rate among patients who completed AC suggests a potential contribution of the treatment to OS; however, this association did not reach statistical significance in univariate analysis. It was also observed that patients with advanced stage T were more numerous in the survival group, but this difference was not statistically significant. The higher prevalence of patients with advanced stage T in the survival group suggests that overall survival in this age group is determined not only by tumor-related factors but also by the interaction of biological reserve, treatment tolerance, and tumor characteristics.

Limitations

Our study has some limitations. First of all, the single-center and retrospective design limits the generalizability of the results obtained. Additionally, the relatively small number of patients may have limited statistical power and caused some variables to lose significance in multivariate analyses.

Another limitation is that the data were evaluated only from patient records. Therefore, it was not possible to examine frailty and nutritional status comparatively with different clinical scales. Similarly, evaluations regarding AC were conducted based on standard protocols, and details such as the type of chemotherapy regimen, treatment duration, and compliance with treatment could not be included in the study.

5. Conclusions

This study evaluated the effects of ECOG PS, GNRI, and FI-Lab on OS in a homogeneous group of middle-old patients undergoing PD. In multivariate analysis, none of these parameters were identified as independent and statistically significant prognostic risk factors for OS. Larger-scale, multicenter, prospective studies are required to validate these findings and to better define their prognostic value.

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