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Preoperative Computed Tomography Nutritional Parameters as Predictors of Adverse Outcomes Following Pancreaticoduodenectomy: A Retrospective Study at a Cancer Center

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ABSTRACT

Pancreaticoduodenectomy (PD) is the only curative option for patients with pancreatic cancer. The mortality rate has decreased; however, postoperative complications pose a significant risk, and nutritional deficiency in such patients further worsens their prognosis. Some nutritional parameters measured using computed tomography (CT) are known to be associated with surgical outcomes. We aimed to evaluate 30-day morbidity and mortality rates and assess their association with radiologic nutritional parameters. We collected patient baseline characteristics, and measured radiologic malnutrition indicators such as psoas muscle area, bone density, and aorta-to-fascia distance using CT. Unadjusted and adjusted logistic regression models were used to determine odds ratios to determine the association between malnutrition measures. Multivariate logistic regression models were used to determine R2 and area under the receiver operating characteristic curve values, measuring the improvement in predictive accuracy and discriminative ability of the baseline model after adding malnutrition measures to the model. Between 2013-2019, 58 patients underwent PD. Postoperative outcomes indicated 30-day mortality rate of 10%. A higher mean psoas muscle area was associated with a lower likelihood of cardiovascular events. A higher baseline bone density was associated with a lower risk of cardiovascular events, anastomotic leakage, and urinary tract infections. A higher aorta-to-anterior fascia distance predicted a higher risk of anastomotic leakage. Malnutrition is common in patients with pancreatic cancer, and CT measurements of sarcopenia, osteopenia, and obesity have an evolving role in predicting postoperative outcomes. Future research could help determine the precise role of these parameters in predicting individual outcomes.

Keywords: pancreaticoduodenectomy; postoperative complications; radiologic malnutrition parameters; sarcopenia

INTRODUCTION

Pancreatic cancer ranks as the seventh leading cause of cancer-related mortality worldwide and the fourth leading cause in the United States[1,2]. Approximately 75–80% of pancreatic cancers are located in the head of the pancreas[3,4]. Pancreaticoduodenectomy (PD), known also as the Whipple procedure, is the only potentially curative intervention for pancreatic head and ampullary cancers. However, owing to a late presentation, the prognosis is poor, even in potentially resectable cancers[5,6].

As a major surgical procedure, PD carries a significant risk of postoperative complications, with significant early morbidity and mortality rates[7,8]. While the mortality rate has decreased from the 1970's to <4%, morbidity rates range from 40% to 50%[9,10]. Common postoperative complications that prolong the inpatient hospital stay include intra-abdominal abscess/hemorrhage, delayed gastric emptying, pancreatic fistula, and bile leak[11].

Pancreatic cancer likely causes pancreatic exocrine insufficiency presenting as malabsorption and malnutrition[12]. With the addition of surgical and chemotherapy effects, nutritional deficiency declines further among these patients[13,14]. Loss of weight and malnutrition are associated with a poorer prognosis and decreased survival[15,16]. Different risk factors have been identified and are associated with an increased incidence of postoperative complications in patients undergoing PD, including age, body mass index (BMI), small pancreatic duct (<3 mm), fatty pancreas, and high intraoperative blood loss[17-19]. In addition to weight loss and BMI, several nutritional measures have been evaluated to detect preoperative malnutrition, including serum albumin and other tools used for nutritional risk assessment such as the malnutrition universal screening tool and subjective global assessment[20,21]. Given BMI does not always reflect body fat distribution and muscle mass, the role of other body composition parameters that, along with functional status, might affect surgical outcomes has been analyzed using computed tomography (CT)[11-14]. These parameters include

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sarcopenia (reduced skeletal muscle mass), osteopenia (reduced bone mineral density), and visceral obesity (visceral fat area, ≥100 cm^2 in both sexes)[22-24].

Abnormal values of these parameters are associated with poorer short-term postoperative complications and overall disease-free survival in patients with gastrointestinal cancer[25]. Moreover, they are associated with postoperative pancreatic resection complications, including fistula formation, infectious complications, and anastomotic leakage (AL). Sarcopenia, osteopenia, and increased visceral adipose tissue have been shown to have a negative effect on perioperative 30-day mortality rates, postoperative complications, prolonged hospitalization, decreased quality of life, and overall survival[26-30].

Different nutritional-related CT-assessed indices have been analyzed as predictors of postoperative pancreatic surgery complications[31,32]; however, conclusive results are required for more comprehensive preoperative determinants to build an objective and standardized approach to stratify patients at risk of postoperative complications, which could thereafter be incorporated into routine clinical practice. This study aimed to assess and determine 30-day morbidity and mortality rates in patients undergoing PD and evaluate their association with radiologic nutritional parameters.

METHODS

Study design: Following approval from the King Abdulaziz University Hospital Biomedical Ethics Research Committee (Reference number: 40-21), we identified 58 patients who had undergone a PD for malignant periampullary tumors at our institution between 2013 and 2019. We undertook a review of their medical records and extracted patient preoperative medical history; baseline laboratory values; American Society of Anesthesiology (ASA) scores; intraoperative details, such as blood loss; and postoperative outcomes, including myocardial infarction (MI), stroke, venous thromboembolism (VTE), wound infection, urinary tract infection (UTI), and AL; and others.

Radiological nutritional parameters: Preoperative CT scans were reviewed by a radiologist. The L4 vertebra was also identified. A 1 cm diameter region of interest (ROI) was centered on the mid-vertebra, and bone density was recorded in Hounsfield units (HU). This marker has previously been used as a surrogate marker for osteopenia[23]. The psoas muscle area and ROI were measured as surrogates for psoas muscle size and fatty infiltration of the muscle, respectively. At the L4 level, we measured the cross-sectional area and HU of the psoas muscle bilaterally, and the mean of both sides was used for statistical analysis. At the L4 level, the anteroposterior diameter of the abdomen spanning from the anterior edge of the vertebra to the internal aspect of the abdominal wall was recorded. This measure was used to assess the amount of visceral fat.

Primary and secondary study outcomes: The primary outcomes were 30-day morbidity and mortality rates concerning the patients who had undergone a PD. The secondary outcome was the association between preoperative radiologic malnutrition parameters and postoperative complications, including cardiovascular-related events and the overall infection rate.

Statistical analyses

***Descriptive statistics*:** To describe the characteristics of the study population, baseline malnutrition parameters, and the prevalence of postoperative outcomes, we determined the mean, standard deviation (SD), and range for continuous variables and frequency and percentage for categorical variables.

Measures of association: Logistic regression models were used to determine the association between baseline measures of malnutrition and 30-day mortality, cardiovascular events, AL, wound infection, and UTI. For each analysis, we employed both unadjusted and adjusted models. The adjusted models included age, sex, and ASA scores. Odds ratios (OR), 95% confidence intervals (CI), and *P*-values were reported to assess the strength and significance of these associations. Additionally, the coefficient of determination (R^2) was applied to quantify the proportion of variation in the outcome explained by the model.

Assessment of predictive ability: Multivariable logistic regression models were constructed to predict the postoperative outcomes. The base model, which incorporated age, sex, and ASA score, served as the foundation, and incremental improvements were evaluated by adding baseline measures of malnutrition. To assess the predictive accuracy and discriminatory ability of the models, we used the R^2 values and the area under the receiver operating characteristic curve (AUC). Higher R^2 and AUC values, if observed, indicated enhanced performance of the models. The progression from Model 1 to Model 4 tested the incremental effect of adding malnutrition measures on the predictive ability. Our findings were further illustrated through generating figures that included receiver operating characteristic (ROC) curves. The ROC curves provided a graphical representation of the incremental

Table 1. General patient characteristics and baseline measures of malnutrition (n = 58)

General characteristics	Mean (SD), range *or* n (%)
Age (years)	59.8 (13.9), range 15.2–84.4
Sex, male	38 (66%)
Anesthesia type	
General	8 (14%)
General and epidural	50 (86%)
ASA	
II	16 (28%)
III	38 (66%)
IV	4 (7%)
History of diabetes	
Type I, yes	3 (5%)
Type II, yes	26 (45%)
History of hypertension, yes	26 (45%)
History of ischemic heart disease, yes	5 (9%)
History of heart failure, yes	2 (3%)
History of respiratory disease, yes	2 (3%)
BMI (kg/m^2)	25.3 (SD 5.5); range 12.5–41.1
Preoperative hemoglobin (g/dL)	11.6 (SD 1.78); range 7.8–16.4
Measures of malnutrition	Mean (SD), range
Psoas area, right (mm^2)	829 (SD 275); range 251–1555
Psoas area, left (mm^2)	848 (SD 264); range 280–1451
Average psoas area	838 (SD 263); range 305–1503
Psoas ROI, right (HU)	55.3 (SD 8.7); range 38–82
Psoas ROI, left HU)	54.3 (SD 8.4); range 39–72
Average ROI (HU)	54.8 (SD 8.0); range 39–72
Preoperative albumin level (g/L)	28 (SD 6.7); range 13–49
Bone density (HU)	174 (SD 50); range 90–387
Anterior aorta-to-fascia distance (mm)	101 (SD 28); range 41–180

ASA: American Society of Anesthesiologists physical status classification; **BMI:** body mass index; **HU:** Hounsfield units; **PD:** pancreaticoduodenectomy; **ROI:** region of interest; **SD:** standard deviation

Table 2. Prevalence of postoperative outcomes and complications in patients who underwent a PD between 2013 and 2019 (n = 58)

Postoperative outcome	n	%
Readmission within 30 days	9	16%
ICU admission	51	88%
Reoperation within 12 months	11	19%
Mortality within 30 days	6	10%
MI	17	29%
Stroke	1	2%
Cardiovascular event (mortality, MI, stroke)	17	29%
AL	12	21%
Wound infection	29	50%
UTI	11	19%
Infection (leak, wound infection, UTI)	35	60%
Postoperative length of stay (days)	median, 13.5 (IQR 9–22); range 2–179	

AL: anastomotic leakage; **ICU:** intensive care unit; **IQR:** interquartile range; **MI:** myocardial infarction; n, number; **UTI:** urinary tract infection

improvements in predictive accuracy achieved through incorporating the baseline measures of malnutrition into our models.

RESULTS

Patient characteristics

This study included 58 patients (men, 66%) who had undergone a PD at King Abdulaziz University Hospital between 2013 and 2019. The baseline demographics are shown in Table 1. The mean patient age was 59.8 years (13.9), and the mean BMI was 25.3 kg/m^2 (5.5). Baseline malnutrition parameters, including preoperative albumin level, psoas muscle area, psoas muscle ROI, anterior aorta-to-fascia distance, and bone density measurements are also shown in Table 1.

Baseline malnutrition parameters

The mean psoas area measurement values were: right side, 829 units (275); left side, 848 units (264) (average value, 838 units [263]). The mean psoas ROI measurement values were: right side, 55.3 HU (8.7); left side, 54.3 HU (8.4) (average ROI, 54.8 HU [8.0]). The mean preoperative albumin level was 28 units ([6.7]; range, 13–49 units). The mean bone density measurement was 174 HU ([50]; range, 90–387 HU). The mean anterior aorta-to-fascia distance was 101 units ([28]; range, 41–180 units).

Prevalence of postoperative outcomes

Postoperative outcome findings indicated that 88% of patients required admission to the intensive care unit. Within 30 days postoperatively, 16% of patients had been readmitted. The 30-day postoperative mortality rate was 10.3%. Cardiovascular-related events encompassing MI and stroke occurred in 29% of patients. The overall infection rate, including AL, wound infection, and UTI, was 60%. The median postoperative length of stay was 13.5 days (interquartile range [IQR], 9–22 days; range, 2–179 days). The prevalence of postoperative outcomes and complications is shown in Table 2.

Association between baseline measures of malnutrition and 30-day mortality and cardiovascular-related event rates

Concerning the average psoas muscle area, while the unadjusted and adjusted models did not show a difference between the risk of 30-day mortality and changes in area size, the R^2 value in the adjusted model showed that 12% of the variation in terms of 30-day mortality was explained by the model. A significant association was observed in the unadjusted model in terms of cardiovascular-related events (OR 0.997, 95% CI 0.994–0.999; *P = .029*), indicating that a higher average psoas muscle area measurement was associated with a lower likelihood of cardiovascular-related events, but this association was no longer observed in the adjusted model, although we note that the OR remained the same. A higher average psoas muscle ROI was associated with higher 30-day mortality as shown in the unadjusted model (OR 1.15, 95% CI 1.01–1.32; *P = .036*) as well as after adjustment (OR 1.17, 95% CI 1.02–1.34; *P = .027*). The R^2 value of the adjusted model indicated that 27% of the variation in 30-day mortality could be explained by the model. No significant associations were observed in relation to the anterior aorta-to-fascia distance and the preoperative albumin level in the unadjusted or adjusted models for either outcome. The unadjusted model showed that higher bone density was associated with a lower risk of cardiovascular-related events (OR 0.98, 95% CI 0.97–0.99; *P = .027*); however, after adjustment this finding was no longer statistically significant, while the OR did not change (Table 3).

Table 3. Unadjusted and adjusted ORs with 95% CIs and R^2 estimating the association between baseline measures of malnutrition and 30-day mortality and cardiovascular-related events in patients who underwent a PD between 2013 and 2019 (n = 58)

	30-day mortality						**Cardiovascular event**					
	Unadjusted regression model			**Adjusted regression model**			**Unadjusted regression model**			**Adjusted regression model**		
	Unadjusted OR (95% CI)	***p*-value**	**R^2**	**Adjusted OR (95% CI)**	***p*-value**	**R^2**	**Unadjusted OR (95% CI)**	***p*-value**	**R^2**	**Adjusted OR (95% CI)**	***p*-value**	**R^2**
Average psoas muscle area	1.00 (0.99–1.00)	0.956	<0.01	1.00 (0.99–1.00)	0.501	0.12	0.997 (0.994–0.999)	**0.029***	0.08	0.997 (0.993–1.00)	0.096	0.09
Average psoas muscle ROI	1.15 (1.01–1.32)	**0.036***	0.15	1.17 (1.02–1.34)	**0.027***	0.27	1.07 (0.99–1.16)	0.067	0.05	1.08 (0.99–1.18)	0.053	0.11
Anterior aorta-to-fascia distance	1.01 (0.98–1.04)	0.412	0.02	1.01 (0.97–1.04)	0.488	0.12	0.99 (0.97–1.02)	0.585	<0.01	0.99 (0.97–1.01)	0.448	0.06
Preoperative albumin level	0.99 (0.88–1.13)	0.925	<0.01	1.07 (0.91–1.26)	0.411	0.12	1.01 (0.93–1.10)	0.794	<0.01	1.04 (0.94–1.16)	0.434	0.06
Bone density	1.00 (0.97–1.02)	0.792	<0.01	1.01 (0.99–1.04)	0.405	0.12	0.98 (0.97–0.99)	**0.027***	0.09	0.98 (0.96–1.00)	0.080	0.10

ASA: American Society of Anesthesiologists physical status classification; **CI:** confidence interval; **OR:** odds ratio; **PD:** pancreaticoduodenectomy; **ROI:** region of interest; **R^2:** coefficient of determination
Adjusted model includes age, sex, and baseline ASA score

Table 4. Unadjusted OR and R^2 estimating the association between baseline measures of malnutrition and postoperative AL, wound infection, and UTI in patients who underwent a PD between 2013 and 2019 (n = 58)

	AL						**Wound infection**						**UTI**					
	Unadjusted regression model			**Adjusted regression model**			**Unadjusted regression model**			**Adjusted regression model**			**Unadjusted regression model**			**Adjusted regression model**		
Measure of malnutrition	Unadjusted OR (95% CI)	*p*-value	R^2	Adjusted OR (95% CI)	*p*-value	R^2	Unadjusted OR (95% CI)	*p*-value	R^2	Adjusted OR (95% CI)	*p*-value	R^2	Unadjusted OR (95% CI)	*p*-value	R^2	Adjusted OR (95% CI)	*p*-value	R^2
Average psoas muscle area	1.00 (0.99–1.00)	0.540	<0.01	1.00 (0.99–1.00)	0.066	0.09	0.998 (0.996–1.00)	0.091	0.04	0.998 (0.996–1.00)	0.391	0.05	0.998 (0.995–1.00)	0.220	0.03	1.00 (0.99–1.01)	0.472	0.13
Average psoas muscle ROI	0.97 (0.90–1.05)	0.506	<0.01	0.96 (0.88–1.05)	0.380	0.04	0.94 (0.88–1.01)	0.089	0.04	0.93 (0.86–1.00)	0.058	0.09	0.96 (0.88–1.04)	0.335	0.02	0.94 (0.86–1.04)	0.277	0.14
Anterior aorta-to-fascia distance	1.02 (0.99–1.05)	0.083	0.05	1.03 (1.00–1.06)	**0.029***	0.12	0.99 (0.97–1.01)	0.463	<0.01	0.99 (0.97–1.01)	0.555	0.04	1.00 (0.98–1.03)	0.719	<0.01	1.01 (0.98–1.03)	0.590	0.13
Preoperative albumin level	1.01 (0.92–1.11)	0.855	<0.01	0.99 (0.89–1.11)	0.922	0.03	0.94 (0.86–1.02)	0.139	0.03	0.91 (0.82–1.01)	0.065	0.08	0.995 (0.90–1.10)	0.929	<0.01	1.03 (0.91–1.17)	0.647	0.13
Bone density	0.98 (0.97–0.99)	**0.048***	0.08	0.97 (0.95–0.99)	0.024*	0.14	0.99 (0.98–1.00)	0.125	0.03	0.99 (0.97–1.00)	0.148	0.06	0.98 (0.96–0.99)	0.019*	0.12	0.97 (0.95–0.99)	**0.045***	0.21

AL: anastomotic leakage; **ASA:** American Society of Anesthesiologists physical status classification; **CI:** confidence interval; **OR:** odds ratio; **ROI:** region of interest; **R^2:** coefficient of determination; **UTI:** urinary tract infection
Adjusted model includes age, sex, and baseline ASA score

In the unadjusted models, a significant association was only observed between bone density and AL (OR 0.98, 95% CI 0.97–0.99; *P = .048*) and UTI (OR 0.98, 95% CI 0.96–0.99; *P = .019*), indicating that lower bone density is associated with a higher likelihood of AL and UTI. In the adjusted models, bone density maintained its significance with AL (OR 0.97, 95% CI 0.95–0.99; *P = .024*; R^2 14%) and UTI (OR 0.97, 95% CI, 0.95–0.99; *P = .045*; R^2 21%). The anterior aorta-to-fascia distance showed significance in the adjusted model of AL (OR 1.03, 95% CI 1.00–1.06; *P = .029*), indicating that a higher distance was associated with a higher risk of AL. No significant associations were observed between the other measures, including average psoas muscle area, average psoas muscle ROI, and preoperative albumin level, and any of the infection outcomes in either the unadjusted or adjusted models (Table 4).

Predicting postoperative outcomes using baseline measures of malnutrition

Table 5 presents the R^2 and area under the receiver operating characteristic curve (AUC) values derived from multivariable logistic regression models, progressively incorporating baseline measures of malnutrition into a base model consisting of age, sex, and ASA score. For each outcome (30-day mortality, cardiovascular-related events, AL, wound infection, and UTI), Table 5 outlines the incremental improvements in the models. The models showed a progressive increase in R^2 and AUC values, with Model 4 reaching the highest values and excellent discriminative ability for predicting 30-day mortality (AUC, 90%) and AL (AUC, 91%), and good discriminative ability for predicting cardiovascular-related events (AUC, 86%) and UTI (AUC, 80%). Across all outcomes, as the models advanced from Model 1 to Model 4, both the R^2 and AUC values consistently increased, indicating enhanced predictive accuracy and discriminatory ability after the inclusion of baseline measures of malnutrition (Figures 1.1–1.5 show the corresponding areas under the ROC curves).

DISCUSSION

The preoperative incidence of sarcopenia and other radiologic-based malnutrition (40–73%) rates are higher in patients with pancreatic cancer than in those with other malignancies[21,33]. Hypothetically, this might be attributed to associated pancreatic exocrine insufficiency, leading to malnutrition and an unfavorable prognosis[12,16]. This wide variation in incidence may be because of a lack of standardized definitions, the use of different tools, and the radiographic characteristics used to diagnose and categorize radiologic-based malnutrition[25,30,32,34,35]. In this study, we aimed to measure 30-day morbidity and mortality rates in patients who had undergone a PD and to determine their association with radiologic nutritional parameters, including psoas muscle area, density, bone density, and the anterior aorta-to-fascia distance.

Psoas muscle

Our findings indicated that a higher average psoas muscle diameter was associated with sarcopenia, which is relatively common among patients with coronary artery disease (CAD)[36]. Our findings also indicated that patients with a low psoas muscle diameter had a higher risk of cardiovascular-related events, which is consistent with previously reports of sarcopenia in patients with CAD being associated with an increased risk of MI and cardiovascular mortality[37-39].

Osteopenia

The ability of osteopenia to predict PD outcomes remains controversial. A retrospective study investigated the clinical significance of osteopenia in 152 patients with pancreatic cancer and showed a significant decrease in 1- and 2-year survival rates in such patients, but no correlation was observed in terms of immediate postoperative outcomes[40]. One study reported that older adult patients with low bone mineral density had a higher risk of developing postoperative pancreatic fistulas, but no association between overall survival and mortality was observed.[41] Our findings indicated that higher bone density was associated with a lower risk of cardiovascular-related events, AL, and UTI. These results align with previous findings that have shown osteopenia to be associated with infectious complications in patients undergoing major emergency gastrointestinal surgeries[42].

Visceral obesity

When the anterior aorta-to-fascia distance was assessed, which was used as a surrogate for increased visceral obesity, a longer distance

Table 5. R^2 and AUC values from multivariable logistic regression models after adding baseline measures of malnutrition to a base model of age, sex, and ASA score* in patients who underwent a PD at King Abdulaziz University Hospital in Jeddah, Saudi Arabia between 2013 and 2019 (n = 58)

	30-day mortality		**Cardiovascular event***		**AL**		**Wound infection**		**UTI**	
	R^2	**AUC**	**R^2**	**AUC**	**R^2**	**AUC**	**R^2**	**AUC**	**R^2**	**AUC**
Model 1	0.108	0.7756	0.1148	0.7145	0.027	0.6232	0.0357	0.5838	0.1227	0.7505
Model 2	0.2706	0.875	0.1933	0.7862	0.0946	0.7174	0.085	0.6885	0.1448	0.7582
Model 3	0.3066	0.8942	0.2245	0.8207	0.199	0.7862	0.0948	0.7122	0.154	0.7718
Model 4	0.3315	0.9038	0.3141	0.8623	0.47	0.9149	0.1355	0.7432	0.2207	0.8046

*Base model for cardiovascular event includes history of hypertension and diabetes

Model specifications:

30-day mortality: Model 1: includes age, sex, and ASA score; Model 2: Model 1 + ROI; Model 3: Model 2 + albumin; Model 4: Model 3 + anterior aorta-to-fascia distance

Cardiovascular event: Model 1: includes age, sex, ASA score, history of hypertension, and history of diabetes; Model 2: Model 1 + ROI; Model 3: Model 2 + average psoas area; Model 4: Model 3 + bone density

AL: Model 1: includes age, sex, and ASA score; Model 2: Model 1 + average psoas area; Model 3: Model 2 + anterior aorta-to-fascia distance; Model 4: Model 3 + bone density + preoperative albumin level

Wound Infection: Model 1: includes age, sex, and ASA score; Model 2: Model 1 + ROI; Model 3: Model 2 + average psoas area; Model 4: Model 3 + preoperative albumin level

UTI: Model 1: Includes age, sex, and ASA score; Model 2: Model 1 + ROI; Model 3: Model 2 + average psoas area; Model 4: Model 3 + bone density

AL: anastomotic leakage; **ASA:** American Society of Anesthesiologists physical status classification; **AUC:** area under the ROC curve; **R^2:** coefficient of determination; **ROI:** region of interest; **UTI:** urinary tract infection

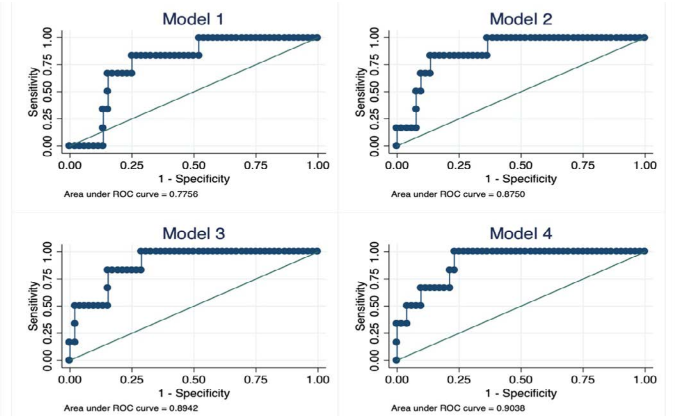

Figure 1.1 30-day mortality

*The base model for cardiovascular-related events includes a history of hypertension and diabetes

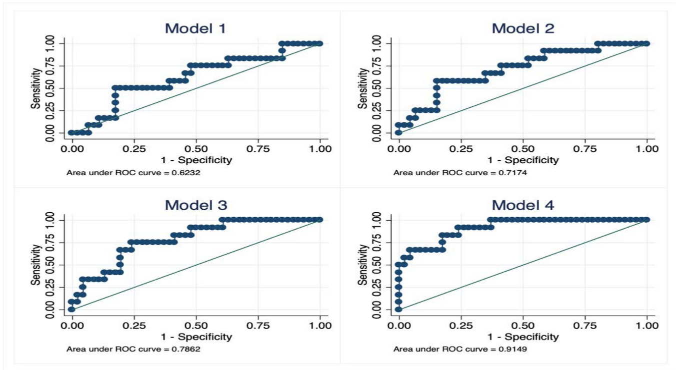

Figure 1.3 AL

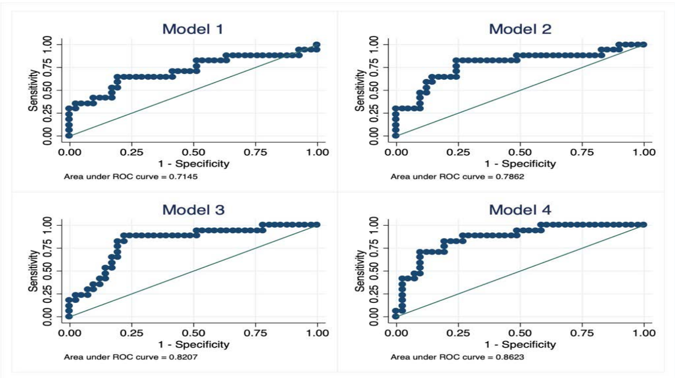

Figure 1.2 Cardiovascular-related events

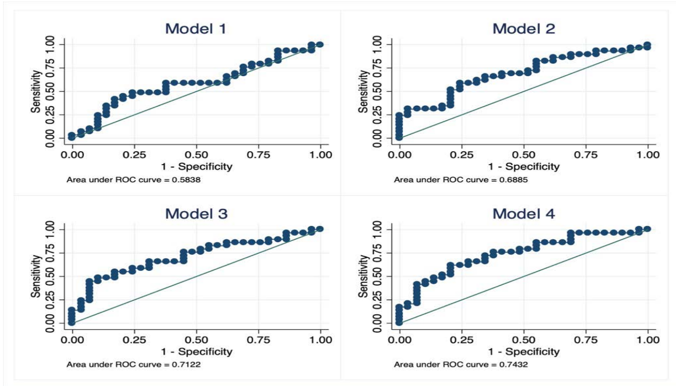

Figure 1.4 Wound infection

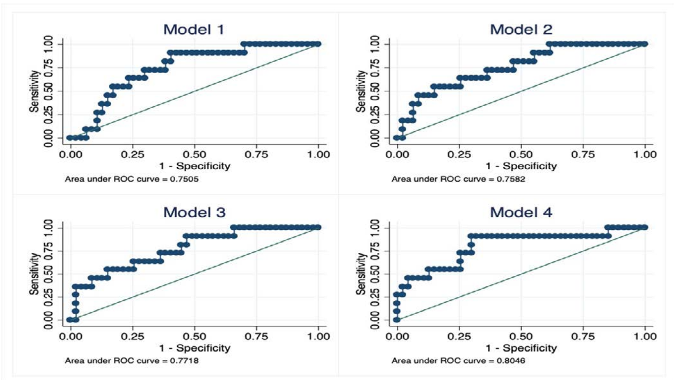

Figure 1.5 UTI

ASA: American Society of Anesthesiologists physical status classification **AL:** anastomotic leakage **UTI:** urinary tract infection **ROC:** receiver operating characteristic

Figure 1. ROC curves showing the prediction of postoperative outcomes after adding baseline measures of malnutrition to a base model of age, sex, and ASA score* in patients who underwent a PD at King Abdulaziz University Hospital in Jeddah, Saudi Arabia between 2013 and 2019

was associated with an increased risk of AL. This finding is similar to that in studies showing that sarcopenic obesity, which occurs when patients have a low skeletal muscle index along with a high BMI, is associated with postoperative AL and mortality[43-45]. This association is logical because an increased amount of visceral fat would make surgery more technically challenging. In addition to mechanical aspects, excessive visceral adipose tissue is associated with insulin resistance and comorbidities, which may adversely affect surgical outcomes, including wound infection, AL, and prolonged hospital stay[45-50].

To date, results correlating radiology-based malnutrition with postoperative morbidity and mortality have been conflicting. Some studies have suggested a significant correlation,[25,27,30] while others have reported no such correlation[51-54]. One potential confounding factor is adjuvant chemotherapy, as any delay in receiving chemotherapy is associated with a reduction in survival[51,55]. In our study, the postoperative 30-day mortality rate was 10%. The only variable in our study that correlated with the 30-day mortality rate was the psoas muscle ROI. While a higher 30-day mortality rate was associated with a higher average psoas muscle ROI, we are not able to fully explain this finding.

In a prospective study of data concerning 78 patients who had undergone surgical resection for pancreatic cancer, radiological changes in body composition during chemotherapy were evaluated, and a significant reduction in the amount of skeletal muscle and fat mass (including intramuscular, visceral, and subcutaneous adipose tissues) was observed. These results showed an association with higher mortality risk[56]. Another study confirmed the finding of adipose tissue depletion during chemotherapy; however, muscle gain during neoadjuvant chemotherapy was independently associated with resectability[57].

This study had several limitations. This was a retrospective single-institution study with a small sample size. The lack of a universal sarcopenia definition and a lack of consensus on the cutoffs for CT-measured malnutrition parameter indices impede its full evaluation in clinical practice. This is the first study conducted in the Middle East to assess the role of CT-derived malnutrition parameters in terms of PD outcomes. Further efforts to incorporate nutritional assessments, including CT malnutrition measures, into routine preoperative preparations for patients undergoing pancreaticoduodenectomy may contribute to improving surgical outcomes.

CONCLUSION

Malnutrition is common in patients with pancreatic cancer, and CT measurements of sarcopenia, osteopenia, and obesity have an evolving role in predicting postoperative outcomes. Further studies could help determine the precise role of these parameters in predicting individual outcomes.

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Competing Interest: None

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