SCIENTIFIC ARTICLE

Preoperative nutritional assessment by using subjective and objective criteria and its implication in the outcome of cancer patients undergoing abdomino-pelvic surgeries

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Keywords: : abdominal pelvic cancer, Post op patients, nutrition, PG SGA, Anthropometry

Introduction

The World Health Organization (WHO) defines "nutritional status" as the condition of the body resulting from the intake, absorption, and utilization of nutrients and the influence of particular physiological and pathological status.[1] Globally, malnutrition affects a significant proportion of individuals, with prevalence rates ranging from 30% to 85%, particularly prevalent among patients with gastric, pancreatic, lung, prostate, and colon cancers.[2] In cancer patients, malnutrition is associated with decreased treatment tolerance, increased postoperative morbidity and mortality, and diminished quality of life [3]

The evaluation of nutritional status in cancer patients commonly relies on subjective methods such as the Patient-Generated Subjective Global Assessment (PG-SGA)[4] and objective measures like anthropometry and biochemical parameters[5] . Despite their widespread use, no single method is universally accepted as the "gold standard," each possessing its' inherent limitations.

Objectives

1.To identify symptoms and signs that impact the nutritional status of cancer patients.

2.To assess nutritional status using subjective (PG-SGA) and objective (anthropometry and laboratory values) methods.

3.To correlate nutritional status with outcomes including morbidity, mortality, complication rates, length of hospital stay, quality of life, tolerance to treatment, and prognosis.

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Received: 25-03-2024 Accepted: 24-07-2024
DOI: http://doi.org/10.4038/sljs.v42i2.9128

Methodology

Study Population:

Study area: The study was conducted at a tertiary care hospital equipped with a comprehensive cancer treatment center.

Selection of subjects: The study included cancer patients undergoing abdominopelvic surgeries who provided signed written informed consent and met the following inclusion criteria:

Inclusion criteria:

Age between 18 and 70 years.

Diagnosis of cancer.

Undergoing abdomino pelvic surgeries.

Exclusion Criteria:

Lost to follow-up.

Chronic kidney disease (CKD).

Patients with distant metastasis.

Second surgery for recurrence.

Type of study: A prospective observational study. Data collection occurred from 2018 to 2020 following approval from the institutional ethics committee. (Army Hospital, research and referral New Delhi, India)

All Cancer patients undergoing abdominopelvic surgeries presenting to the tertiary care hospital with a comprehensive cancer treatment center were evaluated. All patients underwent clinical evaluation, anthropometry, and relevant laboratory investigations.

After duly explaining the surgical procedure, morbidity and mortality to the patient, written informed consent was obtained.

Study methods: In our study, malnutrition was classified based on subjective and objective criteria. subjective (PG-SGA) and objective (anthropometry and biochemical parameters) methods. While objective anthropometry (BMI, MUAC, SFT) and biochemical parameters (Hb, S. Protein, S. Albumin) were used for assessment preoperatively.

Outcomes: Post-operative variables chosen for analysis were the length of hospital stay, ICU stay, cardiac events, respiratory complications, thromboembolic events, sepsis, surgical site infections, and mortality at 30 days. The data is evaluated for morbidity and mortality and was compared with the current literature available.

The sample size (n) was determined using the Cochran formula: The Cochran formula is: n0 = Z2 pq / e 2Where; e is the desired level of precision (i.e., the margin of error) (10%);p is the (estimated) proportion of the population that has the attribute in question (50%),q is 1 – p.

The z-value was found in a Z table to be 1.96. Based on the study by Gupta et al, the calculated sample size for the study was 102, considering a 50% prevalence of malnutrition among cancer patients with a desired Confidence interval of 10% and a Confidence level of 95%. This sample size calculation ensures sufficient statistical power to detect meaningful differences or associations related to nutritional status among cancer patients undergoing abdominopelvic surgeries

Data Collection Methods

1.Instruments used: Pretested PG-SGA (Patient-Generated Subjective Global Assessment) and Objective Criteria Performa were used to collect relevant information.

2.Patient selection: All selected patients had their data collected using these instruments.

The PG-SGA is a comprehensive tool used to assess nutritional status in patients. It is designed for continuous assessment rather than a one-time categorical evaluation. It gathers information across various domains from weight history to physical examination findings It consists of two main components:

1.Patient-Generated Component (Boxes 1–4):

This part is completed by the patient and is known as the PG-SGA Short Form. It reflects approximately 80-90% of the total score.

It includes patient-reported information such as weight changes, dietary intake, symptoms affecting intake, and functional capacity.

2.Professional Component (Worksheets):

Completed by healthcare professionals, this component includes items related to the patient's weight history, physical examination findings (like muscle wasting and edema), and metabolic stress factors.

The PG-SGA provides a numerical score based on all completed data. The categories(A, B &C) are assigned based on the overall assessment and provide a snapshot of the patient's current status (e.g., well-nourished, moderately malnourished, or severely malnourished). The PG-SGA score is a composite score that combines information from both the patient-generated and professional components.It ranges from 0 to 35 points, with higher scores indicating worse nutritional status.

Numerical Score: The numerical score provides a quantitative measure of the patient's nutritional status. 0-1: Well-nourished,2-3: Moderately malnourished,4 or higher: Severely malnourished.

In addition to the numerical score, patients are also categorized into one of three groups based on their overall PG-SGA assessment. A: Well-nourished or mildly malnourished ,B: Moderately malnourished &C: Severely malnourished

Statistical Methods Applied

1.Software: SPSS version 25

2.Significance Level: Statistical significance was set at a p-value of 0.05.

3.Data Preparation

Normality Check: Continuous variables are normally distributed before applying parametric tests like the t-test.

Data Presentation

Continuous data: Mean, standard deviation, and range

Categorical data: Counts and percentages were used for summarization.

4 Statistical Tests

Comparison Between Groups:

For continuous data: A t-test was utilized if assumptions (such as normal distribution) were met.

For categorical data: The chi-square test (or Fisher's exact test for small sample sizes or sparse data)

5 In the methodology below mentioned part is missing: (after patient selection in methodology)

The PG-SGA (Patient-Generated Subjective Global Assessment) is a comprehensive tool used to assess the nutritional status of patients. The PG-SGA is designed for continuous assessment rather than a one-time categorical

Table 01: Demographic Pattern, KPS and Diagnosis of the Patients

Gender	Frequency	Percentage
Male	64	62.70%
Female	38	37.30%
Total	102	100.00%
Age (Years)		
Mean (SD)		52.09 (12.65)
KPS (Karnofsky Performance Status)		
Mean (SD)		83.24 (11.53)
Diagnosis	**Frequency**	**Percentage**
Gastro-Intestinal Malignancy	44	43.10%
Genito-Urinary Malignancy	26	25.50%
Hepato-Biliary Malignancy	23	22.50%
Pancreatic Malignancy	6	5.90%
Pheochromocytoma	2	2.00%
Retroperitoneal Sarcoma	1	1.00%
Total	102	100.00%

evaluation. It gathers information across various domains from weight history to physical examination findings It consists of two main components:

1.Patient-Generated Component (Boxes 1–4):

o This part is completed by the patient and is known as the PG-SGA Short Form. It reflects approximately 80-90% of the total score.

o It includes patient-reported information such as weight changes, dietary intake, symptoms affecting intake, and functional capacity.

2. Professional Component (Worksheets):

o Completed by healthcare professionals, this component includes items related to the patient's weight history, physical examination findings (like muscle wasting and edema), and metabolic stress factors.

The PG-SGA provides a numerical score based on all completed data. The categories(A, B &C) are assigned based on the overall assessment and provide a snapshot of the patient's current status (e.g., well-nourished, moderately malnourished, or severely malnourished). The PG-SGA score is a composite score that combines information from both the patient-generated and professional components.It ranges from 0 to 35 points, with higher scores indicating worse nutritional status.

Table 02: PG SGA Score of the Patients.

Total PG-SGA Score		
Mean (SD)	4.85 (3.50)	
PG-SGA Category	**Frequency**	**Percentage**
A	51	50.0%
B	30	29.4%
C	21	20.6%

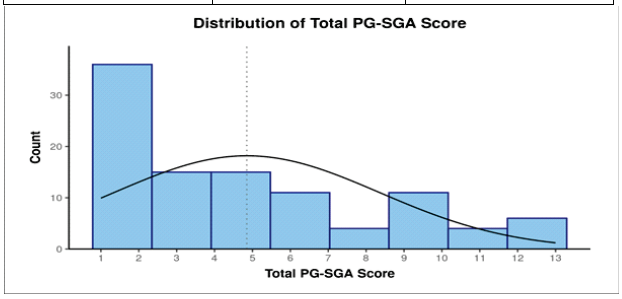

Table 03: pertains to objective, summary of objective assessment

OBJECTIVE ASSESSMENT	MEAN ± SD
Height (m)	1.65 ± 0.08
Weight (kg)	59.41 ± 10.24
BMI (kg/m^2)	21.78 ± 3.36
Mid Arm Circumference (cm)	24.71 ± 2.60
Skin Fold Thickness (mm)	15.70 ± 2.29
Haemoglobin (g/dl)	11.37 ± 2.33
Creatinine (mg/dL)	0.75 ± 0.23
T. Protein (g/dl)	6.49 ± 0.86
Albumin (g/dl)	3.34 ± 0.79
S. Cholesterol (mg/dl)	177.56 ± 26.22
FBS (mg/dl)	87.24 ± 21.84
PPBS (mg/dl)	126.43 ± 33.89

Numerical Score: The numerical score provides a quantitative measure of the patient's nutritional status. 0-1: Well-nourished,2-3: Moderately malnourished,4 or higher: Severely malnourished.

In addition to the numerical score, patients are also categorized into one of three groups based on their overall PG-SGA assessment. A: Well-nourished or mildly malnourished,B: Moderately malnourished &C: Severely malnourished

Result

The study population was predominantly male, comprising

62.7% of the participants. Ages ranged from 25 to 70 years old, with a median age of 52.09 years. Of the 102 patients enrolled, 64 patients were male (62.7%) and 38 were female (37.3%).Nearly half of the participants (48.03%) reported no history of smoking or alcohol consumption. Approximately 37.3% of patients reported a history of either smoking or tobacco use. About 31.4% of patients reported a history of alcohol consumption. A smaller proportion (16.66%) reported using both tobacco and alcohol. Karnofsky Performance Status (KPS):KPS scores ranged from 40 to 90. The median KPS score was 90, indicating that most patients had relatively good functional status, though with variability (SD = 11.53). Shapiro-Wilk test indicated that the KPS scores were not normally distributed (p = 0.0010).(Table no 01)

43.1% of the participants had Gastro-Intestinal Cancer, 25.5% had Genito-Urinary Cancer, 22.5% had Hepato-Biliary Cancer, 5.9% had Pancreatic Cancer, 2.0% had Pheochromocytoma, 1.0% of the participants had Retroperitoneal Sarcoma. 79 (77.5%) of the participants had Open Surgeries, while 23 (22.5%) had Laparoscopic Surgeries. 9 (8.8%) of the participants had Intraoperative Surgical Complications: 3 (2.9%) had Intraoperative Haemorrhage, 2 (2.0%) had Bladder Injury

Summary of subjective assessment

The total PG-SGA Score shows a skewed distribution with half of the patients (50%) categorized as PG-SGA Category A, indicating good nutritional status, while nearly a third

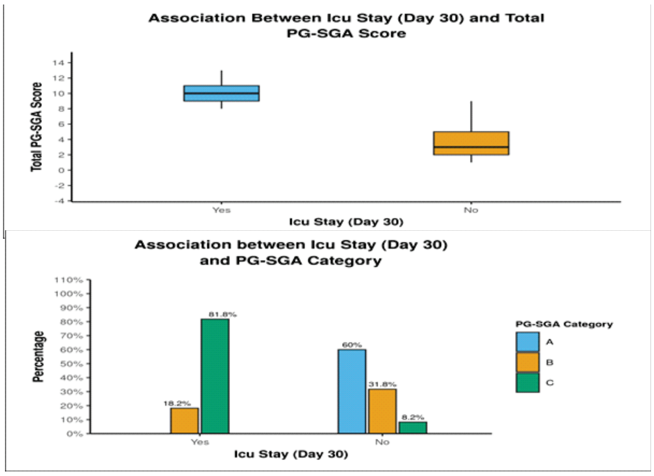

Figure 01: PG -SGA score, category & ICU stay

(29.4%) were in Category B, indicating moderate malnutrition. The remaining 20.6% were classified as Category C, indicating severe malnutrition or significant risk. (Table no: 02)

Summary of subjective assessment

As per the objective classification Table No. 03 depicts the various parameters on which the patient was assessed. (Table no:03)

i) Anthropometry:

The mean height (m) was 1.65 ± 0.08, weight (Kg) was 59.41 ± 10.24, BMI (Kg/m2) was 21.78 ± 3.36, mid arm circumference (cm) was 24.71 ± 2.60, triceps skin fold thickness (mm) was 15.70 ± 2.29.

ii) Lab Parameters:

The mean Hemoglobin (g/dl) was 11.37 ± 2.33, Creatinine (mg/dl) was 0.75 ± 0.23, T. Protein (g/dl) was 6.49 ± 0.86, Albumin (g/dl) was 3.34 ± 0.79, S. Cholesterol (mg/dl) was 177.56 ± 26.22, FBS (mg/dl) was 87.24 ± 21.84, PPBS (mg/dl) was 126.43 ± 33.89.

Summary of Operative details:

The mean OT Time was 273.72 minutes with a standard deviation of 89.28 minutes, indicating variability in the duration of surgeries. The mean Blood Loss (ml) was 351.27 ± 245.84. Most surgeries were conducted via the open approach (77.5%), while laparoscopic surgeries constituted a smaller proportion (22.5%).

Correlation between Prolonged ICU stay (Day 30) and parameters:

Over half of the participants (53.9%) required ICU stay immediately after surgery, primarily for post-operative monitoring following prolonged surgical procedures. A

Table 04: correlation of various parameters with ICU stay

Parameters	ICU Stay (Day 30)		p-value
	Yes (n = 11)	No (n = 85)	
Age (Years)* **	65.73 ± 5.16	49.94 ± 12.37	<0.001[1]
Gender			0.742[2]
Male	6 (54.5%)	54 (63.5%)	
Female	5 (45.5%)	31 (36.5%)	
KPS* **	70.91 ± 10.44	86.00 ± 8.62	<0.001[1]
Total PG-SGA Score* **	9.82 ± 2.14	3.81 ± 2.71	<0.001[1]
PG-SGA Category* **			<0.001[2]
A	0 (0.0%)	51 (60.0%)	
B	2 (18.2%)	27 (31.8%)	
C	9 (81.8%)	7 (8.2%)	
BMI (Kg/m2)* **	19.68 ± 4.37	22.32 ± 2.99	0.021[1]
BMI* **			<0.001[2]
<18.5 Kg/m2	6 (54.5%)	8 (9.4%)	
18.5-22.9 Kg/m2	2 (18.2%)	47 (55.3%)	
23.0-24.9 Kg/m2	0 (0.0%)	18 (21.2%)	
25.0-29.9 Kg/m2	3 (27.3%)	11 (12.9%)	
35.0-39.9 Kg/m2	0 (0.0%)	1 (1.2%)	
Mid Arm Circumference (cm)* **	22.56 ± 3.09	25.20 ± 2.24	0.011[1]
Skin Fold Thickness (mm)* **	13.76 ± 2.62	16.14 ± 1.96	0.007[1]
Hemoglobin (g/dL)* **	8.15 ± 1.01	11.95 ± 2.06	<0.001[1]
T. Protein (g/dL)* **	5.27 ± 1.07	6.72 ± 0.65	<0.001[1]
Albumin (g/dL)* **	2.23 ± 0.63	3.55 ± 0.65	<0.001[1]

Table 05: Trigger for blood transfusion WRT BMI , KPS & PG-SGA score

COMPARISON OF THE 5 SUBGROUPS OF THE BMI IN TERMS OF BLOOD TRANSFUSIONS							
Blood Transfusions (In Units)	**BMI (Kg/m^2)**					**Kruskal Wallis Test**	
	<18.5	**18.5-22.9**	**23.0-24.9**	**25.0-29.9**	**35.0-39.9**	**X^2**	**p-value**
Mean (SD)	1.94 (1.47)	0.54 (0.93)	0.47 (0.84)	0.64 (0.93)	2.00 (NA)	18.677	0.001

Correlation	Rho	P Value
KPS vs Blood Transfusions (In Units)	-0.67	<0.001

significant proportion (36.3%) required ICU stay by POD 7, mainly due to post-operative complications that necessitated intensive care. By POD 30, a smaller but notable number of participants (11.5%) still required ICU stay due to ongoing post-operative complications.The variables significantly associated (p<0.05) with prolonged ICU Stay were found to be age, KPS, Total PG-SGA Score, PG-SGA Category, BMI, Mid Arm Circumference, Skin Fold Thickness, Hemoglobin, T. Protein, and S. Albumin. (Table 04).

There was a significant difference between the 2 groups in terms of Total PG-SGA Score (W = 881.000, p = <0.001), with the Total PG-SGA Score being highest in the patients with prolonged ICU Stay (Day 30): 10 (9-11).

The Box-and-Whisker plot depicts the distribution of Total PG-SGA Scores in the 2 groups. There was a significant difference between the various groups in terms of distribution of the PG-SGA Category (X^2 = 38.835, p = <0.001). (Figure no 01)

Parameters	Cardiac Events (Day 30) Yes (n = 4)	Cardiac Events (Day 30) No (n = 92)	p-value
Age (Years)	61.50 ± 6.19	51.33 ± 12.85	0.106[1]
Gender			1.000[2]
Male	3 (75.0%)	57 (62.0%)	
Female	1 (25.0%)	35 (38.0%)	
KPS*	72.50 ± 9.57	84.78 ± 9.78	0.004[1]
Total PG-SGA Score*	9.75 ± 3.59	4.27 ± 3.08	0.009[1]
PG-SGA Category*			0.005[2]
A	0 (0.0%)	51 (55.4%)	
B	1 (25.0%)	28 (30.4%)	
C	3 (75.0%)	13 (14.1%)	
BMI (Kg/m2)	19.02 ± 4.94	22.14 ± 3.14	0.113[1]
BMI*			0.012[2]
<18.5 Kg/m2	3 (75.0%)	11 (12.0%)	
18.5-22.9 Kg/m2	0 (0.0%)	49 (53.3%)	
23.0-24.9 Kg/m2	0 (0.0%)	18 (19.6%)	
25.0-29.9 Kg/m2	1 (25.0%)	13 (14.1%)	
35.0-39.9 Kg/m2	0 (0.0%)	1 (1.1%)	
Mid Arm Circumference (cm)	22.02 ± 3.58	25.02 ± 2.37	0.077[1]
Skin Fold Thickness (mm)	13.15 ± 2.82	15.99 ± 2.07	0.056[1]
Hemoglobin (g/dL)*	8.55 ± 1.24	11.64 ± 2.26	0.009[1]
T. Protein (g/dL)*	5.30 ± 1.32	6.61 ± 0.78	0.039[1]
Albumin (g/dL)*	2.50 ± 0.78	3.44 ± 0.75	0.033[1]

Figure 02: association of cardiac events with the various parametres

Correlation between blood transfusion and parameters

The average fall in hemoglobin was 1.36 g% at POD 1, 0.95 g% at POD 7 and 0.23 g% at POD 30. A total of 39 of 102 patients (38.2%) required blood transfusions at POD 1, 34 (33.3%) at POD 7 and 10 (9.8%) at POD 30. There was a weak positive correlation between Age (Years) and blood transfusions (In Units), and this correlation was statistically significant (rho = 0.29, p = 0.003). There was a strong negative association between KPS and blood transfusions. For every 10 points increase in KPS, the blood transfusions decreases by 0.7 units. Total PG-SGA Score and blood transfusions (In Units) correlation was statistically significant (rho = 0.73, p = <0.001). For every 1-point increase in Total PG-SGA Score, the blood transfusions increases by 0.26 units with the highest median blood transfusions seen in the patients in PG-SGA Category There was a moderate negative correlation between BMI (Kg/m2) and blood transfusions (rho = -0.33, p = <0.001). For every 1 Kg/m2 increase in BMI, the need for blood transfusion is reduced by 0.12 units. There was a moderate negative correlation between mid arm circumference (cm) and skin fold thickness (mm) with blood transfusions (In Units) and this correlation was statistically significant (rho = -0.38, p = <0.001) & (rho = -0.39, p = <0.001). blood transfusions statistically significant (rho = - 0.59, p = <0.001) strong negative correlation was seen between S. Albumin and blood transfusions . For every 1 g/dl increase in S. Albumin, the blood transfusions decreased by 0.90 units. (Table no 05)

Association of Cardiac events with the various parameters

lower KPS scores, indicating poorer functional status, were associated with cardiac events. Higher scores on the Patient-Generated Subjective Global Assessment (PG-SGA), which assesses nutritional status and health, were associated with cardiac events. Lower haemoglobin levels were associated with cardiac events, potentially indicating anaemia or

Parameters	Respiratory Complications (Day 30)		p value
	Yes (n = 9)	No (n = 87)	
Age (Years)* **	65.56 ± 5.61	50.32 ± 12.48	<0.001[1]
Gender			1.000[2]
Male	6 (66.7%)	54 (62.1%)	
Female	3 (33.3%)	33 (37.9%)	
KPS* **	70.00 ± 11.18	85.75 ± 8.71	<0.001[1]
Total PG-SGA Score* **	10.00 ± 2.29	3.93 ± 2.80	<0.001[1]
PG-SGA Category* **			<0.001[2]
A	0 (0.0%)	51 (58.6%)	
B	1 (11.1%)	28 (32.2%)	
C	8 (88.9%)	8 (9.2%)	
BMI (Kg/m2)* **	19.09 ± 4.28	22.32 ± 3.01	0.010[1]
BMI* **			<0.001[2]
<18.5 Kg/m2	6 (66.7%)	8 (9.2%)	
18.5-22.9 Kg/m2	1 (11.1%)	48 (55.2%)	
23.0-24.9 Kg/m2	0 (0.0%)	18 (20.7%)	
25.0-29.9 Kg/m2	2 (22.2%)	12 (13.8%)	
35.0-39.9 Kg/m2	0 (0.0%)	1 (1.1%)	
MAC (cm)* **	22.10 ± 3.00	25.19 ± 2.25	0.005[1]
Skin Fold Thickness (mm)* **	13.48 ± 2.54	16.12 ± 1.98	0.005[1]
Hemoglobin (g/dL)* **	7.98 ± 1.02	11.88 ± 2.09	<0.001[1]
T. Protein (g/dL)* **	5.10 ± 1.10	6.71 ± 0.65	<0.001[1]
Albumin (g/dL)* **	2.18 ± 0.69	3.53 ± 0.66	<0.001[1]

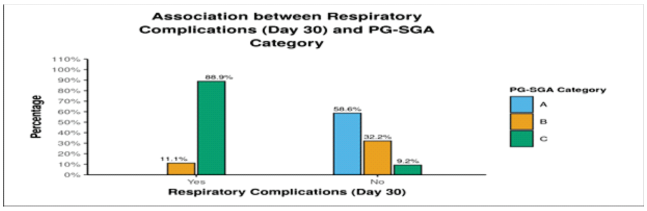

Figure 03: figure depicting pulmonary complication wrt various parameters.

physiological stress. Lower serum albumin levels were associated with cardiac events, indicating nutritional and health status.(Figure 02)

Respiratory complications

20 (19.6%) of the participants had respiratory complications at POD 1, 27 (26.5%) of the participants had Respiratory complications at POD 7, and 9 (9.4%) of the participants had respiratory complications (Day 30) in the form of post-op ventilation and pneumonia.

Older age was associated with an increased incidence of respiratory complications. Lower KPS scores, indicating poorer functional status, were associated with respiratory complications. Higher scores on the PG-SGA, which assesses nutritional status and health, were associated with respiratory complications. Specific categories within PG-SGA (A, B, C) were associated with respiratory complications, reflecting different levels of nutritional and health status. Patients with lower BMI were more likely to experience respiratory issues post-operatively. Low BMI can indicate poor nutritional status and reduced physiological reserves, which may contribute to increased susceptibility to respiratory

Table 06: association between length of hospital stay and parameters

Parameters	Length Of Hospital Stay (Days)	p-value
Age (Years)* **	Correlation Coefficient (rho) = 0.26	0.009[1]
Gender		0.385[2]
Male	21.80 ± 10.84	
Female	21.74 ± 13.80	
KPS* **	Correlation Coefficient (rho) = -0.44	<0.001[1]
Total PG-SGA Score* **	Correlation Coefficient (rho) = 0.61	<0.001[1]
PG-SGA Category* **		<0.001[3]
A	15.12 ± 5.81	
B	25.60 ± 10.57	
C	32.48 ± 14.87	
BMI (Kg/m2)* **	Correlation Coefficient (rho) = -0.34	<0.001[1]
BMI* **		0.003[3]
<18.5 Kg/m2	32.67 ± 14.58	
18.5-22.9 Kg/m2	20.28 ± 10.11	
23.0-24.9 Kg/m2	15.79 ± 5.07	
25.0-29.9 Kg/m2	21.50 ± 13.65	
35.0-39.9 Kg/m2	18.00 ± 0	
Mid Arm Circumference (cm)* **	Correlation Coefficient (rho) = -0.37	<0.001[1]
Skin Fold Thickness (mm)* **	Correlation Coefficient (rho) = -0.36	<0.001[1]
Haemoglobin (g/dl)* **	Correlation Coefficient (rho) = -0.47	<0.001[1]
T. Protein (g/dl)* **	Correlation Coefficient (rho) = -0.47	<0.001[1]
Albumin (g/dl)* **	Correlation Coefficient (rho) = -0.49	<0.001[1]

***SIGNIFICANT AT P<0.05, 1: SPEARMAN CORRELATION, 2: WILCOXON-MANN-WHITNEY U TEST, 3: KRUSKAL WALLIS TEST

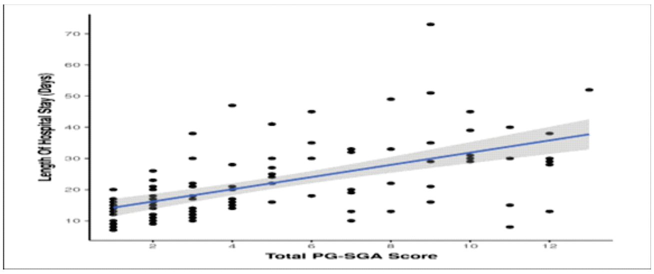

Figure 05: scatter plot depicting the relation of PG SGA score vs length of stay in the hospital

complications such as pneumonia or decreased respiratory muscle strength. Lower serum albumin levels were associated with increased respiratory issues. Albumin is a marker of nutritional status and also plays a role in maintaining vascular integrity and immune function. Low albumin levels can predispose patients to infections and impair wound healing, potentially leading to respiratory complications. Patients with lower haemoglobin levels were also more likely to experience respiratory issues. Low haemoglobin levels can indicate anaemia, which may impair oxygen delivery to tissues and increase the risk of respiratory distress post-operatively. (figure 03)

Length of hospital stay(Los)

The mean (SD) of the length of hospital stay (Days) was 21.77 (11.96). The length of hospital stay (Days) ranged from 7 - 73. The variables significantly associated (p<0.05) with

Table 07: mortality wrt various parameters.

Parameters	Mortality (Day 30)		p value
	Yes (n = 7)	No (n = 93)	
Age (Years)	58.57 ± 8.77	51.31 ± 12.74	0.160[1]
Gender			0.422[2]
Male	3 (42.9%)	59 (63.4%)	
Female	4 (57.1%)	34 (36.6%)	
KPS* **	68.57 ± 21.16	84.73 ± 9.51	0.027[1]
Total PG-SGA Score* **	10.57 ± 1.81	4.29 ± 3.10	<0.001[1]
PG-SGA Category* **			<0.001[2]
A	0 (0.0%)	51 (54.8%)	
B	1 (14.3%)	29 (31.2%)	
C	6 (85.7%)	13 (14.0%)	
BMI (Kg/m2)	19.21 ± 4.18	22.05 ± 3.22	0.059[1]
BMI			0.050[2]
<18.5 Kg/m2	4 (57.1%)	13 (14.0%)	
18.5-22.9 Kg/m2	1 (14.3%)	48 (51.6%)	
23.0-24.9 Kg/m2	1 (14.3%)	18 (19.4%)	
25.0-29.9 Kg/m2	1 (14.3%)	13 (14.0%)	
35.0-39.9 Kg/m2	0 (0.0%)	1 (1.1%)	
Mid Arm Circumference (cm)	22.64 ± 3.33	24.95 ± 2.45	0.081[1]
Skin Fold Thickness (mm)	13.86 ± 3.05	15.92 ± 2.12	0.077[1]
Haemoglobin (g/dl)* **	8.33 ± 1.24	11.64 ± 2.23	<0.001[1]
T. Protein (g/dl)* **	4.90 ± 1.01	6.63 ± 0.73	<0.001[1]
Albumin (g/dl)* **	2.04 ± 0.64	3.45 ± 0.71	<0.001[1]

LOS were: age, KPS, total PG-SGA score, PG-SGA category, BMI, mid arm circumference, skin fold thickness, hemoglobin, t. protein, and s. albumin.).There was a statistically significant weak positive correlation between age and LOS. For every 1-year increase in the age of the patients, the LOS (Days) increased by 0.29 days. There was a statistically significant moderate negative correlation noted between KPS and LOS. For every 10-point increase in KPS, the LOS decreased by 0.42 days. A statistically significant strong positive correlation was noted between the PG-SGA score and LOS. For every 1-point increase in the PG-SGA score, the LOS increased by 1.96 days. A statistically significant moderate negative correlation was observed between Hb and LOS. For every 1 g/dl increase in Hb, the LOS decreased by 2.43 days. Strong negative correlations of t. protein (g/dl) and s. albumin with LOS were observed, and these correlations were statistically significant. For every 1 unit increase in t. protein (g/dl) or s. albumin, the LOS decreased by 6.04 and 7 days respectively.(Table no 06).

The scatterplot depicts the correlation between total PG-SGA score and LOS. Individual points represent individual cases. The blue trendline represents the general trend of correlation between the two variables. The shaded grey area represents the 95% confidence interval of this trendline (figure 5)

There was a statistically significant moderate negative correlation of LOS with variables BMI (Kg/m2), MUAC (cm) and TSFT (mm). For every 1 unit increase in BMI, MUAC and TSFT, the LOS decreased by 1.22, 2.04, and 2.33 days.

Correlation between mortality (Day 30) and parameters

No mortality was reported during POD1 following surgery. We lost 07 patients at the end of 30 days. The variables significantly associated ($p<0.05$) with mortality (Day 30) were: KPS, total PG-SGA Score, PG-SGA category, hemoglobin, t. protein and s. albumin. There was no significant difference between the groups noticed in terms of age, gender or BMI. However, there was a significant difference between the 2 groups in terms of Hb (g/dl) (W = 63.000, p = <0.001), with the median Hb (g/dl) being lowest in the Mortality group (Day 30): 7.91 (7.7-8.95). The median (IQR) of Hb (g/dl) in the other group in which no mortality was seen at day 30 was 11.7 (10-13.5). (Table 07).

Discussion

Malnutrition is highlighted as a significant issue among cancer patients undergoing abdominopelvic surgeries. It represents an imbalance between energy and nutrient needs and actual dietary intake, which can compromise the body's ability to respond to surgical stress and other environmental challenges.[8].

The study aims to assess how pre-operative nutritional assessment, using both subjective and objective criteria, influences surgical outcomes. Effective nutritional assessment and intervention may potentially mitigate the risks associated with malnutrition, such as increased complications and poorer recovery outcomes post-surgery. [9].

While traditionally malnutrition is associated with middle-aged and elderly cancer patients, the study indicates that younger age groups are also affected. This broadens the scope of nutritional assessment and intervention strategies across different age demographics.[10] In our study the mean age of presentation was 52 years with male predominance (62%). This is similar to one of the published data from a reputed cancer center in India where the author observed a mean age of 45.7 years with 33% of the patients being younger than 40 years of age[11]. Both studies indicate a middle-aged demographic profile among cancer patients undergoing treatment in India. This age range suggests that cancer affects individuals typically in their 40s to 50s, highlighting a significant period of life where cancer diagnoses are prevalent.

In our study, there was a statistically significant (p = 0.001) positive correlation noticed between age and LOS, postoperative complications, overall morbidity and mortality and this correlation was by global literature.[12]

In this study, we observed that there was no significant difference in the distribution of gender among various groups in terms of malnutrition. This finding contrasts with some previous studies that suggested females were more likely to present with severe malnutrition. Various hypotheses that have been put forward include social structure, immunity, psychological factors or could be due to combination of multiple factors. The non-significant p-value ($p = 0.422$) indicates that there is no statistically significant difference in the distribution of gender among different groups categorized by malnutrition severity ($X^2 = 1.171$, $p = 0.422$).

The impact of cancer treatment and disease progression on nutritional status is multifaceted, affecting food intake, metabolism, and overall quality of life. The KPS score is indeed a valuable tool in assessing functional status and predicting outcomes in cancer patients, particularly following surgery. A KPS score of ≤40 indicates severe impairment in functional status, often associated with poor survival outcomes in cancer patients. Studies have consistently shown that lower KPS scores are predictive of worse survival rates across various types of cancers.

Our study indicates a statistically significant inverse correlation between KPS score and LOS. This suggests that patients with lower KPS scores tend to have longer hospital stays, likely due to increased postoperative complications or slower recovery &increased mortality rates. The significant inverse correlation between KPS score and postoperative outcomes underscores its role as a valuable prognostic tool in cancer surgery. By integrating KPS assessment into routine clinical practice, healthcare providers can better predict and manage surgical outcomes, ultimately improving patient care and optimizing treatment strategies in cancer patients.

PG-SGA scores ranged from 1 to 13. The numerical score is more sensitive to a small change in nutritional status than the global categorization.[13]

51 out of 102 patients were classified as malnourished, indicating an incidence of 50% within our study population. Malnourished participants had significantly higher PG-SGA scores (median 6, IQR 4–7) compared to well-nourished participants (median 2, IQR 1–2). This indicates that higher PG-SGA scores are associated with more severe malnutrition, as assessed subjectively through the PG-SGA tool. This result agrees with studies[14] that have used the PG-SGA score as a screening tool to assess the nutritional status of patients with cancers. PG-SGA is validated for assessing nutritional status in cancer patients, considering both subjective and objective criteria.

Patients categorized as PG-SGA category C or those with a numeric score ≥9 demonstrated significant differences in terms of Length of Stay (LOS), overall morbidity, and mortality at day 30 when compared to categories A & B. Higher PG-SGA scores (indicative of more severe malnutrition and symptom burden) are associated with poorer outcomes. The lack of significant difference in survival between categories A and B suggests that nutritional interventions performed during the preoperative period may have positively impacted outcomes. These interventions likely mitigated the effects of malnutrition and improved the patients' nutritional status before surgery, potentially leading to comparable survival outcomes as those with better nutritional status.

This result is consistent with the study by Shahmoradi et al.[15], which found that almost all patients needed some type of recommendation to improve their nutritional status and quality of life and that the higher the PG-SGA score was, the worse the individual outcome.

In our study, despite a substantial prevalence of malnutrition diagnosed by PG-SGA score (50%), we observed that low BMI (<18.5 Kg/m^2) was not significantly correlated with malnutrition. Despite the low BMI category, the prevalence of malnutrition diagnosed by PG-SGA was much higher at 50%. The finding that low BMI was not significantly correlated with malnutrition as diagnosed by PG-SGA suggests that BMI alone may not adequately capture the complex nutritional status of cancer patients undergoing abdominopelvic surgeries.

PG-SGA is designed to comprehensively assess nutritional status based on subjective and objective criteria, including weight changes, dietary intake, symptoms, and functional status, which may provide a more nuanced evaluation compared to BMI alone. This is in agreement with several other authors who have reported that only 10% of malnourished patients are detected when using the BMI criterion, vs 40-80% with PG-SGA score.[16]

Total protein and s. albumin serve as biomarkers reflecting nutritional status and overall health status preoperatively. Both T. Protein and S. Albumin showed a moderate negative correlation with LOS, postoperative complications, and mortality at day 30 and this correlation was statistically significant (rho = -0.47 & -0.49, p = <0.001).

Limitations of our study were mainly the small sample size, heterogeneity of surgical interventions, and the short-term follow-up (30 days). The inclusion of various abdominopelvic surgeries with different complexities and perioperative management protocols introduces variability that can confound results. Differences in surgical techniques, anesthesia protocols, and postoperative care pathways can obscure specific effects related to nutritional status and outcomes.

Conclusion

Malnutrition remains a major issue for cancer patients and requires a multi-disciplinary approach including clinical nutrition experts, peri-operative physicians and surgeons. Our study underscores the critical role of comprehensive nutritional assessment and management in enhancing outcomes for cancer patients undergoing surgery.

It highlights that the integration of various parameters—age, KPS, PG-SGA score, anthropometric measures (BMI, MUAC, TSFT), and biochemical markers (total protein, serum albumin)—as independent risk factors for assessing preoperative nutritional status.

PG-SGA score has better efficacy and significant discriminatory power to predict malnutrition and postoperative outcomes and can be used as a reference method along with anthropometry and biochemical parameters for proactive risk assessment (screening), monitoring, and triaging for nutritional interventions in patients with cancer.

Our study reiterates the concept of continued nutritional care even after discharge and suggests patient-centric nutrition management. Patients at nutritional risk should be promptly referred for comprehensive nutritional assessment and support, which must be actively managed and targeted for each patient according to their nutritional conditions, clinical status, planned treatment, and expected outcome.

There seems to be a lack of available literature regarding both short-term and long-term nutritional assessment in Southeast Asian countries and longer duration of follow-up in future studies to evaluate the sustained impact of nutritional factors on long-term complications, disease recurrence, disease-free survival, and overall survival in cancer patient is needed.

By integrating multiple assessment tools and adopting a patient-centric approach to nutritional care, healthcare providers can optimize treatment outcomes and improve the quality of life for patients throughout their cancer journey.

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