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Original Research Article

TO ASSESS THE EFFECT OF PREOPERATIVE NUTRITIONAL STATUS ON EARLY POST-OPERATIVE OUTCOMES AFTER SURGERY FOR HEPATO-PANCREATO-BILIARY MALIGNANCY

Hitesh kumar Dubey[1], Venu Madhav Thumma[2], Surya Ramachandra Varma Gunturi[3], Nava Kishore K[4], N. Bheerappa[5]

[1]Senior resident, Department of Surgical Gastroenterology, Nizam's Institute of Medical Sciences, Hyderabad, India.
[2]Additional Professor, Department of Surgical Gastroenterology, Nizam's Institute of Medical Sciences, Hyderabad, India.
[3]Additional Professor, Department of Surgical Gastroenterology, Nizam's Institute of Medical Sciences, Hyderabad, India.
[4]AssociateProfessor, Department of Surgical Gastroenterology, Nizam's Institute of Medical Sciences, Hyderabad, India.
[5]Professor, Department of Surgical Gastroenterology, Nizam's Institute of Medical Sciences, Hyderabad, India.

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Corresponding Author:
Dr. Venu Madhav Thumma,
Additional Professor, Department of Surgical Gastroenterology, Nizam's Institute of Medical Sciences, Hyderabad, India.
Email: thummavenumadhav@gmail.com

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ABSTRACT

Background: Malnutrition is common in patients with malignancy and is associated with poor treatment outcomes. There is a need for a reliable and valid scoring system to identify patients with poor nutrition status at the time of admission. **Aim:** The aim of the present study was to determine the effect of preoperative nutritional status on early post-operative outcomes in patients undergoing surgery for Hepato-pancreato-biliary malignancy.

Material and Methods: All patients who underwent surgery for HPB malignancy in the Department of Surgical gastroenterology, Nizam's Institute of Medical Sciences, Hyderabad between March 2018 to March 2019 were included. It was a prospective cross-sectional study. Various nutritional indices were calculated which include the Nutritional Risk Index (NRI), Prognostic nutritional index [PNI], Malnutritional Universal screening tool (MUST)and Subjective global assessment (SGA). Patients were considered well-nourished if SGA -A, NRI>100, PNI>50, MUST – 0 (Low risk) Rest were considered malnourished. The effect of nutritional status as defined by the aforementioned parameters was studied on various outcome measures such as morbidity, mortality and Length of hospital stay.

Results: A total of 49 patients underwent pancreatic surgery for malignancy during the study period. Malnutrition was seen in a high percentage of the patients undergoing surgery for pancreatic cancer in the present study. It ranged from 42.85% as estimated by NRI to 77.54% as estimated by MUST. All the four nutritional indices NRI, PNI, MUST and SGA were associated with poor post-operative outcomes after pancreatic surgery. Patients with high NRI had a significantly lower incidence of Delayed gastric emptying(DGE) after pancreatic surgery. In the present study, Post-operative pancreatic fistula(POPF) and mortality were significantly higher in malnourished patients (SGA B,C). A total of 24 patients underwent surgery for hepatobiliary malignancy during the study period. Malnutrition was seen in a significant percentage of the patient's undergoing surgery for hepatobiliary cancer in the present study. It ranged from 29 % as estimated by MUST to 43.83% as estimated by PNI.All four nutritional indices NRI, PNI, MUST and SGA were not associated with significant post-operative complications in patients who underwent hepatobiliary surgery.

Conclusion: In patients undergoing pancreatic surgery for malignancy. 1.Malnutrition identified by nutritional indices NRI, PNI, MUST and SGA were associated with increased postoperative complications. 2. MUST was

associated with most post-operative complications. 3. Subjective Global Assessment(B&C) patients were associated with increased risk postoperative pancreatic fistula.
Keywords: Nutritional Status, Surgery, Hepato-Pancreato-Biliary Malignancy.

INTRODUCTION

Malnutrition is common in patients with malignancy and is associated with poor treatment outcomes. Numerous studies have showed that nearly 30 to 87% of patients with malignancy have underlying malnutrition.[1]

The etiology of malnutrition in malignancy is multifactorial. The etiology is related to both underlying disease (local effect of tumor, host response, systemic effects of disease, alteration in metabolism due to resting energy expenditure) and treatment effects (adverse effects and psychological effects).

Previous studies have shown a link between malnutrition and delayed wound healing, infection (surgical site and deep infections), increased ICU and hospital stay, readmission and overall hospital cost.[2,3] There are relatively few studies documenting the effect of preoperative malnutrition on morbidity following surgery for hepatobiliary pancreatic surgery.

There is a need for a reliable and valid scoring system to identify patients with poor nutrition status at the time of admission. Many traditional scoring systems to assess malnutrition were based on anthropometric data (weight, height, triceps skin fold thickness, etc),weight loss,body composition analysis, laboratory values(total lymphocyte count, serum albumin, ferittin) and cell-mediated immunity. When these parameters were measured individually, they will not detect all malnourished patients at risk. Researchers have developed various nutritional indices to identify patients at risk for malnutrition leading to poor outcomes and a combination of parameters results in better predictive power.[4]

Aim

The aim of the present study was to determine the effect of preoperative nutritional statuson early post-operative outcomes in patients undergoing surgery for Hepato-pancreato-biliary malignancy.

Objectives

To assess malnutrition using nutritional risk index, prognostic nutritional index, subjective global assessment, malnutritional screening tool in patient undergoing surgery for hepato-pancreato-biliary(HPB) malignancy.

To identify the effect of preoperative malnutrition on incidence of various post-operative complications following surgery for HPB malignancy.

MATERIAL AND METHODS

All patients who underwent surgery for HPB malignancy in the Department of Surgical gastroenterology, Nizam's Institute of Medical Sciences, Hyderabad between March 2018 to March 2019 were included. It was a prospective cross-sectional study. All cases meeting inclusion criteria were assessed preoperatively for various comorbidities and were optimized. Patients underwent preoperative estimation of various nutritional indices and were classified as malnourished and well-nourished patients. These patients then underwent surgery and were monitored for any complications. All complications wereidentified and graded according to Clavien-Dindo grading. Various nutritional indices were compared to identify which index was best associated with postoperative complications.

Inclusion Criteria

- All patient who underwent surgery for HPB malignancy

Exclusion Criteria

- Patient who received preoperative nutritional therapy
- Metastatic disease
- Emergency surgery

Assessment of nutritional status:

Various nutritional indices were calculated which include the Nutritional RiskIndex (NRI),[5], Prognostic nutritional index [PNI],[6] Malnutritional Universal screening tool(MUST),[7] and Subjective global assessment (SGA).[8].

The NRI was based on serum albumin concentrations and the ratio of present/usual weight, which were used in the following equation-(1:489 X serum albumin) +{(41:7 X(present weight/usual weight)}The NRI was scored as follows: > 100 indicates that the patient is not malnourished; 97.5 to 100 indicates mild malnourishment; 83.5 to 97.5 indicates moderate malnourishment; and < 83.5 indicates severe malnourishment. The usual weight was defined as the stable weight 6 months or more before admission or before illness. The present weight was determined with a calibrated balance.

The value of PNI was calculated as 10 X serum albumin (g/dL) + 0.005 X total lymphocyte count (/mm3) of peripheral blood. A PNI value >50 is defined as normal<50, as mild malnutrition; ,45, as moderate to severe malnutrition; and <40, as serious malnutritionMalnutrition Universal Screening Tool: Patients were be classified into 0 - low risk, 1- medium risk, 2- high risk MUST by asking questioners which include loss of weight, how much

weight loss and decreased appetite and score of 2 or more is a risk for malnutrition.

SGA(9)was determined by weight loss in past 6 months, dietary intake in past 2 weeks ,GI symptoms, functional status, disease state affecting nutritional requirement muscle wasting, subcutaneous fat loss, edema. Based on these evaluation patients were classifies as mild, moderate and severe malnourished.

Patients were considered well-nourished if SGA -A, NRI>100, PNI>50, MUST –0 (Low risk) Rest were considered malnourished.

The effect of nutritional status as defined by the aforementioned parameters was studied on various outcome measures as outlined below

Outcome measures

Morbidity

Mortality

Length of hospital stay

Morbidity

All postoperative complications were assessed according to validated definitions and rated in accordance with the validated Clavien–Dindo classification(10). The association between malnutrition and complications was evaluated for each of nutritional scores. Minor complications wasdefined as Clavien- Dindo grade 1 and 2 and major complications as grade 3 and above. The most suitable nutritional score was defined as that with the greatest association between malnutrition and complications.

Definitions

- **Pancreatic fistula** :Any measurable amount of fluid after post-operative day 3 with an amylase level 3 times or greater than serum amylase(11).Pancreatic fistula was graded into grade A, B or C according to the ISGPF classification(11).Grade B and Grade C fistulas are together considered as clinically relevant fistulas.
- **Delayed gastric emptying**(12):Any nasogastric tube intubation lasting longer than 3 postoperative days or the inability to tolerate a solid diet by POD 7.DGE was graded into Grade A, B and C according to the ISGPS classification(12).
- **Post pancreatectomy Hemorrhage**(13)**:**Time of onset : Early(within 24hrs) or Late (>24hrs after end of index operation).Location : Intraluminal or extraluminal

PPH was graded into grade A, B and C according to the ISGPS classification (13).

- **Postoperative liver failure**(14)(PLF) and **biliary leakage**(15) were defined in accordance with the criterion of International Study Group of Liver Surgery. PLF was classified into three categories (grade A, B, and C)(14)
- **Abscess (intraperitoneal/extraperitoneal)** requires operative or spontaneous drainage of an abdominal purulent collection.
- **Atelectasis**: confirmed by chest radiography, requiring bronchoscopy.
- **Cardiac failure**: symptoms or signs of left ventricular or congestive cardiac failure that requirean alteration from preoperative therapeutic measures.
- **Cerebrovascular accident**: development of a new and persistent (> 48 hours) central neurologic deficit.
- **Chest infection**: production of purulent sputum with positive bacteriologic cultures, with or without chest radiographic changes or pyrexia, or consolidation seen on chest radiography.
- **Coexisting disease**: A history of congestive heart failure, myocardial infarction, angina, or cerebrovascular disease was defined as cardiovascular disease. Chronic obstructive lungdisease, respiratory insufficiency, or bronchial asthma was defined as respiratory disease. Diabetesmellitus included types I and II. Chronic liver disease documented by either biopsy or by persistently elevated serum transaminases was defined as liver disease. All of the patients with coexisting diseases were self-dependent and were not hospitalized because of thesepathologies.
- Hypotension: a fall in systolic blood pressure below 90 mmHg for more than 2 hours.
- Impaired renal function: Criteria for diagnosis
- Urine output < 400 ml per 24 hours
- Serum creatinine > 150 mmol/l
- **Infection:** Infection occurring within 30 days of surgery with at least one of the following
  - Purulent drainage with or without laboratory confirmation, from the incision
  - Organisms isolated from an aseptically obtained culture of fluid or tissue from the incision
  - At least one of the following signs or symptoms of infection: pain or tenderness, localized swelling, redness, or local rise of temperature.
  - **Dehiscence:** Superficial or deep wound breakdown

Mortality: Thirty-day mortality or mortality during admission was taken into account.

Statistical Analysis

Data was recorded in a predesigned proforma and managed using Microsoft Excel 2010 (Microsoft Corp, Redmond, WA). All the entries were double checked for any possible error. Mean and standard deviation was calculated for continuous variables. The data was presented as mean ± standard deviation and compared between the groups using student t test or ANOVA test where appropriate. Statistical analysis for the categorical variables was performed by computing the frequencies in each category. Frequency differences between groups were compared using Chi-square test or Fisher exact test when appropriate. All tests were two tailed; a p-value $\leq$ 0.05 was considered as significant. Statistical software SPSS version 16 (SPSS Inc., Chicago, IL) was used for statistical analysis.

RESULTS

A total of 49 patients underwent pancreatic surgery for malignancy during the study period. Out of them 23 were male patients and 26 were female. Forty-five underwent Pancreaticoduodenectomy and 4 underwent distal pancreatosplenectomy. Patients in whom pancreaticoduodenectomy was done, 28 patients had ampullary adenocarcinoma, 8 patients had carcinoma head of pancreas, 2 patients had distal cholangiocarcinoma and 7 patients had duodenal adenocarcinoma.Distal pancreatosplenectomy was done for pancreatic body and tail adenocarcinoma.

Nine patientshad diabetes, 11 had hypertension, 2 had cardiac comorbidities and 1 had cirrhosis. Eight of the 49 patients were smokers and 7 were alcohol.

Mortality was seen in 4 out of the 49 patients (8.14%) during the 30 day follow up period. Causes of death were aspiration pneumonia in 2 patients, myocardial infarction in one patient and pulmonary thromboembolism in one patient.

Morbidity

Total no of patients having post operative complications were 22(44.89%) out of 49.

Post operative pancreatic fistula was seen in 29 patients (59.18%). Grade A was seen in 19 patients, Grade B was seen in 8 patients, Grade C fistula was seen in 2 patients. Clinically relevant pancreatic fistula (Grades B and C) was seen in a total of 10 patients (20.49%).

Delayed gastric emptying was seen in 27 patients (55.10%) out of 49. All were Grade A according to the ISGPS classification of DGE.

Post pancreatectomy hemorrhage was seen in only 1 patient (2.04%). It was Grade B. Patient was managed conservatively and recovered uneventfully.

Surgical site infections were seen in 15 patients (30.61%). Cardiac complications were seen in 2 patients. Chest infection was seen in 4 patients. UTI was seen in 3 patients . Acute kidney injury was seen in 1 patient.

Nutritional status of patients was assessed preoperatively using 4 parameters i.e. NRI, PNI, Malnutrition Universal Screening Tool (MUST) and Subjective Global Assessment (SGA)

NRI

Out of 49 patients included in the study, 21 patients (42.85%) were malnourished (NRI < 100). 28 patients (57.14%) were well nourished NRI (>100). So, with NRI value as the criterion, 42.85% of the study group was malnourished.

Delayed gastric emptying was seen in 8 of 21(38.09%) malnourished patients and 9 out of 28 (67.85%) patients in the well-nourished group. This difference was statistically significant (p = 0.04).

There was no significant difference in the incidence of POPF, Clinically relevant POPF, Post pancreatectomy hemorrhage, surgical site infections, length of stay and morbidity between both the groups. [Table 1] There was no difference in the incidence of minor and major complications between both the groups. [Table 2]

PNI

PNI was measured preoperatively in all patients. Out of 49 patients 25 patients (51.02%) were Well nourished (PNI of >50) and 24 patients (48.98%) were Malnourished (PNI < 50).

There was no significant difference in the incidence of POPF, Clinically relevant POPF, DGE, Post pancreatectomy hemorrhage, surgical site infections, length of stay and morbidity between both the groups (Table 3). There was no difference in the incidence of minor and major complications between both the groups. [Table 4]

Malnutrition Universal Screening Tool (MUST)

As assessed by malnutrition universal screening tool (MUST),11 (22.44%) were at low risk of malnutrition, 12 (24.48%) were at medium risk and 26 patients (53.06%) were at high risk of malnutrition. Eleven (22.44%) were well nourished and 38 (77.55%) patients were categorized as malnourished.

There was no significant difference in the incidence of POPF, Clinically relevant POPF, DGE, Post pancreatectomy hemorrhage, surgical site infections, length of stay and morbidity between both the groups. [Table 5] There was no difference in the incidence of minor and major complications between both the groups. [Table 6]

Subjective Global Assessment (SGA)

When assessed by SGA out of 49 patients, 24 patients (48.98%) were well nourished i.e. grade A, 20 patients (40.82%) had mild – moderate malnutrition (grade B), and 5 patients (10.20%) had severe malnutrition (grade C). So the total number of malnourished patients were 25 (52%).

POPF was seen in 8 patients (33.33%) in the grade A group, 16 patients (80%) in the grade B group, and 5 patients (100%) in the grade C group. This difference was statistically significant (p = 0.001). Clinically relevant POPF was seen in 3 patients (12.5%) in the grade A group, 4 patients (20%) in the grade B group, and 3 patients (60%) in the grade C group. This difference was not significant statistically. (p = 0.056). [Table 7]

There was no significant difference in the incidence of DGE, Post pancreatectomy hemorrhage, surgical site infections, length of stay and morbidity between both the groups. [Table 7] There was no difference in the incidence of minor and major complications between both the groups. [Table 8]

All four nutritional indices NRI, PNI, MUST and SGA were associated with overall increased post-operative complications in malnourished patients with p value of 0.0001. MUST being associated with more number of complications in the malnourished group followed by SGA, PNI and NRI. [Table 9]

Hepato biliarymalignancy

A total of 24 patients underwent surgery for hepatobiliarymalignancy during the study period. Out of them 10 were male patients and 14 were female. Eleven patients underwent hepatectomy (8 hepatocellular carcinoma, 3intra hepatic cholangiocarcinoma),1 patient underwent excision of extrahepatic bile duct and 12 patients underwent radical cholecystectomy. Total of 3 right hemihepatectomy,2 lefthemihepatectomy,1 left trisectionectomy, 2 left lateral segmentectomy, 2 non anatomical resection was done.

The comorbidities seen were Diabetes (5), hypertension (8), Cardiac (1) patient. Out of 24, 4 patients were smokers, 7 were alcoholic. Mortality is seen 1 out of the 24 patients (4%) during the 30 day follow up period. Cause of death was liver failure.

Morbidity

Total number of patients who had post-operative complications were 9/24 (37.5%). Total number of complications seen in above 24 patients were 17.

Post-operative liver failure was seen in 1 patient (4%). This was Grade C liver failure. Bile leak was observed in 4 patients (16 %). Ascites was seen in 1(4%) patient.

Surgical site infections were seen in 5 patients (20.83%). Cardiac complications were seen in 1 patients. Chest infection was seen in 4 patients. UTI seen in 1 patient

Nutritional status of patients was assessed preoperatively using 5 parameters i.e. NRI, PNI, Malnutrition Universal Screening Tool (MUST) and Subjective Global Assessment (SGA)

NRI

Out of 24 patients, 9 patients (37.5%%) were malnourished (NRI < 100). 15 patients (62.5%) were well-nourished NRI (>100).

There was no significant difference in Liver failure, bile leak, ascites, surgical site infections and mortality between the 2 groups. [Table 10]

Mean hospital stay was 19.36 days in the malnourished group (NRI<100), 16.54 days in the well-nourished (NRI>100) group. This difference was not statistically significant (p = 0.4216).

Prognostic nutrition index(PNI)

Out of 24 patients,11 patients (45.83%) were malnourished (PNI<50), 13 patients (54.16%) were well nourished had an (PNI >50).

There was no significant difference in General or specific complications between both the groups. [Table 12]

Mean hospital stay was 18.66 days in the malnourished group, 14.16 days in the other group. This difference was not statistically significant (p = 0.5360).

Malnutrition Universal Screening Tool (MUST):

As assessed by MUST, out of 24 patients in the study group, 17 (70.83%) were at low risk of malnutrition, 6 (25%) were at medium risk and 1 patient (4.16%) were at high risk of malnutrition. So 17(70.83%) patients were well nourished and 7(29.16%) were malnourished. [Table 13]

There was no significant difference in General or specific complications between both the groups. [Table 14] Mean hospital stay was 12.44 days in low risk group, 14.58 days in medium risk group, and 20.36 days in the high risk group. This difference was not statistically significant (p = 0.61).

SUBJECTIVE GLOBAL ASSESSMENT (SGA):

When assessed by SGA, out of 24 patients,15 patients (62.5%) were well nourished i.e. grade A, 7 patients (29.16%) had mild – moderate malnutrition (grade B), and 2 patients (8.33%) had severe malnutrition (grade C). So,15(62.5) patients were well nourished and 9(37.5) were malnourished.

There was no significant difference in General or specific complications between both the groups. [Table 16] Mean hospital stay was 9.66 days in grade A group, 16.35 days in grade B group, 18.28 days in the grade C group. This difference was not statistically significant. (p = 0.9126).

Although not significant SGA malnourished group had maximum number of complications. [Table 18]

Table 1: Difference in measures of nutritional status according to NRI

	Malnourished (NRI<100)(n=21)	Well nourished(NRI ≥ 100) (n=28)	p value
GENDER			
Male	10 (47.61)	13(46.4)	0.783
Female	11(52.38)	15(53.57)	0.972
AGE (median)	47 (43-50)	52 (49 -55)	0.653
BMI (median)	21	26.72	0.456
ADDICTION	8(38.09)	7(25.00)	0.592
COMORBIDITY			
DM	8(38.09)	5(17.85)	0.632
HTN	5(23.80)	6(21.42)	0.932
Cardiac	1(4.76)	1(3.57)	0.743
DURATION OF SURGERY (min)	280±30	320±30	0.823
BLOOD LOSS(ml)	120±30	100 ±20	0.654
MORTALITY	3(14.28)	1(3.57)	0.3006
MORBIDITY			
GENERAL			
Cardiac	1(4.76)	1(3.57)	0.578
Chest infection	2(9.52)	2(7.14)	0.852
UTI	0	3(10.71)	0.10

AKI	1(4.76)	0	0.465
SSI	4(19.04)	11(39.28)	0.2103
SPECIFIC			
CRPPOPF	4(19.04)	6(21.42)	1.000
DGE	8(38.09)	19(67.85)	0.0476
PPH	1(4.76)	0	0.2103

Table 2: Total number of complications between Malnourished (NRI< 100) and well nourished (NRI ≥ 100) patients

	Malnourished (NRI<100)(n=21)	Well-nourished(NRI≥ 100) (n=28)	p value
Minor complications(Clavien Dindo grade 1 and 2)	13(15.85)	31(37.80)	0.6379
Majorcomplications (Clavien Dindo grade 3 and above)	14(17.10)	24(29.26)	

Table 3: Difference in measures of nutritional status according to PNI

	Mall nourished (PNI<50) (n=24)	Well nourished (PNI>50) (n=25)	p value
GENDER			
Male	11(45.83)	12(48.00)	0.823
Female	14((58.33)	12(48.00)	0.578
AGE (median)	48 (44-51)	52 (49 -55)	0.753
BMI (median)	19.32	26.88	0.782
ADDICTION	9(37.5)	6(25.00)	0.592
COMORBIDITY			
DM	7(29.16)	6(24.00)	0.632
HTN	7(29.16)	4(16.00)	0.932
Cardiac	1(4.16)	1(4.00)	0.743
DURATION OF SURGERY (min)	270±30	300±30	0.823
BLOOD LOSS(ml)	110±40	120 ±30	0.654
MORTALITY	1(4.16)	3(12.00)	1.000
MORBIDITY			
GENERAL			
Cardiac	1(4.16)	1(4.00)	0.678
Chest infection	2(8.33)	2(8.00)	0.932
UTI	0	3(12)	0.08
AKI	1(4.16)	0	0.635
SSI	4(16.66)	11(44.00)	0.538
SPECIFIC			
CRPOPF	2(8.33)	8(32.00)	0.073
DGE	12(50.00)	15(60.00)	0.570
PPH	1(4.16)	0	1.000

Table 4: Total number of complications between Malnourished (PNI< 50) and Well nourished (PNI ≥ 50) patients

	Malnourished (37)	Well nourished(45)	p value
Minor complications(Clavien Dindo grade 1 and 2)	22(26.82)	24(29.26)	0.6572
Major complications(Clavien Dindo grade 3 and above)	15(18.29)	21(25.60)	

Table 5: Difference in measures of nutritional status according to MUST

	Mall nourished on MUST score(n=38)	Well-nourished on MUST score(n=11)	p value
GENDER			
Male	18(47.36)	5(45.45)	0.623
Female	20(52.66)	6(54.540	0.478
AGE (median)	48 (44-51)	52 (49 -55)	0.853
BMI (median)	21.55	28.32	0.582
ADDICTION	12(31.57)	3(27.27)	0.392
COMORBIDITY			
DM	9(23.68)	4(36.36)	0.232
HTN	8(21.05)	3(27.27)	0.132
Cardiac	1(2.63)	1(9.09)	0.083
DURATION OF SURGERY (min)	310±30	290±30	0.453
BLOOD LOSS(ml)	130±40	120 ±30	0.745
MORTALITY	4(10.52)	0	0.1456
MORBIDITY			
GENERAL			
Cardiac	1(2.63)	1(9.09)	0.578
Chest infection	1(2.63)	3(27.27)	0.432
UTI	1(2.63)	2(18.18)	0.165

AKI	1(2.63)	0	0.334
SSI	10(26.31)	5(45.45)	0.2587
SPECIFIC			
CRPOPF	7(18.42)	4(36.36)	0.800
DGE	20(52.63)	7(63.63)	0.137
PPH	1(2.63)	0	0.636

Table 6: Total number of complications between between well nourished (Low risk) and mal nourished (medium and high risk)

	Malnourished (57)	**Well nourished (35)**	**p value**
Minor complications (Clavien Dindo grade 1 and 2)	30(36.58)	14(17.07)	0.8141
Major complications(Clavien Dindo grade 3 and above)	27(32.92)	11(13.41)	

Table 7: Difference in measures of nutritional status according to SGA

	Mall nourished (SGA B,C)(n=24)	**Well nourished(SGA A) (25)**	**p value**
GENDER			
Male	12(50.0)	11(44.00)	0.782
Female	12(50.00)	14(56.00)	0.634
AGE (median)	45 (42-48)	52 (49 -55)	0.953
BMI (median)	21.22	26.64	0.262
ADDICTION	7(29.16)	10(40.00)	0.542
COMORBIDITY			
DM	5(20.83)	8(32.00)	0.752
HTN	4(16.66)	7(28.00)	0.832
Cardiac	1(4.16)	1(4.00)	0.783
DURATION OF SURGERY (min)	290±30	320±30	0.924
BLOOD LOSS(ml)	110±40	120 ±30	0.453
MORTALITY	0	4(16.00)	0.001
MORBIDITY			
GENERAL			
Cardiac	1(4.16)	1(4.00)	0.883
Chest infection	1(4.16)	3(12.00)	0.645
UTI	2(8.33)	1(4.00)	0.243
AKI	1(4.16)	0	0.543
SSI	9(37.5)	6(24.00)	0.689
SPECIFIC			
CRPF	7(29.16)	3(12.00)	0.056
DGE	17((70.83)	10(40.00)	0.570
PPH	1(4.16)	0	1.000

Table 8: Total number of complications between Well-nourished (SGA grade A) and Malnourished (SGA grade B and C)

	Malnourished (SGA B,C)(n=53)	**Well nourished (SGA A) (n=29)**	**p value**
Minor complications(Clavien Dindo grade 1 and 2)	28(34.14)	17(20.83)	0.6572
Major complications(Clavien Dindo grade 3 and above)	25(30.04)	12(14.63)	

Table 9: Total number of complications in malnourished and well nourished patients according to different nutritional indices

	Malnourished	**Wellnourished**	**p value**
NRI	27(37.92)	55(67.07)	**0.0001**
PNI	37(45.12)	45(54.87)	
MUST	57(69.57)	35(42.68)	
SGA	53(64.63)	29(35.36)	

Table 10: Difference in measures of nutritional status according to NRIin patients who underwent hepatobiliary surgery

	Mall nourished (n=9) NRI<100	**Well nourished (n=15) NRI>100**	**p value**
GENDER			
Male	4(44.44)	6(40.00)	0.847
Female	5(55.55)	9(60.00)	0.821
AGE (median)	62(58-66)	64(60-68)	0.284
BMI (median)	23.42	25.62	0.549
ADDICTION	6(66.66)	5(33.33)	0.753

COMORBIDITY			
DM	3(33.33)	2(13.33)	0.473
HTN	3(33.33)	5(33.33)	0.478
Cardiac	0	1(6.66)	0.852
DURATION OF SURGERY (min)	360 ± 40	340 ± 50	0.673
EXTENT OF SURGERY			
Limited < 3 segments	7(63.63)	11(73.33)	0.438
Complex > 3 segments	2(22.22)	4(26.66)	0.521
BLOOD LOSS(ml)	400 ± 50	420 ± 50	
MORTALITY	1(11.11)	0	0.375
MORBIDITY			
GENERAL			
Cardiac	1(11.11)	0	0.563
Chest infection	2(22.22)	2(13.33)	0.782
UTI	1(11.11)	0	0.245
SSI	3(33.33)	2(13.33)	0.326
SPECIFIC			
Liver failure	1(11.11)	0	0.375
Bile leak	2(22.22)	2(13.33)	0.615
Ascites	0	1(6.66)	1.000

Table 11: Total number of complications after hepatobiliary surgery between Malnourished (NRI< 100) and well nourished (NRI ≥ 100) patients

	Malnourished (10) NRI<100	**Well nourished (7) NRI>100**	**p value**
Minor complications(Clavien Dindo grade 1 and 2)	6(35.29)	5(29.41)	
Major complications(Clavien Dindo grade 3 and above)	4(23.52)	2(11.76)	1.000

Table 12: Difference in measures of nutritional status according to PNI in patients who underwent hepatobiliary surgery

	Mall nourished (n=11) PNI<50	**Well nourished (n=13) PNI>50**	**p value**
GENDER			
Male	5(45.45)	5(38.48)	0.478
Female	6(54.54)	8(61.53)	0.745
AGE (median)	60(56-64)	61(57-66)	0.684
BMI (median)	24.42	26.31	0.569
ADDICTION	6(54.54)	5(38.46)	0.353
COMORBIDITY			
DM	2(18.18)	3(23.07)	0.674
HTN	4(36.66))	6(46.15)	0.334
Cardiac	0	1(7.69)	0.756
DURATION OF SURGERY (min)	340 ± 50	350 ± 40	0.486
EXTENT OF SURGERY			
Limited < 3 segments	7(63.63)	11(84.61)	0.634
Complex > 3 segments	3(27.27)	3(23.07)	0.842
BLOOD LOSS(ml)	410 ± 40	450 ± 50	0.463
MORTALITY	1(9.09)	0	0.458
MORBIDITY			
GENERAL			
Cardiac	1(9.09)	0	0.654
Chest infection	3(27.27)	1(7.69)	0.982
UTI	1(9.09)	0	0.865
SSI	4(36.66)	1(7.69)	0.1421
SPECIFIC			
Liver failure	1(9.09)	0	0.428
Bile leak	2(18.18)	2(15.38)	1.000
Ascites	0	1(7.69)	1.000

Table 13: Comparison of incidence of specific complications between patients with Malnourished (PNI< 50) and well-nourished patients (PNI ≥ 50)

	Malnourished (n=12) PNI<50	**Well nourished (n=5) PNI>50**	**p value**
Minor complications (ClavienDindo grade 1 and 2)	8(47.05)	3(17.64)	1.000
Major complications (Clavien Dindo grade 3 and above)	4(23.52)	2(11.76)	

Table 14: Difference in measures of nutritional status according to MUST

	Mall nourished (n=7)	Well nourished (17)	p value
GENDER			
Male	3(42.85)	7(41.17)	0.784
Female	3(42.85)	11(64.70)	0.445
AGE (median)	61(57-65)	61(57-66)	0.592
BMI (median)	22.56	25.74	0.456
ADDICTION	3(42.85)	9(52.94)	0.378
COMORBIDITY			
DM	1(14.28)	4(23.52)	0.578
HTN	2(28.57)	8(47.05)	0.885
Cardiac	0	1(5.88)	0.687
DURATION OF SURGERY (min)	350 ± 40	380 ± 50	0.524
EXTENT OF SURGERY			
Limited < 3 segments	6(85.71)	12(70.58)	0.657
Complex > 3 segments	2(28.57)	4(33.33)	0.754
BLOOD LOSS(ml)	400 ± 50	450 ± 50	0.837
MORTALITY	1(14.28)	0	0.262
MORBIDITY			
GENERAL			
Cardiac	1(14.28)	0	0.654
Chest infection	3(42.85)	1(5.88)	0.237
UTI	1(14.28)	0	0.569
SSI	3(42.85)	2(11.76)	0.074
SPECIFIC			
Liver failure	1(14.28)	0	0.209
Bile leak	2(28.57)	2(11.76)	0.429
Ascites	0	1(5.88)	0.807

Table 15: Total number of complications between between well nourished (Low risk) and mal nourished (medium and high risk)

	Malnourished (n=7)	Wellnourished (n=17)	p value
Minor complications (Clavien Dindo grade 1 and 2)	7(41.17)	3(17.64)	0.6437
Major complications (Clavien Dindo grade 3 and above)	4(23.52)	3(17.64)	

Table 16: Difference in measures of nutritional status according to SGA

	Mall nourished (n=9)SGA B,C	Well nourished (n= 15) SGA A	p value
GENDER			
Male	3(33.33)	7(46.66)	0.843
Female	6(66.66)	8(53.33)	0.654
AGE (median)	60(56-64)	62(58-64)	0.397
BMI (median)	21.96	25.32	0.543
ADDICTION	4(44.44)	8(53.33)	0.698
COMORBIDITY			
DM	2(22.22)	3(20.00)	0.437
HTN	2(22.22)	8(53.33)	0.985
Cardiac	0	1(6.66)	0.574
DURATION OF SURGERY (min)	360 ± 40	370 ± 50	0.682
EXTENT OF SURGERY			
Limited < 3 segments	5(55.55)	13(86.66)	0.356
Complex > 3 segments	3(33.33)	3(20.00)	0.475
BLOOD LOSS(ml)	370 ± 50	400 ± 50	0.753
MORTALITY	1(11.11)	0	0.282
MORBIDITY			
GENERAL			
Cardiac	1(11.11)	0	0.549
Chest infection	3(33.33)	1(6.66)	0.386
UTI	1(14.28)	0	0.437
SSI	4(11.11)	1(6.66)	0.074
SPECIFIC			
Liver failure	1(11.11)	0	0.282
Bile leak	3(33.33)	1(6.66)	0.183
Ascites	1(11.11)	0	0.086

Table 17: Total number of complications between Well nourished (SGA grade A) and Malnourished (SGA grade B and C)

	Malnourished SGA grade B and C	Well nourished SGA grade A	p value
Minor complications(Clavien Dindo grade 1 and 2)	8(47.05)	3(17.64)	0.5147
Major complications(Clavien Dindo grade 3 and above)	6(35.29)	0	

Table 18: Total number of complications in malnourished and well nourished patients according to different nutritional indices

	Malnourished	Wellnourished	p value
NRI	10(58.82)	7(41.17)	**0**.4915
PNI	12(70.58)	5(29.4)	
MUST	11(64.70)	6(25.29)	
SGA	14(82.35)	3(42.68)	

DISCUSSION

Morbidity is still high after surgery for HPB malignancy. Prolonged ICU care increases hospital costs. If patients at high risk for complications can be identified pre operatively, resources can be allocated selectively to them, thus minimizing the health care costs. There were few studies specifically studying the effect of nutrition on post-operative outcomes following HPB surgery.

Malnutrition was seen in a high percentage of the patients undergoing surgery for pancreatic cancer in the present study. It ranged from 42.85% as estimated by NRI to 77.54% as estimated by MUST. The prevalence of malnutrition in various studies is summarized in Table 19.

All the four nutritional indices NRI, PNI, MUST and SGA were associated with poor post-operative outcomes after pancreatic surgery.

NRI is a commonly used parameter to assess nutritional status. When measured by NRI, 42.85% of the patients who underwent pancreatic surgery were malnourished. [Table 19] This was comparable to the study by Shinkawa et al.[17] NRI was not found to be a significant predictor of major and minor complications, POPF, clinically relevant POPF, PPH, mortality, SSI or length of hospital stay in the present study. However, patients with high NRI had a significantly lower incidence of DGE after pancreatic surgery. Shinkawa et al have found that NRI is an independent factor associated with the SSI. But a recent study conducted by P Probst et all,[19] found that NRI was not associated with poor post operative outcome after pancreatic surgery.

In our study, when estimated by PNI levels, 48.98% of the patients who underwent pancreatic surgery were malnourished. This was high as compared to study done by Kanda et all.[18] In our study, patients with low preoperative PNI did not have a higher incidence of post operative complications nor found to be associated with major or minor complications or mortality. This is contradictory to study done by Kanda at all who found that low PNI was associated with more post-operative complications.

MUST is a screening tool to assess nutritional status that has shown its strength across all healthcare settings including oncology.[7] It's a five step screening tool to identify patients who are malnourished and at risk of malnutrition. When assessed by MUST, 22.44% of our patients were at low risk for malnutrition, 24.48% were at medium risk and 53.06% were at high risk. In the study by La torre et al,[16] 17% were at low risk, 42% were at medium risk, 41% were at high risk.

In our study, incidence of post-operative complications, major and minor complications mortality and length of hospital stay was not significantly different among the three groups, implicating that MUST is not a good predictor of post-operative outcome. [Table 20] These findings were at par with the findings of study done by P Probst,[19] that MUST scoring is not a good predictor of post-operative outcome. But these results are contradictory with that of La torre et al,[16] who found MUST to be a good predictor or overall morbidity, mortality, SSI and length of hospital stay.[Table 21]

SGA is a well-established tool to assess nutritional status. Based on SGA, mild to moderate malnutrition (grade B) was seen in 40.82%, severe malnutrition (grade C) was seen in 10.2%. In the study by La torre et al,[16] 37% were SGA grade B, 15% were SGA grade C. [Table 22]

In the present study, POPF and mortality were significantly higher in malnourished patients but not associated with major or minor complications. These findings are consistent with the study by La torre et al,[16] which showed that SGA was predictive of overall morbidity, SSI and length of hospital stay. But contradictory to the findings of P probustetal,[19] which founded that SGA is not a good predictor of post-operative outcomes.

The main complications after hepatobiliary surgery were intractable ascites, bile leakage, intra-abdominal hemorrhage and liver failure. Numerous studiesfocused on the nutritional status of patients and found that complication III-V after hepatectomy was not only associated with liver function reserve, but also with nutritional status. Malnutrition was seen in a significant percentage of the patient's undergoing surgery for hepatobiliary cancer in the

present study. It ranged from 29 % as estimated by MUST to 43.83% as estimated by PNI. [Table 23]

All four nutritional indices NRI, PNI, MUST and SGA were not associated with significant post-operative complications.

NRI is a commonly used parameter to assess nutritional status. When measured by NRI, 37.5% of the patients in the present study were malnourished. NRI was not found to be a significant predictor of post-operative complications nor major or minor complications, liver failure, bile leak, ascites, mortality, SSI or length of hospital stay in the present study.

In our study, when estimated by PNI levels, 43.83% of the patients were malnourished These patients with low preoperative PNI did not have a higher incidence of post-operative complications major or minor complications and mortality which is contrary to the study conducted by Mengyum at all,[20] where incidence of malnutrition was 29.95% and post-operative complications are more in patients with low PNI.

When assessed by MUST, 70.83% of our patients were at low risk for malnutrition, 25% were at medium risk and 4.16% were at high risk. MUST was not found to be a significant predictor of post-operative complications major or minor complications, liver failure, bileleak, ascites, mortality, SSI or length of hospital stay in the present study implicating that MUST is not a good predictor of post-operative outcome.

Based on SGA, prevalence of malnutrition was 37.5 % in the present study. Tzu hao hang at al,[21] found a prevalence of 33.4% malnutrition in patients who underwent hepatectomy for hepatocellular carcinoma. In their study,[21] patients with malnutrition had higher frequency of post-operative complications and longer hospital stay which is contrary to our study.

The limitations of study were limited sample size, simplifications of malnutrition to achieve homogeneity and there was no survival analysis.

Table 19: Prevalence of malnutrition in patients who underwent pancreatic surgery

	NRI	PNI	MUST	SGA
La Torre et al(16)	-	-	89%	52%
Shinkawa et al(17)	43.75%	-	-	-
Kanda et al (18)	-	27.6 %	--	-
Present study	42.85%	48.98%	77.54%	51.02%

Table 20: Prevalence of malnutrition in patients who underwent pancreatic surgery as defined by Malnutrition Universal Screening Tool (MUST)

	Low risk	Medium Risk	High risk
La torre et al(16)	12%	34%	54%
Present study	22.44%	24.48%	53.06%

Table 21: Comparison of outcomes among groups classified according to MUST

		Low	Medium	High	P-value
Mortality (number)	La torre etal(16)	0	3	5	0.001
	Present Study	0	0	4	0.1456
SSI (%)	La torre et al(16)	10	35.7	53.3	0.001
	Present Study	54.54	41.66	26.92	0.2587
Length of Stay (days)	La torre et al(16)	9	21	35	0.001
	Present study	12.18	11.58	10.65	0.5160

Table 22: Prevalence of malnutrition in patients who underwent pancreatic surgery as assessed by Subjective Global Assessment (SGA)

	Grade A	Grade B	Grade C
La torre et al (16)	48%	37%	15%
Present study	48.98%	40.82%	10.2%

Table 23: Prevalence of malnutrition in patients who underwent liver resection

	NRI	PNI	MUST	SGA
Present study	37.5%	43.83%	29%	38.19%

CONCLUSION

This prospective observational study assessed the prevalence of malnutrition in patients undergoing HPB surgery for malignancy and the impact of pre-operative malnutrition as assessed by various parameters on the early post-operative outcomes.

The following conclusions can be drawn from this study:

In patients undergoing pancreatic surgery for malignancy

1. Malnutrition identified by nutritional indices NRI, PNI, MUST and SGA were associated with increased postoperative complications.
2. MUST was associated with most post-operative complications.

3. Subjective Global Assessment(B&C) patientswere associated with increased risk postoperative pancreatic fistula and mortality.

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