Original Article

Association between Preoperative Nutritional Status and Surgical Outcome in Digestive System Cancer Patients

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Background: Malnourished patients are less likely to tolerate surgical procedures and tend to have more serious postoperative complications.

Objective: The present study is to determine the association between preoperative nutritional status and surgical outcome in digestive system cancer patients.

Materials and Methods: Retrospective cohort of digestive system cancer patients had undergone surgery between December 2018 and July 2019 in Ramathibodi Hospital and Buriram Hospital. The patients were classified into three groups according to Nutrition Alert Form (NAF): NAF A, NAF B, and NAF C. Postoperative complications were recorded.

Results: 126 patients were classified to NAF A 68 patients, NAF B 45 patients, and NAF C 13 patients. According to Clavien-Dindo system, postoperative complications were classified to grade I 6 patients (NAF A=4, NAF B=0, NAF C=2), grade II 26 patients (NAF A=10, NAF B=13, NAF C=3), grade IIIa 4 patients (NAF A=2, NAF B=2, NAF C=0), grade IIIb 5 patients (NAF A=2, NAF B=3, NAF C=0), grade IVa no patients (NAF A=0, NAF B=0, NAF C=0), grade IVb 1 patient (NAF A=1, NAF B=0, NAF C=0), and grade V 1 patient (NAF A=0, NAF B=0, NAF C=1). There are no significant difference between re-admission rate and ICU stay (p=0.18, p=0.195, respectively). The length of hospital stay in patients who were classified into NAF C is longer than the other groups.

Conclusion: There is no statistically significant difference between preoperative nutritional status classified by NAF and surgical outcomes in digestive system cancer patients.

Keywords: Nutrition alert form; Malnutrition; Digestive system cancer; Postoperative complication

J Med Assoc Thai 2021;104(Suppl.5): S42-7
Website: http://www.jmatonline.com

The incidence of malnutrition in cancer patients ranges from 40% to 80%. The risk of malnutrition increases 8-fold or as much as 16-fold when tumor located in the upper gastrointestinal tract. Malnourished patients are less likely to tolerate major surgical procedures, radiotherapy, and chemotherapy. They are likely to have more serious postoperative complications (i.e. wound dehiscence from poor wound healing and surgical site infection), increase length of hospital stay, decrease quality of life and survival[1-5]. Gastrointestinal tract can be divided into two main parts: the upper and the lower gastrointestinal tract. The primary functions of the upper gastrointestinal tract are enzymatic digestion, absorption of nutrients, and protection against external environment. The primary function of lower gastrointestinal tract is to dehydrate and store fecal material[6]. In the present study, the upper and lower gastrointestinal tract are divided by its function. The upper gastrointestinal tract consists of esophagus, stomach, and small intestine. The lower gastrointestinal tract starts from cecum to anus.

Clavien-Dindo system which is widely used to classify postoperative complication, originally described in 2004.

This classification is based on the therapy used to treat the complication. The Clavien-Dindo classification consisted of 7 severity grades, including 2 subgroups for grades III and IV. Grade I complication was defined as any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic, and radiological intervention. Grade II complication was defined as complication requiring pharmacological treatment with drugs other than such allowed for grade I complication. Grade III complication was defined as complications requiring intervention. It was subdivided into grade IIIa and grade IIIb depending on the need for general anesthesia. Grade IV complication was defined as life-threatening complication (including central nervous system complication) required

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How to cite this article:
Palitnonkiat V, Supsamutchai C, Thampongsa T, Wilasrusmee C, Choikrua P, Rakchob T, Seehawong U. Association between Preoperative Nutritional Status and Surgical Outcome in Digestive System Cancer Patients. J Med Assoc Thai 2021;104 (Suppl.5): S42-7
doi.org/10.35755/jmedassocthai.2021.S05.00070

intermediate care or ICU management. It was subdivided into grade IVa and IVb depending on the number of organ involvement. Grade V complication was defined as the death of a patient. In this paper, postoperative complications were divided into major and minor subgroup depending on the need for general anesthesia[7]. The major complications composed of Clavien-Dindo grade IIIb, IVa, IVb, and V. The minor one composed of Clavien-Dindo grade I, II, and IIIa.

Recently, many nutritional risk assessment systems have been developed, however no nutritional screening tool can provides satisfactory results in identifying nutritional risk of patients who have digestive system cancer. Nutrition Alert form (NAF) contains eight sections: height, weight and body mass index, body build, weight change, dietary intake change, gastrointestinal symptoms, functional capacity and patient's disease. NAF was modified from the original version of Subjective Global Assessment (SGA) by adding albumin level and total lymphocyte count for patient whose weight was not be taken. It is well-known and used for screening of malnutrition in hospitalised Thai patient and in cancer patient receiving radiotherapy because it is concise and simple tool[8,9]. By assessing the nutritional status at the early phase and correcting nutrient depletions before the patients had undergone surgery, it could reduce or virtually eliminate nutrition-related morbidity and mortality.

The aim of this study is first to determine the association between preoperative nutritional status and surgical outcome in digestive system cancer patients so that preoperative intervention may be performed to minimized the development of postoperative morbidity in the malnourished patients. The secondary objective is to determine the predictive value of NAF system in digestive surgery.

The present study was approved by ethics committee, Faculty of Medicine Ramathibodi Hospital, Mahidol University (No. MURA2021/176).

Materials and Methods

This is a retrospective study of digestive system cancer patients who had undergone surgery between December 2018 to July 2019 in two tertiary Thailand hospitals, Ramathibodi Hospital and Buriram Hospital. The inclusion criteria were patients' age between 18 to 80 years old, ASA classification 1 to 3, and elective digestive system cancer surgery either curative or palliative treatment. The exclusion criteria were patients who had treatment history of other cancers, synchronous tumors, recurrence of tumor, and the intraoperative findings of peritoneal metastasis (Figure 1).

In this study, the patients were classified into three groups according to Nutrition Alert Form (NAF): Group 1 NAF A (normal-mild malnutrition), defined as the sum of score 0 to 5 points. Group 2 NAF B (moderate malnutrition), defined as the sum of score 6 to 10 points. Group 3 NAF C (severe malnutrition), defines as the sum of score more than

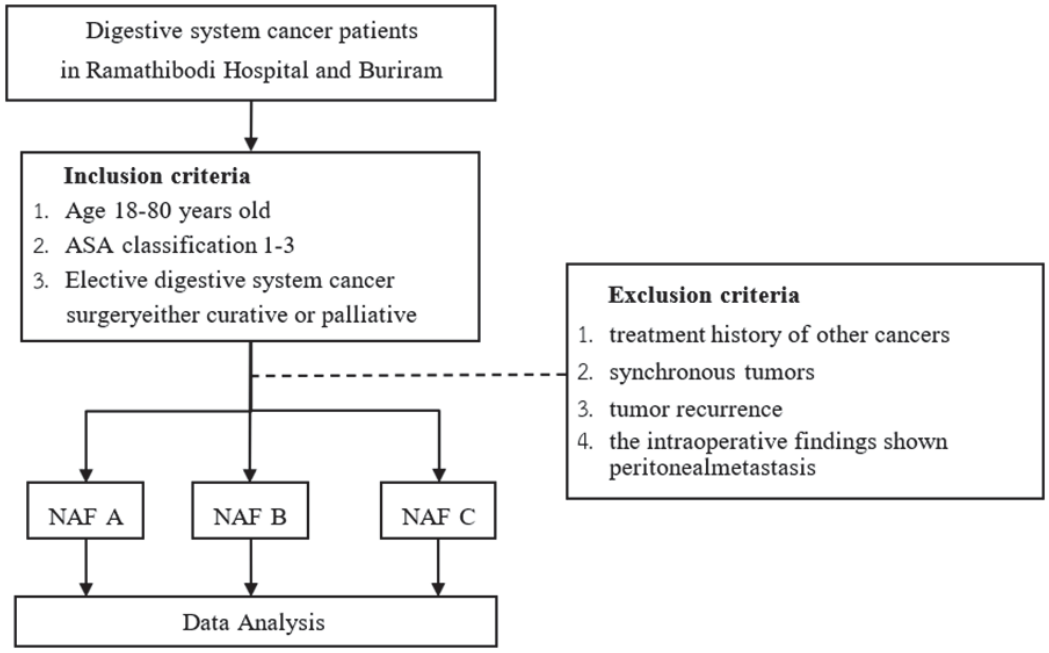

Figure 1. Protocol flow chart of the selection process of the study.

11 points[8]. Postoperative complications were reviewed and classified base on Clavien-Dindo classification.

Data collection included weight, serum albumin, ASA classification, operative site, operative procedures, pathology, ICU stay, length of hospital stay, and re-admission rate.

The association between preoperative nutritional status and surgical outcomes in digestive system cancer patients were analyzed. Catagorical and continuous data were reported as frequency with percentages and mean with standard deviation, respectively. ANOVA or Kruskal-Wallis test were applied to determine the association with p-value of <0.05 was considered significance. All data were analyzed with the statistical software "STATA" version 14.0 for window (StataCorp LLC, College Station, Texas, USA).

Results

One hundred and twenty-six patients were included. Sixty eight patients (male = 27, female = 41), 45 patients (male = 33, female = 12), and 13 patients (male = 9, female = 4) were classified as NAF A, B, and C, respectively. The body weight at 6 months before surgery, the day of admission, 1 month, and 3 months after surgery in NAF A were 59.27±9.90, 58.45±10.15, 55.17±9.53, and 56.83±9.77, respectively. The body weight of NAF B were 61.81±13.14, 61.22±12.13, 58.55±11.71, and 60±12, respectively. The body weight of NAF C were 60.62±15.44, 56.15±11.17, 56.50±9.26, and 55.53±9.65, respectively. The serum albumin at the day of admission, 1 month, and 3 months after surgery of NAF A were 35.20±4.37, 34.4±5.57, and 36.52±5.58, respectively. The serum albumin of NAF B were 36±5.26, 34.26±6.85, and 36.26±4.99, respectively. The serum albumin in NAF C were 31.50±5.95, 30.73±5.93, and 32.02±6.88, respectively. In NAF A, there were 5, 37, and 26 patients in ASA classification I, II, and III, respectively. In NAF B, there were 1, 19, and 25 patients in ASA classification I, II, and III, respectively. In NAF C, there were 0, 8, and 5 patients in ASA classification I, II, and III, respectively (Table 1).

In NAF A, operation site consisted of stomach operation, small bowel operation, colon, and rectum operations in 6, 3, 20, and 39 patients, respectively. In NAF B, operation site consisted of esophagus, stomach, colon, and rectum operations in 1, 3, 26, and 15 patients, respectively. In NAF C, operation site consisted of stomach, colon, and rectum operations in 5, 3, and 5 patients, respectively (Table 2).

Grade I, Clavien-Dindo postoperative complications were found in 4 and 2 patients of NAF A and NAF C, respectively. Grade II were found in 10, 13, and 3 patients of NAF A, B, and C, respectively. Grade IIIa were found in 2 and 2 patients of NAF A and B, respectively. Grade IIIb were found in 2 and 3 patients of NAF A and B, respectively. There was no patient in this Grade IVa. There were 1

Table 1. Baseline patient characteristic

	Nutrition Alert Form				p-value
	NAF A n=68	NAF B n=45	NAF C n=13	Total n=126	
Age: median (range)	61.5 (53.5 to 71)	67 (60 to 72)	70 (58 to 77)	65 (56 to 72)	0.101
Gender: n (%)					
Male	27 (39.71)	33 (73.33)	9 (69.23)	69 (54.76)	0.001*
Female	41 (60.29)	12 (26.67)	4 (30.77)	57 (45.24)	
Weight 6 month before surgery: mean±SD	59.27±9.90	61.81±13.14	60.62±15.44	60.32±11.73	0.532
Weight: mean±SD	58.45±10.15	61.22±12.13	56.50±9.26	59.20±11.03	0.247
Weight 1 month after surgery: mean±SD	55.17±9.53	58.55±11.71	56.50±9.26	56.48±10.36	0.248
Weight 3 month after surgery: mean±SD	56.83±9.77	60.00±12.00	55.53±9.65	57.80±10.65	0.262
Albumin at admission: mean±SD	35.20±4.37	36.00±5.26	31.50±5.95	35.15±4.97	0.026*
Albumin 1 month after surgery: mean±SD	34.40±5.75	34.26±6.85	30.73±5.93	33.97±6.25	0.261
Albumin 3 month after surgery: mean±SD	36.52±5.58	36.26±4.99	32.02±6.88	35.93±5.58	0.108
Underlying disease: n (%)					
No	31 (45.59)	13 (28.89)	2 (15.38)	46 (36.51)	0.055
Yes	37 (54.41)	32 (71.11)	11 (84.62)	80 (63.49)	
ASA classification: n (%)					
I	5 (7.35)	1 (2.22)	0	6 (4.72)	0.262
II	37 (54.41)	19 (42.22)	8 (61.54)	64 (50.79)	
III	26 (38.24)	25 (55.56)	5 (38.46)	56 (44.44)	

Table 2. Operative data

	NAF A n=68	NAF B n=45	NAF C n=13	Total n=126	p-value
Operation site: n (%)					
Esophagus	0	1 (2.22)	0	1 (0.79)	0.002*
Stomach	6 (8.82)	3 (6.67)	5 (38.46)	14 (11.11)	
Small bowel	3 (4.41)	0	0	3 (2.38)	
Colon	20 (29.41)	26 (57.78)	3 (23.08)	49 (38.89)	
Rectum	39 (57.35)	15 (33.33)	5 (38.46)	59 (46.83)	
Operation					
Gastrectomy (total/partial)	6 (8.82)	5 (11.11)	5 (38.46)	16 (12.6)	0.012*
Segmental small bowel resection	3 (4.41)	0	0	3 (2.36)	0.478
Right hemicolectomy	8 (11.76)	3 (6.67)	1 (7.69)	12 (9.52)	0.814
Extended right hemicolectomy	5 (7.35)	6 (13.33)	1 (7.69)	12 (9.52)	0.618
Left hemicolectomy	4 (5.88)	3 (6.67)	0	7 (5.51)	0.999
Sigmoidectomy	3 (4.41)	9 (20)	0	12 (9.52)	0.019*
Subtotal colectomy	0	1 (2.22)	1 (7.69)	2 (1.59)	0.084
Anterior resection	6 (8.82)	5 (11.11)	0	11 (8.73)	0.655
Low anterior resection	24 (35.29)	10 (22.22)	3 (23.08)	37 (29.37)	0.303
Abdominoperineal resection	10 (14.71)	3 (6.67)	2 (15.38)	15 (11.90)	0.377
Other	1 (1.47)	0	0	1 (0.79)	0.999
Open/Laparoscopy					
Open	45 (66.18)	38 (84.44)	10 (76.92)	93 (73.81)	0.092
Laparoscopy	23 (33.82)	7 (15.56)	3 (23.08)	33 (26.19)	
Pathology: n (%)					
Adenocarcinoma	60 (88.24)	44 (97.78)	12 (92.31)	116 (92.06)	0.159
Lymphoma	0	1 (2.22)	2 (15.38)	3 (2.38)	0.012*
GIST	6 (8.82)	0	0	6 (4.72)	0.089
Other	2 (2.94)	0	0	2 (1.59)	0.611

NAF A and 1 NAF C patients in Grade IVb and Grade V, respectively (Table 3).

There was no significant association between postoperative complications classified by Clavien-Dindo and perioperative nutritional status classified by NAF (p=0.089).

All patients in this study did not need ICU stay. The length of hospital stay in NAF A, B, and C were 8 days (6 to 12 days), 8 days (7 to 13 days), and 13 days (9 to 27 days), respectively (p=0.144) (Table 3). The re-admission rate in NAF A, B, and C were 3 (4.48%), 1 (2.22%), and 2 (15.38%) patients, respectively (p=0.1080) (Table 3).

Discussion

In this study, the cohort of 126 patients who had undergone digestive system cancer surgery from 2 large tertiary care hospitals in capital and major city of Thailand were analyzed. These patients were classified in three group according to their preoperative nutritional status based on Nutritional Alert Form (NAF) which was published as simple malnutrition tool for Thai people[8]. The postoperative complications were recorded and classified using Clavien-Dindo system. The results showed that no statistically significant difference between preoperative nutritional status classified by NAF and surgical outcomes in digestive system cancer patients. There were also no significant difference in re-admission rate and ICU stay. The length of hospital stay in patients who were classified into NAF C was longer than the other groups (NAF A=8 days, NAF B=8 days, NAF C=13 days) without statistically difference. This seems to have negative results, the nutritional evaluation scoring system using Nutrition Alert Form (NAF) may not appropriate for digestive system cancer surgery patients.

The patient-generated-subjective global assessment (PG-SGA) was adapted from the Subjective Global Assessment (SGA) and developed specifically for patients with cancer[10]. It includes additional questions regarding the presence of nutritional symptoms and short-term weight loss. For each component of the scored PG-SGA, points (0

Table 3. Association between postoperative complications classified by Clavien-Dindo and preoperative nutritional status classified by NAF

	Nutrition Alert form				p-value
	NAF A n=68	NAF B n=45	NAF C n=13	Total n=126	
Length of hospital stay (days): median (range)	8 (6 to 12)	8 (7 to 13)	13 (9 to 27)	9 (7 to 13)	0.144
ICU stay (days): median (range)	0	0	0	0	0.195
Re-operation: n (%)					
No	64 (94.12)	42 (93.33)	13 (100)	119 (94.44)	0.999
Abdominal toilet/open drainage	1 (1.47)	1 (2.22)	0	2 (1.59)	0.999
Re-anastomosis	3 (4.41)	0	0	3 (2.38)	0.478
Hartmann's/diversion	1 (1.47)	1 (2.22)	0	2 (1.59)	0.999
Internal bypass	0	1 (2.22)	0	1 (0.79)	0.460
Re-admission: n (%)	3 (4.48)	1 (2.22)	2 (15.38)	6 (4.80)	0.180
Postopeartive complication (clavien-dindo classification): n (%)					
No operative complication	49 (72.06)	27 (60)	7 (53.85)	83 (65.87)	0.089
I	4 (5.88)	0	2 (15.38)	6 (4.76)	
II	10 (14.71)	13 (28.89)	3 (23.08)	26 (20.63)	
IIIa	2 (2.94)	2 (4.44)	0	4 (3.17)	
IIIb	2 (2.94)	3 (6.67)	0	5 (3.97)	
IVa	0	0	0	0	
IVb	1 (1.47)	0	0	1 (0.79)	
V	0	0	1 (7.69)	1 (0.79)	
Postoperative complication: n (%)					
No complication	49 (72.06)	27 (60)	7 (53.85)	83 (65.87)	0.611
Minor complication	16 (23.53)	15 (33.33)	5 (38.46)	36 (28.57)	
Major complication	3 (4.41)	3 (6.67)	1 (7.69)	7 (5.56)	

to 4) are awarded depending on the impact of the symptom on nutritional status. A total score is then summed and this provides a guideline as to the level of nutrition intervention required, as well as facilitating quantitative outcome data collection[11]. The scored PG-SGA, unlike SGA, is continuous measure. The score typically ranged from 0 to 35, with a higher score reflecting a greater risk of malnutrition. A score ≥9 indicates a critical need for nutrition intervention. By providing early nutrition support, it may be possible to prevent or delay deterioration in the patient's nutritional status[12].

DeWys, et al reported that weight loss has been demonstrated to be a major prognostic indicator of poor survival in cancer patients[13]. In this study, the patient's body weight for each group that had been recorded 6 months before surgery, at the day of admission, 1 month, and 3 months after surgery are not statistical significance. This parameter do not associate with the result in the study and cannot be used for the single indicator to assess malnutrition and predict the postoperative outcome.

Malnourished patients had a significantly longer length of stay compared to well-nourished patient. There was a difference in the length of hospital stay of patients who were well-nourished compared to patients who were moderately or severely malnourished (NAF A=8 days, NAF B=8 days, NAF C=13 days). This fact is supported with the report from Naber, et al and Reilly, et al[14,15].

Limitation of this study is the patients in each sample groups are small and heterogeneous. As the results cannot be shown statistical significance.

The further study is needed to validate its sensitivity and specificity of NAF score to the cancer patients and compare with PS-SGA scoring system. The scored patient-generated-subjective global assessment (PS-SGA) has been accepted by the Oncology Nutrition Dietetic Practice Group of the American Dietetic Association as the standard for nutrition assessment for patients with cancer[12].

At present, preoperative nutrition assessment is

practical as we known the consequences of malnutrition that may include an increased risk of complications, decrease tolerance major surgical procedures, radiotherapy and chemotherapy, a lower quality of life, reduced survival and higher health-care cost[4,10,11].

Conclusion

In conclusion, there is no statistically significant difference between preoperative nutritional status and surgical outcome in digestive system cancer patients. The further study is needed to confirm the results of this study since the number of patients who join this study is not much enough to represent the digestive system cancer patients with malnutrition.

What is already known on this topic?

The incidence of malnutrition in cancer patients ranges from 40% to 80%. Malnourished patients are less likely to tolerate major surgical procedures, radiotherapy and chemotherapy and generally tend to have more serious postoperative complications from poor wound healing to infection and dehiscence, besides increasing length of hospital stay and decreasing survival and quality of life[1-5]. At present, no nutritional screening tool provides satisfactory results in identifying nutritional risk.

What this study adds?

There is no statistically significant difference between preoperative nutritional status and surgical outcome in digestive system cancer patients. As the nutritional evaluation scoring system using Nutrition Alert Form (NAF) do not specific for cancer patients, the further study is needed to validate its sensitivity and specificity of NAF score to the cancer patients and compare with PS-SGA scoring system.

Potential conflicts of interest

The authors declare no conflict of interest.

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