Original Article

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Nutrition Screening Tools and Prediction of Malnutrition Incidence in Major Abdominal Surgery Patients at a Tertiary Hospital in Bangkok, Thailand

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Abstract

Malnutrition appears to be a prevalent and largely unrecognized problem in hospitalized patients. The objectives of this study were; to screen for nutritional status of patients who underwent major abdominal surgery and to determine a relationship of nutritional status to health outcomes. Simple tools including subjective global assessment (SGA), body mass index (BMI), level of serum albumin (Alb) and total lymphocyte count (TLC) were used in the screening process. Prevalence of mal-nourished patients, length of hospital stay, and hospital cost were determined. Nutritional status of 300 patients underwent major abdominal surgery at Phramongkutklao Hospital were screened on admission and every seven days during hospitalization until discharge. Results showed that 34 patients (11.4%) were mal-nourished when SGA was used, but there was 16 (5.4%), 44 (14.6%) and 72 patients (24%) mal-nourished, when BMI, Alb, and TLC were screening tool, respectively, with the positive predictive value to SGA at 20%, 18.2%, and 40%, respectively. Well nourished patients spent less time and cost (6.1 days, 52,023.70 Baht) in hospital than patients with malnutrition (17.5 days, 95,979.30 Baht), or severe malnourished (16.6 days, 85,461.10 Baht). It is concluded that screening with SGA is possible and nutritional status of patients is associated with length of hospital stay and hospital.

Keyword: Malnutrition, Nutritional status, Screening tools, Abdominal surgery

INTRODUCTION

Malnutrition appears to be a prevalent and largely unrecognized problem in hospitalized patients. Several studies have shown that the prevalence of malnutrition in hospitalized patients is high, ranging from 20% to 50%.[1-11] Malnutrition is associated with tissue and muscle wasting and organ function impairment which leads to increase in morbidity and longer period of hospital stay.[12] It has shown that muscle function is decreased by nutrition depletion as well[13]. Poor nutritional status can compromise the function of many organ systems, including heart, lungs, kidneys, and gastrointestinal tract.[14] Thus, mal-nourished patients may have high risk of developing complications during treatment.[14,15] As a consequence, morbidity, mortality, the length of hospital stay and hospital cost are increased. Hence, the nutritional status should be screened so that patients who are at risk of malnourished will be discovered early and nutrition support could be provided as soon as possible.

Patients who undergo abdominal surgery are naturally at risk of malnutrition due to long periods of starvation before and after surgery, stress of surgery and increase in metabolic rate after surgery. Patients with preoperative malnutrition are significantly at higher risk of postoperative complications and death than those who are well nourished prior to surgery. Impaired immune function may also occur and lead to increase in infection risk. From previous studies, the prevalence

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of malnutrition in surgical patients has been reported to be in the range of 40%-65%.[2,16-19] This percentage seems to be unchanged over time and remains problematic until now. However, nutritional screening of patients at risk of malnutrition was not routinely conducted in many hospitals. It was therefore believed that malnutrition problem in hospital remained.

Many types of nutritional assessment tools were used in several studies to assess nutritional status of hospitalized patients.[20-24] They were; body mass index, functional test, laboratory parameters such as serum albumin, serum transferrin, serum creatinine, and immune competence.[25] The Subjective Global Assessment (SGA), developed by Detsky et al, is suggested as another tool to screen nutritional status.[20] It is composed of two parts. The first part included interviewing of weight change, change of dietary intake, presence of GI symptoms, and alteration of functional status. The second part included physical examination of subcutaneous loss of fat at triceps and chest, muscle wasting at deltoid and quadriceps, ascites at abdomen, and edema at ankle/sacral. In Thailand, reports of prevalence of malnourished patients in hospital using SGA were 39.07% to 40%.[26,27-28] However, nutritional status was still not routinely monitoring in hospital of Thailand. This study was therefore, conducted with the objectives to bring routine measures including body mass index, serum albumin level, and total lymphocyte count to be used as nutritional screening tools and compared to SGA. In addition, incidence of malnutrition, length of hospital stay and hospital cost were determined.

METHODS

Study design

This was a prospective-observational study approved by the Committee on Human Rights Related to Research Involving Human Subjects, Mahidol University Institutional Review Board (MU- IRB), and the Royal Thai Army Medical Institutional Review Board.

Study population

The study included adult patients aged 18 years or older, who were admitted into Phramongkutklao Hospital for more than 48 hours, and planned for elective major abdominal surgery during June 2009 to May 2011. Surgical patients who were coma, mental disable, unable to communicate in Thai language, unable to stand for weight determination, and having hearing loss, were excluded. Those who underwent emergency operations before nutrition screening, or appendectomy or hernia repair were also excluded. The enrolled patients who were discharged from the hospital, moved to ICU, passed away within 48 hours after admission, or refused to continue in the study were dropped-out. All participants gave informed consent before enrolling into the study.

Data collection

Nutritional status of patients were screened by four methods, i.e., subjective global assessment (SGA), body mass index (BMI), serum albumin level (Alb), and total lymphocyte count (TLC). The screening was conducted within 48 hours of admission (before surgery) and every seven days after surgery until discharge.

SGA was conducted by interviewing and observing patients according to the application guidelines.[29] Data of physical examination for loss of subcutaneous fat at triceps and chest, muscle wasting at deltoid and quadriceps, ascites, ankle edema, and sacral edema were collected from the inpatients' charts. In case of no physicians' note, patients were observed for muscle loss at shoulder, chest, arm, and thigh, and the swelling of abdomen and ankle. Data from the SGA questionnaire was summarized into one of three classes; A-well nourishment, B-moderate malnutrition and C-severe malnutrition.[20,29]

Patient's weight and height were measured using the bathroom scale and stadiometer, respectively. If the measurement is not possible, the patient's weight and height recently reported in OPD cards were collected. Weight and height of patients were used to calculate for body mass index (BMI).[30] The value of 18.5-24.99 kg/m^2 was the normal range and the lower value was recognized as malnutrition.

Serum albumin level (Alb) was collected from the inpatient's charts. A level of less than 3.5 g/dL was recognized as malnutrition. Total lymphocyte count (TLC)[31] were obtained from inpatient's charts. A level of less than 1,500 cells/mm^3 was recognized as malnutrition. Data of nutrition support by either enteral or parenteral route were collected daily from the inpatient charts. Length of hospital stay (LOS) and total hospital cost were obtained from the inpatient charts and the Financial Department, respectively.

Accuracy of nutrition screening tools

SGA was normally used as gold standard for screening nutritional status of patients, therefore, it was set as reference in comparison of accuracy to BMI, Alb, and TLC. Accuracy was determined as positive and negative predictive value. Malnutrition determined by BMI, Alb, and TLC that were in accordance to SGA was recognized as positive predictive value. Well-nourished patients by BMI, Alb, and TLC, when compared SGA, were recognized as negative predictive value. In addition, BMI, Alb, TLC were analyzed for its sensitivity and specificity to determine malnutrition status.

Data analysis

Data were analyzed using SPSS version 17.0. Demographics and nutritional status of patients were presented by descriptive statistics, as frequencies or as mean ± standard deviations. Difference in body weight, BMI, Alb, and TLC between well-nourished and mal-nourished patients were analyzed by Mann-Whitney U test.

RESULT AND DISCUSSION

Demographic data

A total of 300 patients were included. Their demographic data were presented in Table 1. Half were male patients. The average age, weight, and height was 60 ± 14.7 years, 63.8 ± 13.1 kg, and 161.9 ± 8.5 cm, respectively. Patients had average BMI of 24.3 ± 4.4 kg/m^2, Alb 4.1 ± 0.6 g/dL, TLC 2,071.7 ±781.1 cells/mm^3. The average length of hospital stay (LOS) was 7.4 ± 6.1 days.

Comparison of screening tools for nutritional status

On admission (Table 2), 5.4%, 14.6%, 24%, and 11.4% of patients were found to be mal-nourished according to BMI, Alb, TLC, and SGA, respectively. The incidence was lower than a previous study at Ramathibodi Hospital.[27] This was likely to be due to the fact that all patients of the present study came to hospital for surgery and had good or almost good health status as a pre-requisite of surgery. However, difference was found in incidence of malnutrition at discharge; SGA revealed less number of mal-nourished patients at discharge (7.7%). This was in contrast to those found with BMI, Alb, and TLC, which showed more patients with malnutrition. It could be due to the fact that patients were ill with the diseases such as cancer that impaired BMI, Alb and TLC.

Cancer and non-cancer patients

Number of patients with or without cancer whose nutritional status classified by BMI, Alb, TLC, and SGA on admission and at discharge were presented in Table 3. All screening tools revealed that more cancer patients were malnourished, compared to non-cancer patients. At discharge, TLC revealed much more cancer patients (24.4%) with severe malnutrition compared to the admission time (4.2%). BMI and Alb revealed similar trend of each nutritional status in patients with cancer and non-cancer at both admission and discharge. This is not surprised as cancer is a well-known disease that caused muscle wasting, impaired immune function, and malnutrition.[32]

Table 1. Demographic data of 300 patients at surgical ward

Characteristics	n (%)	mean ± SD
Sex		
Male 154 (51.3)	-	
Female	146 (48.7)	-
Age (years)		60 ± 14.7
18 - 40 years	34 (11.3)	
41 - 60 years	114 (38.0)	
61 - 80 years	132 (44.0)	
More than 80 years	20 (6.7)	
Weight (kg)		63.8 ± 13.1
Height (cm)		161.9 ± 8.5
Body mass index (kg/m2)		24.3 ± 4.4
	< 18	12 (4.0)
	18-23	112 (37.3)
	>23	176 (58.7)
Serum albumin (g/dL)		4.1 ± 0.6
Total lymphocyte count (cells/mm^3)		2,071.7 ± 781.1
Length of hospital stay (day)		7.4 ± 6.1

Table 2. Nutritional status of 300 patients, screened by body mass index (BMI), serum albumin level (Alb), total lymphocyte count (TLC), and subjective global assessment (SGA)

Parameter/ nutritional status	Number of patients (%)	
	at admission	at discharge
BMI (kg/m2)		
> 40 (obesity level 3)	1 (0.3)	1 (0.3)
30 - 39.99 (obesity level 2)	27 (9.0)	27 (9.0)
25 - 29.99 (obesity level 1)	77 (25.7)	75 (25.0)
18.5 - 24.99 (normal)	179 (59.7)	179 (59.7)
17 - 18.49 (mild malnutrition)	11 (3.7)	13 (4.3)
16 - 16.99 (moderate malnutrition)	3 (1.0)	4 (1.3)
< 16 (severe malnutrition)	2 (0.7)	1 (0.3)
Alb (g/dL)		
> 3.5 (normal)	256 (85.3)	211 (70.0)
2.8 - 3.5 (mild malnutrition)	34 (11.3)	67 (22.3)
2.1 - 2.8 (moderate malnutrition)	10 (3.3)	19 (6.3)
< 2.1 (severe malnutrition)	-	3 (1.0)
TLC (cells/mm3)		
> 1,500 (normal)	228 (76.0)	194 (64.7)
1,200 - 1,500 (mild malnutrition)	39 (13.0)	35 (11.7)
800 - 1,200 (moderate malnutrition)	21 (7.0)	38 (12.7)
< 800 (severe malnutrition)	12 (4.0)	33 (11.0)
SGA		
A (well nourished)	266 (88.7)	277 (92.3)
B (moderate malnutrition)	29 (9.7)	21 (7.0)
C (severe malnutrition)	5 (1.7)	2 (0.7)

Table 3. Admission and discharged nutritional status determined by different screening tools in cancer and non-cancer patients

Nutritional status	Admission, n (%)		Discharged, n (%)	
	Cancer (n = 119)	Non cancer (n = 181)	Cancer (n = 119)	Non cancer (n = 181)
BMI (kg/m2)				
Obese	29 (24.4)	76 (42.0)	27 (22.7)	76 (42.0)
Well nourished	80 (67.2)	99 (54.7)	80 (67.2)	99 (54.7)
Mild to moderate malnutrition	8 (6.7)	6 (3.3)	11 (9.2)	6 (3.3)
Severe malnutrition	2 (1.7)	-	1 (0.8)	-
Alb (g/dL)				
Well nourished	87 (73.1)	169 (93.4)	54 (45.4)	157 (86.7)
Mild to moderate malnutrition	32 (26.9)	12 (6.6)	63 (52.9)	23 (12.7)
Severe malnutrition	-	-	2 (1.7)	1 (0.6)
TLC (cells/ mm3)				
Well nourished	77 (64.7)	151 (83.4)	44 (37.0)	150 (82.9)
Mild to moderate malnutrition	37 (31.1)	23 (12.7)	46 (38.6)	27 (14.9)
Severe malnutrition	5 (4.2)	7 (3.9)	29 (24.4)	4 (2.2)
SGA				
Well nourished	90 (75.6)	176 (97.2)	99 (83.2)	178 (98.3)
Moderate malnutrition	25 (21.0)	4 (2.2)	18 (15.1)	3 (1.7)
Severe malnutrition	4 (3.4)	1 (0.6)	2 (1.7)	-

BMI = Body mass index, Alb = Serum albumin level, TLC = Total lymphocyte count, and SGA = Subjective global assessment

Accuracy of nutrition screening tools

Results of BMI, Alb, and TLC were compared to SGA-assessed nutritional status to determine the accuracy in prediction of mal-nutrition (Table 4). Alb had highest value of sensitivity, BMI had highest value of specificity, and TLC had highest value of positive prediction. However, they all gave more than 90% specificity and nearly 90% negative predictive value.

Table 4. Accuracy of three nutrition screening tools estimated by sensitivity, specificity, positive predictive value, and negative predictive value

Nutrition screening tools	Sensitivity	Specificity	Positive prediction value	Negative prediction value
Body mass index	2.9%	98.5%	20.0%	88.8%
Serum albumin level	17.6%	89.8%	18.2%	89.5%
Total lymphocyte count	11.8%	97.7%	40.0%	89.7%

Although BMI had the highest specificity in this study, it had the lowest sensitivity. This is in accordance to previous report that BMI alone was not a sensitive parameter to determine nutritional status. It was further shown to be still high or normal in patients with ascites or edema.[33] This study showed the highest sensitivity of Alb to screen nutritional status but the lowest in specificity. Previous report claimed the same and proposed the relatively long half-life and correlation with stress and illness of Alb to be the explanation of its non-specific parameter of nutritional status.[33]

Change in nutritional status

Based on SGA classification, patients of SGA-A had higher body weight and BMI than other groups either on admission or at discharge, as shown in Table 5. Alb and TLC showed similar results but significant difference were found only between SGA-A and SGA-B (p-value < 0.05).

Among the four screening tools, only SGA could be determined at discharge. The change of nutritional status from admission to discharge was thus based on SGA. Most patients with well-nourished status from admission to discharge were recognized as normal group (88.7%), as shown in Table 6. Nearly seven percent had stable nutritional status, either SGA-B or SGA-C from admission to discharge and was recognized as maintained group. The rest (4.7%) had nutritional status at discharge better than on admission, either from SGA-B on admission to SGA-A at discharge or from SGA-C on admission to SGA-B at discharge. These patients were recognized as an improved group. Lowering in nutritional status along hospitalization, recognized as declined group was not observed in the study.

Table 5. Admission and discharged nutritional status determined by different screening tools in cancer and non-cancer patients

Characteristics	SGA-A (n = 266)	SGA-B (n = 29)	SGA-C (n = 5)
	Admission		
Body weight, kg	64.8 ± 13.3	57.5 ± 7.6[a]	48.2 ± 8.5[a,b]
Body Mass Index (kg/m^2)	24.8 ± 4.4	21.4 ± 2.1[a]	17.4 ± 2.1[a,b]
Serum albumin level (g/dL)	4.1 ± 0.6	3.6 ± 0.7[a]	4 ± 0.6
Total lymphocyte count (cells/ mm^3)	2,112.7 ± 776.4	1,720.4 ± 759.7[a]	1,930.7 ± 775.0
	Discharge		
Body weight, kg	64.4 ± 13.2	56.2 ± 8.9a	52 ± 8.5
Body Mass Index (kg/m2)	24.6 ± 4.4	20.7 ± 2.5a	19 ± 0.8a
Serum albumin level (g/dL)	4.1 ± 0.6	3.7 ± 0.8a	4 ± 0.3
Total lymphocyte count (cells/ mm3)	2,101.3 ± 775.3	1,696.6 ± 801.2a	1,919.3 ± 645.9

[a] significantly different from SGA A, p < 0.05 (Mann-Whitney U Test)
[b] significantly different from SGA B, p < 0.05 (Mann-Whitney U Test)
SGA-A = well nourished, SGA-B = mal-nourished, SGA-C = severe mal-nourished

Nutritional support

Among the 300 patients, only 51 (17%) received nutrition support. As shown in Table 6. All patients in "maintained" and "improved group" got nutritional support but only 17 (6.4%) of the normal group did.

Length of hospital stay and cost

It was found that patients who admitted to hospital with SGA-A status had the shortest length of hospital stay, compared to others (6.1 ± 4.2, 17.5 ± 9, and 16.6 ± 10.9 days in SGA-A, SGA-B, and in SGA-C group respectively). The same trend was found, i.e., the normal group SGA-A -- > A had shortest LOS (6.1 ± 4.2 days), followed by the maintained group (14.6 ± 9 days in SGA-B -- > B, and 9 ± 4.2 days in SGA-C -- > C), and the improved group (22.3 ± 7 days in SGA-B -- > A, and 21.7 ± 11.6 days in SGA C -- > B, no patients from SGA-C -- > A), as shown in Table 6.

Table 6. Nutrition support, length of hospital stay (LOS), and total hospital cost of patients with different nutritional status from admission to discharge

Nutritional status SGA-	Nutritional support	Usual diet	LOS (days)	Total hospital cost (Baht)
Normal group				
A → A	17 (5.7)	249 (83.0)	6.1 ± 4.2	52,023.70 ± 31,988.70
Maintained group				
B → B	18 (6.0)	-	14.6 ± 9.0	118,444.30 ± 45,025.60
C → C	2 (0.7)	-	9 ± 4.2	38,193.30 ± 3,540.90
Improved group				
B → A	11 (3.7)	-	22.3 ± 7.0	82,250.60 ± 41,293.20
C → B	3 (1.0)	-	21.7 ± 11.6	116,973.00 ± 70,916.60
C → A	-	-	-	-
Declined group				
A → B	-	-	-	-
A → C	-	-	-	-
B → C	-	-	-	-

SGA-A = well nourished, SGA-B = mal-nourished, SGA-C = severe mal-nourished

Total hospital cost was found to be the lowest in the normal group, followed by the maintained group and the improved group (Table 6). The cost of SGA-B (95,979.30 ± 46,467.90 Baht) group was approximately double of the SGA-A group (52,023.70 ± 31,988.70 Baht). Results of LOS and total hospital cost were similar to previous studies, although with different type of patients, medicine patients in the previous study but surgical ones in the present study.[27,34] Those studies also reported that LOS and hospital expense of those who could not maintain their nutritional status from the time of admission to discharge was doubled if decline over one level, and four times if decline over two levels.[34] If nutrition

support was started on the first day of detection of declining nutritional status, LOS and hospital expense were shortened from 19.5 days to 7.2 days and from US$ 2,691.74 to US$ 559.46, when compared to those receiving nutrition support at a later time.[34]

CONCLUSION

The study suggested the importance of nutritional status to be determined since admission so that early detection of malnutrition would result in prompt support of nutrition to patients and thus, better health outcomes could be achieved. SGA remains the gold standard to identify patients with malnutrition. Other simple tools including BMI, Alb, TLC were specific but not sensitive to predict malnutrition status. These simple tools were better to predict well nourished patients than malnutrition patients.

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