A Comparison of Nutritional Screening Tools in the Prediction of Post-Operative Infectious and Wound Complications in the Elderly Patients Undergoing Abdominal Operations

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Abstract

Objective : To compare four nutritional screening tools - the Short Form Mini Nutritional Assessment (MNA-SF), the Nutrition Risk Classification (NRC), the Malnutrition Screening Tool (MST), and the Nutrition Risk Score (NRS) - in the prediction of post-operative infectious and wound complications in elderly patients undergoing abdominal surgery.

Patients and Method : During the nine-month period from April 2002 to December 2002 nutritional screening was performed on 190 patients aged 60 years or over who underwent major abdominal surgery. Each patient was classified as either at risk or not at risk of malnutrition. This classification, for each screening tool, was tested for association with the occurrence of post-operative infectious and wound complications. Each screening tool was calculated and compared under the area of Receiver Operating Characteristic (ROC) curve.

Result and Conclusion : The NRC classification was the best prediction for the occurrence of post-operative infectious and wound complications in elderly surgical patients.

Key word : Malnutrition, Nutrition Screening Tools, Serum Albumin, Postoperative Infectious, Wound Complications

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Malnutrition is one of the most common important risk factors for post-operative infectious and wound complications in surgical patients regardless of age[1-3]. Elderly surgical patients are also at higher risk for infectious and wound complications [3,4]. As a relatively high proportion of elderly surgical patients is malnourished[4,5], their risk of post-operative complications is compounded by both age

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and nutrition-related effects. In this latter group of patients screening for nutritional status should be performed[4,5]. The administrative pre-operative nutritional support to the elderly malnourished surgical patients evaluated to reduce post-operative complications[2].

Recently the screening tools Mini Nutritional Assessment (MNA)[5] and its simplified version, the Short Form Mini Nutritional Assessment (MNA-SF) [6] were developed for assessing nutritional status in the elderly population. Both tools have been validated in terms of agreement with expert opinion, biochemical and anthropometry measurements, and in terms of the ability to predict the length of hospital stay. Similarly, their reliability has also been confirmed[4-6]. The objective of this study was to assess the association between pre-operative malnutrition status as identified by the MNA-SF and post-operative infectious and wound complications in elderly surgical patients, and to compare this association with that of three other recent but more general nutritional screening tools, namely the Nutrition Risk Classification (NRC)[7], the Malnutrition Screening Tool (MST)[8], and the Nutrition Risk Score (NRS)[9], all of which have been similarly validated and tested for reliability. Also, the serum albumin level was used as a standard for comparison.

PATIENTS AND METHOD

During the 9-month period from April 2002 to December 2002, one hundred and ninety consecutive patients aged 60 years and over who were admitted to the General surgical and Urological wards for surgery at a Thai tertiary care hospital were prospectively enrolled into the study. All patients were operated on for various intraabdominal conditions (Table 1). Patients who were in exclusive criteria; such as 1) patients who needed transplantation, 2) the patients with no reliable nutritional history could not be obtained, 3) patients with too short a duration of admission, and inadequate nutritional assessment. All patients in the study group gave informed consent prior to nutritional evaluation. The study protocol was approved by the hospital ethical committee.

The nutritional assessment included routine biochemical markers such as serum albumin level, and

Table 1. Characteristics of the patients in the study (n = 190).

Characteristics	Summary	%
Age (years) : mean (SD) [range]	69 (7.1) [60-92]	
Sex (females)	104	55
Organ system disease		
Hepato-biliary-pancreas	97	51
Colorectal	47	25
Esophago-gastric	22	12
Urological	16	8
Vascular	2	1
Miscellaneous	6	3
Cancer (yes)	76	40
Diabetes Mellitus (yes)	47	25
Pre-operative nutritional support (yes)	15	8
Wound classification		
Clean	15	8
Clean-contaminated	157	82
Contaminated	15	8
Dirty	3	2
Body Mass Index (kg/m2) : mean (SD) [range]	23 (3.9) [13.8-38.8]	
Serum albumin (g/L) : mean (SD) [range] n = 189*	38.5 (5.2) [22.9-50.1]	
MNA-SF at risk (yes)	67	33
NRC at risk (yes)	88	46
MST at risk (yes)	62	33
NRS at risk (yes)	101	53
Albumin < 35 g/L (yes)	44/186*	23

* This is one less observation for serum albumin due to one missing value.

a questionnaire consisting of items abstracted from the following nutrition screening tools: the NRC, the MAN-SF, the MST, and the NRS. A research nurse collected all the relevant data. Outcomes of the study included hospital mortality and various infectious and wound complications listed in Table 2, occurring within 30 days after operation. All these complications were defined according to those given by the Centers for Disease Control and Prevention (CDC), US Department of Health and Human Services[10]. All patients were followed until hospital death, or 30 days after the primary operation, and till the first follow-up visit after hospital discharge.

All infectious and wound complications were pooled together as post-operative complications and analyzed as a single outcome. Hospital mortality was not analyzed in detail since too few of such an outcome actually occurred. Each nutritional screening tool was used to classify patients as "at risk" or "not at risk" of malnutrition, according to criteria set in the original publications[6-9]. For the MNA-SF, scores of 10 or below (at risk and malnourished categories) were considered "at risk" and 11 or above as "not at risk". For the NRS, scores of 4 or above (needs monitoring and high risk categories) were considered "at risk" and below 4 as "not at risk". Serum albumin level of 35 g/L was used as a cut-off for malnutrition status. The association between the classification of malnutrition or at risk of malnutrition and post-operative complications was measured by the c-index (i.e. the area under the receiver operating characteristic (ROC) curve [3]. Pair-wise agreement between nutrition screening tools was measured using the kappa statistic. The ROC areas were compared using the method of DeLong, DeLong and Clarke-Pearson[11].

A two-sided p-values of 0.05 or less was considered statistically significant. STATA version 7 was used for all statistical analyses.

RESULTS

Characteristics of the patients are presented (Table 1). Patients in the studied sample were 69 years old on average, of whom 55 per cent were females and predominantly (88%) undergoing gastrointestinal or hepatobiliary-pancreas surgery. Forty per cent were operated on for cancer. The proportion of malnutrition "at-risk" status varied between 33 per cent and 53 per cent.

The various post-operative infectious and wound complications are presented in Table 2. These complications occurred in 20 per cent of patients. The mortality rate was 3 per cent.

The relationship between the malnutrition "at-risk" status and post-operative complications as measured by the risk ratio, and the discriminatory ability of each screening tool to predict post-operative complications measured as the area under the ROC curve are presented in Table 3. Malnutrition at-risk status according to the NRC was associated with a 5-fold increase in the risk of post-operative infectious and wound complications, while that for the MNA-SF the risk was 3-fold. The discriminatory ability of the NRC appeared to be the best (with the highest c-index of 0.72) while the MST appeared to be the worst (with c-index of 0.625), although all c-indices were not statistically different from one another. The C-index for MNA-SF was relatively low (0.674) compared to that of the NRC.

There was moderate agreement between each of the screening tools (the kappa statistic for pairwise

Table 2. Post-operative infections, wound complications, and mortality.

Events*	Number (n = 190)	%
Total number of patients with post-operartive complications	38	20
Surgical site infection type I-II	23	12
Surgical site infection type III (intra-abdominal abscess)	3	2
Pneumonia	8	4
Catheter-related infection	8	4
Urinary tract infection	9	5
Wound dehiscence	5	3
Hospital death	5	3

* Each category of infection is defined according to the CDC.

Table 3. Risk ratios and c-indices for each nutrition screening tool.

Screening tool	Risk ratio (95%CI)	C-Index (95%CI)	P-value*
MNA-SF	3.15 (1.78-5.67)	0.674 (0.589-0.76)	< 0.001
NRC	5.13 (2.38-11.08)	0.72 (0.65-0.794)	< 0.001
MST	2.29 (1.31-4.02)	0.625 (0.537-0.713)	0.003
NRS	2.84 (1.42-5.67)	0.645 (0.566-0.724)	0.001
Serum albumin < 35 g/L	2.68 (1.55-4.59)	0.634 (0.549-0.72)	0.001

* p-values are for chi-square tests for association between at-risk status and post-operative complications.

agreement was between 0.4 to 0.58), and low agreement between screening tools and serum albumin level (the kappa statistic was between 0.23 to 0.31).

DISCUSSION

The MNA was developed to measure or grade the nutritional status in the elderly population in a wide variety of settings. A recent modification of the MNA simplified the assessment to 6 questions (weight loss; general assessment related to lifestyle, and mobility; subjective assessment related to self-perception of health and nutrition; and body mass index)[6]. This simplified screening tool, called the MNA-SF, was shown to have a high correlation with the original MNA, and was able to correctly identify malnutrition or non-malnutrition status (compared to the MNA) in 98.7 per cent of patients[6]. The present study was conducted to determine if the MNA-SF at risk classification, as a measure of nutritional status, was associated with the occurrence of post-operative infections and wound complications in elderly surgical patients. At the same time other recent and more general nutritional screening tools were also applied to the same sample of patients to compare their ability to predict the same complications. Although malnutrition as identified by the MNA-SF was associated with a 3-fold increase in the infectious and wound complications, it seems that the NRC was able to discriminate or predict the same complications in this group of patients better than the MNA-SF, despite the latter having been developed especially for this patient population. This finding may be surprising, given that the MNA-SF performed better in terms of discriminatory ability than the MST, the NRS and serum albumin level at cut-off of 35 g/L, as might be expected. However, all the differences in the c-indices (Table 3) were not statistically significant.

Although chance occurrence might have explained this finding, an inspection of both the MNA-SF and NRC screening tools revealed that besides an assessment of food intake, stress level and a measure of body weight standards, the NRC (Appendix) has a screening question for underlying illness as well. Since some of these illnesses are associated with increased infections or wound complications (e.g. diabetes mellitus, end stage renal and liver disease and cancer)[12-14], the NRC was, therefore, able to predict more of these complications. Also, the only screening in the MNA-SF more relevant to the elderly population was one concerning neuropsychological disorder; since almost all patients in this sample were intact psychologically, the MNA-SF might not perform as well as it should. Other screening tools (the MST and the NRS) contained similar assessments as the MNA-SF, except for the neuropsychological items, and, therefore, performed almost as well as the MNA-SF. Serum albumin level, on the other hand, was probably measuring a different aspect of the nutritional status (as can be seen by the low agreement with other nutritional screening tools) and therefore was not directly comparable to the other screening tools.

Since the nutritional screening tools classify the patients as either "at-risk" or "not at-risk" of malnutrition to facilitate the "treat" or "not to treat" strategy, some information may have been lost to this dichotomization[15]. This may be relevant to the MNA-SF and the NRS (both are tools with three degrees or grades of malnutrition, while the NRC and the MST have two grades, although the MNA-SF, the NRS, and the MST have a scoring system as well). Nonetheless, for therapeutic purposes dichotomized final assessment is probably most useful and future studies could attempt to compare these tools using different cutoffs for dichotomization.

SUMMARY

For elderly patients (aged 60 years or over) undergoing abdominal surgery, malnutrition status as identified by the NRC appeared to better predict post-operative infectious and wound complications than that identified by the MNA-SF. The NRC is recommended as a nutritional screening tool for elderly patients undergoing abdominal surgery.

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Appendix
Nutrition Risk Classification (NRC)

Diagnosis

If the patient has at least ONE of the following diagnoses, circle and proceed to section E to consider the patient AT NUTRITIONAL RISK and stop here.

Anorexia nervosa/bulimia nervosa
Malabsorption (celiac sprue, ulcerative colitis, Crohn's disease, short bowel syndrome)
Multiple trauma (closed-head injury, penetrating trauma, multiple fractures)
Decubitus ulcers
Major gastrointestinal surgery within the past year
Cachexia (temporal wasting, muscle wasting, cancer, cardiac)
Coma
Diabetes
End-stage liver disease
End-stage renal disease
Nonhealing wounds

Nutrition intake history

If the patient has at least ONE of the following symptoms, circle and proceed to section E to consider the patient AT NUTRITIONAL RISK and stop here.

Diarrhea (> 500 ml x 2 days)
Vomiting (> 5 days)
Reduced intake (< $^1/_2$ normal intake for > 5 days)

Ideal body weight standards

Compare the patient's current weight for height to the ideal body weight chart on the back of this form. If at < 80 per cent of ideal body weight, proceed to section E to consider the patient AT NUTRITIONAL RISK and stop here.

Weight history

Any recent unplanned weight loss? No _____ Yes _____ Amount (lbs. or kg) _____
If yes, within the past _____ weeks or _____ months
Current weight (lbs. or kg) _____
Usual weight (lbs. or kg) _____
Height (ft, in or cm) _____
Find percentage of weight lost : $\frac{\text{usual wt - current wt}}{\text{usual wt}} \times 100 =$ _____ % wt loss

Compare the % of wt loss with the chart values and circle appropriate value

Length of time	Significant (%)	Severe (%)
1 week	1-2	> 2
2-3 weeks	2-3	> 3
1 month	4-5	> 5
3 months	7-8	> 8
5+ months	10	> 10

If the patient has experienced a significant or severe weight loss, proceed to section E and consider the patient **AT NUTRITIONAL RISK**

Nurse assessment

Using the above criteria, what is this patient's nutritional risk? (Circle one)
_____ LOW NUTRITIONAL RISK
_____ AT NUTRITIONAL RISK

การเปรียบเทียบเครื่องมือประเมินภาวะทางโภชนาการในการทำนายภาวะติดเชื้อหลังผ่าตัดและภาวะแทรกซ้อนที่แผลผ่าตัดในผู้ป่วยสูงอายุ

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วัตถุประสงค์ : เพื่อเปรียบเทียบเครื่องมือประเมินภาวะทางโภชนาการ 4 แบบ นั่นคือ Mini Nutritional Assessment–Short Form (MNA–SF), Nutrition Risk Classification (NRC), Malnutrition Screening Tool (MST), และ Nutrition Risk Score (NRS) ในการทำนายการเกิดภาวะติดเชื้อหลังผ่าตัดและภาวะแทรกซ้อนที่แผลผ่าตัด ในผู้ป่วยสูงอายุ

ผู้ป่วยและวิธีการ : ได้ทำการศึกษาในผู้ป่วยอายุ 60 ปี หรือมากกว่า จำนวน 190 คน ที่ได้รับการผ่าตัดช่องท้องในระยะเวลา 9 เดือน ระหว่าง เมษายน 2545 ถึงธันวาคม 2545 ผู้ป่วยทุกคนจะได้รับการประเมินว่ามีความเสี่ยงหรือไม่เสี่ยงต่อการเกิดภาวะทุพโภชนาการ ความเสี่ยงดังกล่าว ซึ่งประเมินโดยเครื่องมือแต่ละแบบ จะถูกนำไปทดสอบหาความสัมพันธ์กับการเกิดภาวะติดเชื้อและภาวะแทรกซ้อนที่แผลผ่าตัด ความสัมพันธ์นี้วัดโดยพื้นที่ใต้ Receiver operating characteristic curve ซึ่งได้นำมาใช้เป็นตัวเปรียบเทียบความสามารถในการทำนายการเกิดภาวะแทรกซ้อนหลังการผ่าตัดของเครื่องมือทั้ง 4 แบบ

ผลการศึกษาและข้อสรุป : เครื่องมือ NRC สามารถทำนายการเกิดภาวะติดเชื้อหลังผ่าตัดและภาวะแทรกซ้อนที่แผลผ่าตัดได้ดีที่สุดในผู้ป่วยสูงอายุ

คำสำคัญ : ภาวะทางโภชนาการ, เครื่องมือประเมินภาวะทางโภชนาการ, ซีรั่มอัลบูมิน, ภาวะติดเชื้อหลังผ่าตัด, ภาวะแทรกซ้อนที่แผลผ่าตัด

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