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Preoperative nutritional status and postoperative outcome in elderly general surgery patients: a systematic review

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ABSTRACT

Background

Poor nutritional status is considered a risk factor for postoperative complications in the adult population. In elderly patients, who often have a poor nutritional status, this relationship has not been substantiated. Thus, the aim of this systematic review was to assess the merit of preoperative nutritional parameters used to predict postoperative outcome in the elderly patients undergoing general surgery.

Methods

A systematic literature search of ten consecutive years, 1998-2008, in Pubmed, EMBASE, and Cochrane databases was performed. Search terms used were nutrition status, preoperative assessment, postoperative outcome, and surgery (hip or general), including their synonyms and MeSH terms. Limits used in the search were human studies, published in English, and age (65 years or older). Articles were screened using inclusion and exclusion criteria. All selected articles were checked on methodology and graded.

Results

Of 463 articles found, 15 were included. They showed profound heterogeneity in the parameters used for preoperative nutritional status and postoperative outcome. The only significant preoperative predictors of postoperative outcome in elderly general surgery patients were serum albumin and ≥10% weight loss in the previous six months.

Conclusions

This systematic review revealed only two preoperative parameters to predict postoperative outcome in elderly general surgery patients: weight loss and serum albumin. Both are open to discussion in their use as a preoperative nutritional parameter. Nonetheless, serum albumin seems a reliable preoperative parameter to identify a patient at risk for nutritional deterioration and related complicated postoperative course.

INTRODUCTION

The number of elderly people in need of surgery is steadily growing, creating a medical and economic challenge. A focus on optimizing their preoperative medical condition might improve postoperative outcome and reduce costs in these patients. One of these measures may be nutrition intervention to improve preoperative nutrition status. To achieve this, we should be able to determine adequately the preoperative nutrition status to undertake preventive measures.

The elderly patient differs, among other things, from younger adult patients in their reduced adaptive and regenerative capacity, making rehabilitation a profound challenge [1,2]. Advanced age in itself is independently associated with poor nutrition status in admitted patients and is a significant predictor of postoperative mortality in surgical patients [3-5]. The poor nutrition status in the elderly is explained by low nutrient intake, less access to adequate nutrition food, reduced appetite, chronic disease, medication, and/or psychological condition [5,6].

For the elderly patient, it is assumed that a poor nutrition status is associated with enhanced occurrence of postoperative complications. This association has already been established in the adult patient population [3,7-13]. Furthermore, in adult patients, improvement in clinical outcome by nutrition intervention was highest in patients who were nutritionally at risk [14].

To be able to identify reliable preoperative nutrition status parameters for the elderly patient that can eventually be used for preventive measures, the aim of the present study was to systematically review the available evidence on the relationship between preoperative nutrition status and postoperative outcome in the elderly general surgery patient.

METHODS

Data sources

Relevant articles from 10 consecutive years, 1998–2008, were identified by using the electronic databases PubMed, Cochrane, and EMBASE. Search terms used were nutrition status, preoperative assessment, postoperative outcome, and surgery (hip or general), including their synonyms and MeSH terms. Limits used in the search were human studies, published in English, and age (65 years or older). The full search strategy can be requested from the corresponding author.

Data selection

The articles were screened for eligibility by 2 reviewers separately, by reading the article abstract or full text. Inclusion criteria were as follows: age (65 years or older), published between 1998 and 2008 in English, general or hip surgery, and a relation between preoperative nutrition status and postoperative outcome. Exclusion criteria were as follows: poor/not defined preoperative nutrition status, no outcome criteria, other types of surgery than hip or general surgery (eg, gynecological, cardiothoracic, transplant, ear/nose/throat, urological, neurosurgery), preoperative immune function measurements, non-responding author (when extra information was needed: eg, full text or age criteria), and no original data included. Where discordance existed between the 2 reviewers, a joint decision was made.

Data evaluation

A methodology checklist for cohort studies, produced by the National Institute for Health and Clinical Excellence (NICE), April 2007, was used to grade for quality [15]. The methodological check was done separately by 2 reviewers. Discordances between the reviewers were found using cross-tabs and the χ^2 test. Both reviewers, separate from each other, checked the discordances for appropriateness. The remaining discordances were debated until a joint decision was made.

The final data were put in a new database, and all items were set into comparable digit ordinal variables (per item a minimum of 1, maximum of 5; "not applicable" was set as 0) to be able to make a grading. The grading was subjected to a reliability analysis to verify for dissonant items in the checklist. In addition, a regression analysis was done to analyze which items were more or less of an influence on the grading.

The 2 sections of the checklist were analyzed separately because they differ: section 1 is about the internal validity of the study, and section 2 concerns the overall assessment of the study. Ultimately, a final grade was given per section of the checklist. When only worst scores per item were given, grade 1 should be given, and when only best scores per item were given, grade 10 should be given. This led to the following equations per section: for section 1, the final grade = 10 - [("sum of items section 1" - 11)/(74/9)], and for section 2, the final grade = 10 - [("sum of items section 2" - 3)/2].
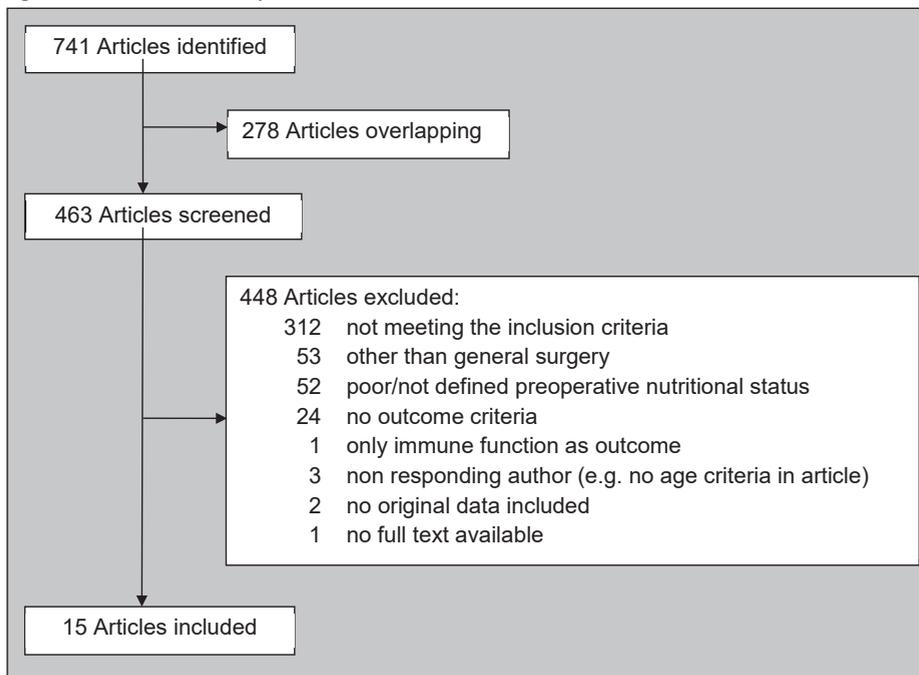
RESULTS

Study characteristics

The search resulted in a total of 741 articles. The overlap between the search databases was 278 articles, leaving 463 articles for screening. Fifteen articles were considered eligible for the review (Figure 1). These articles could be separated into 2 groups:

patients with hip surgery (Table 1) and patients with other types of general surgery (Table 2).

Figure 1. Flowchart of study inclusion

Data evaluation

The reliability analysis on the grading of the methodology checklist resulted in a Cronbach's α of 0.702 on section 1, for which 3 items had to be deleted (items 1.4, 1.5, and 1.12). In addition, the regression analysis showed that the deleted items were not of great influence on the grade. With the reliability analysis on section 2, a Cronbach's α of 0.683 was accepted, although a higher Cronbach's α (0.887) could be obtained deleting item 2.1. Because item 2.1 is considered an important item, it was decided to accept the lower Cronbach's α. In addition, the regression analysis on section 2 revealed no less or more important items. The final grades on both sections are presented in Tables 1 and 2.

Postoperative outcome

The outcome parameters used in the 15 included articles could easily be divided into 4 categories: postoperative complications, mortality, length of hospital stay, and other postoperative parameters. The outcome parameters will be addressed using these categories to simplify the presentation of the results.

Table 1. Hip surgery

Author, country and year of publication	Study design	Age groups (years)	Sample size	Indication for surgery	Intervention
Chu P.S.[30] (UK, 1998)	Prospective cohort study	60-74 > 75	13 8	Total hip replacement	_
Formiga F.[17] (Spain, 2005)	Prospective study	mean 81.5	73	Hip fracture	protein supplements (20g/day)
Foss N.B.[26] (Denmark, 2007)	Prospective, descriptive study	> 65	262	Hip fracture	additional nutritional support
Hedström M.[28] (Sweden, 1999)	Prospective cohort study	mean 77 mean 80	20 23	Coxarthrosis Hip fracture	_
Koval K.J.[16] (USA, 1999)	Retrospective study	> 65	490	Hip fracture	_
Lindström M.[29] (Sweden, 2001)	RCT	> 75	44 44 control	Hip fracture	Extra 200 kcal/day
Lindström M.[22] (Sweden, 2000)	Prospective randomized follow-up study	> 75	100	Hip fracture	protein- and energy-enriched food vs. no intervention
Lewis B.K.[20] (UK, 1998)	Prospective study	> 75	30	Hip fracture or total hip replacement	_
Symeonidis P.[24] (UK, 2006)	Retrospective study	> 65	214	Hip fracture	_
Pedersen PU.[27] (Denmark, 2005)	Quasi- experimental study	> 65	253	Hip fracture	additional nutritional support provided by nurses
Pioli G.[21] (Italy, 2006)	Prospective cohort study	> 70	248	Hip fracture	_

ADL, activities of daily living; AMC, arm muscle circumference; ASA, American Society of Anesthesiologists; BMD, bone mineral density; BMI, body mass index; FM, fat mass; GH, growth hormone; Hb, hemoglobin; IADL, instrumental activities of daily living; IGF-1, insulin-like growth factor 1; IGFBP-1, insulin-like growth factor binding protein 1; IGFBP-3, insulin-like growth factor binding protein 3; LBM, lean body mass; LOS, length of hospital stay; MAC, mid-arm circumference; MNA, Mini-Nutrition Assessment; MNA-SF, Mini-Nutrition Assessment–Short Form; RBC, red blood cell count; TLC, total lymphocyte count; TSF, triceps skinfold thickness; Waterlow score, a risk assessment card for pressure sores [48].

Preoperative assessment	Postoperative outcome parameters	Methodological quality	
		Section 1 Internal validity	Section 2 Overall assessment
BMI, MAC, TSF, MNA, TLC, Hb, albumin	BMI, MAC, TSF, MNA, TLC, RBC, Hb, albumin, LOS, complications	7.6	7
MNA-SF, cholesterol, co-morbidity, albumin, TLC	mortality, nosocomial infection, pressure ulcers	6.1	7
BMI, albumin, Hb, dementia, ASA-classification, pre-fracture functional level	mortality, LOS, complications, energy intake	7.6	7
albumin, IGF-1, IGFBP-1, IGFBP-3, GH, BMD, FM, LBM	IGF-1, IGFBP-1, IGFBP-3, GH, BMI, FM, LBM	6.1	6
albumin; TLC, ADL, IADL and co-morbidity	in-hospital mortality; complications; LOS; mortality, ADL and IADL one year after surgery	7.9	7
BMI, TSF, AMC, albumin, IGF-I, GH, mental state, ADL	mortality, LOS	8.2	4
BMI, TSF, MAC, AMC, albumin, ADL, IADL, dietary intake	albumin, one-year mortality	7.7	5
food frequency questionnaire, Waterlow score	pressure ulcers	7.0	5
albumin, TLC	in-hospital mortality, one-year mortality, LOS	8.9	6
BMI, protein and energy intake	Postoperative energy and protein intake	8.3	7
albumin, ADL, IADL, co-morbidity	mortality	8.3	8

Table 2. Other types of general surgery

Author, country and year of publication	Study design	Age groups (years)	Sample size	Type of surgery
Bozzetti F. [19] (Italy, 2007)	Retrospective study	< 55	318	Gastrointestinal
		55-66	460	
		65-75	481	
		> 75	151	
Ganai S. [18] (USA, 2007)	Retrospective case series study	> 70	228	Gastric
Girvent M. [23] (Spain, 1998)	Prospective cohort study	> 70	66	Acute
Nair S. [25] (USA, 2000)	Case-control study	mean 83.3	92	Percutaneous endoscopic gastrostomy

BMI, body mass index; CRP, C-reactive protein; EN, enteral nutrition; IL-6, interleukin-6; Hb, hemoglobin; LOS, length of stay; MMC, muscle mid-arm circumference; PN, parenteral nutrition; TLC, total lymphocyte count; TSF, triceps skinfold thickness; TSH, thyroid-stimulating hormone.

Intervention	Preoperative assessment	Postoperative outcome parameters	Methodological quality	
			Section 1 Internal validity	Section 2 Overall assessment
four types of nutrition: standard intravenous fluids, TPN, EN, immune-enhancing EN	Hb, TLC, albumin, weight loss	morbidity	7.1	7
_	morbidity, albumin	delirium, LOS, mortality	8.8	8
_	cortisol, IL-6, CRP, albumin, TSH, TSF, hand-grip strength	mortality, LOS	7.2	9
_	BMI, TLC, albumin, MMC, TSF, cholesterol	morbidity, mortality	6.8	7

<u>Postoperative complications.</u> Five of the 15 included articles described a relation between preoperative nutrition parameters and postoperative complications [16-20].

In detail, 4 studies studied serum albumin as a preoperative predictor of postoperative complications. In the study by Koval et al. [16], serum albumin was not found to be predictive of complications in general. In contrast, however, the other 3 studies showed that low serum albumin significantly predicted postoperative complications (complications in general, p = 0.019 [19]; nosocomial infections, p = 0.008 [17]; pressure ulcers, p = 0.008 [17]; delirium, p = 0.02 [18]). Koval et al. [16] defined low serum albumin as serum albumin <35 g/L, Formiga et al. [17] and Ganai et al. [18] as serum albumin <30 g/L, and Bozzetti et al. [19] as serum albumin ≤30 g/L.

Three studies used total lymphocyte count (TLC) as a preoperative predictor. In 1 study, TLC was a significant predictor of postoperative complications (pressure ulcers, p = 0.02 [17]) but not in 3 studies (complications in general [16,19], nosocomial infections [17]).

In 1 study, weight loss ≥10% in the previous 6 months was a significant preoperative predictor of postoperative complications in general (p = 0.019) [19].

No significance was reported for cholesterol (nosocomial infections and pressure ulcers [17]), Mini-Nutrition Assessment-Short Form (MNA-SF; nosocomial infections and pressure ulcers [17]), hemoglobin (Hb; complications in general [19]), and intake of energy, protein, iron, zinc, copper, vitamin A, vitamin C, or folic acid (pressure ulcers [20]).

<u>Mortality.</u> Eight of the 15 included articles described a relation between preoperative nutrition parameters and mortality [16-18,21-25].

In detail, 7 studies used serum albumin as a preoperative predictor of mortality. In 5 studies, low serum albumin was a significant predictor of mortality (in-hospital mortality [16,18,21]: p = 0.03 [16], p = 0.04 [18] odds ratio [OR] = 6.82, 95% confidence interval [CI] = 1.56-29.72, p = 0.011 [21]; <6-month mortality [25]: p = 0.05 [25]; 6-month mortality [21]: OR = 2.59, 95% CI = 1.20-5.60, p = 0.016 [21]; 12-month mortality [21,24]: OR = 2.32, 95% CI = 1.09-4.92, p = 0.029 [21], and OR = 5.59, 95% CI = 1.57-19.97, p = 0.08 [24]), but in 2 studies, it was not significant (in-hospital mortality [17], mortality in general [23]). See the definitions, listed earlier, of low serum albumin used by Koval et al. [16], Formiga et al. [17], and Ganai et al. [18]. Pioli et al. [21] defined low serum albumin as serum albumin <30 g/L, Girvent et al. [23] and Symeonidis et al. [24] as serum albumin <35 g/L, and Nair et al. [25] as serum albumin <28 g/L.

Three studies used TLC as a preoperative predictor of mortality. In 1 study, TLC was a significant predictor (12-month mortality: OR = 2.5, 95% CI = 1.3-4.9, p < 0.01[16]) but not in 2 studies (in-hospital mortality [17,25]).

Two studies combined serum albumin and TLC as a preoperative predictor. In both studies, patients with low serum albumin and low TLC preoperatively were more likely to die within 12 months after surgery than patients with normal levels of both parameters (OR = 3.5, 95% CI = 1.2-10.2, p = 0.02 [16]; OR = 3.02, 95% CI = 1.11-8.27, p = 0.031 [24]).

In 1 study, dietary intake was not significantly related to 12-month mortality [22].

Two studies described triceps skin fold thickness (TSF) as a preoperative predictor of mortality. TSF was a significant predictor in one of these studies (12-month mortality: p < 0.01 [22]) but not in the other (in-hospital mortality [25]).

Non-significant preoperative predictors of in-hospital mortality were cholesterol [17,25], MNA-SF [17], body mass index (BMI) [25], and muscle mid-arm circumference (MMC) [25].

Length of hospital stay. Four of the 15 included studies showed a relation between preoperative nutrition status and length of stay (LOS). In detail, 3 studies used serum albumin as a preoperative predictor of LOS. In all 3 studies, low serum albumin was a predictor of prolonged LOS (OR = 1.9, 95% CI = 1.1-3.4; p = 0.03 [16], p = 0.001 [18], and p = 0.002 [23]). In 1 study, low TLC was not significantly associated with LOS [16]. Two studies combined serum albumin and TLC as a preoperative predictor of LOS. Patients with a low serum albumin and low TLC were more likely to have a prolonged LOS than patients with normal levels of both parameters (OR = 2.9, 95% CI = 1.1-7.8, p = 0.03 [16]; OR = 2.78, 95% CI = 0.95-8.16, p = 0.062 [24]).

Other postoperative outcome parameters. Six of the 15 included studies used other postoperative outcome parameters than postoperative complications, mortality, and LOS in association with preoperative nutrition parameters.

Two studies had postoperative energy intake as a postoperative outcome parameter. Low serum albumin (p = 0.03) [26] was a significant preoperative nutrition parameter associated with decreased postoperative energy intake, but BMI [26,27] was not a significant preoperative nutrition parameter.

One study had postoperative protein intake as a postoperative outcome parameter, which was not significantly associated with preoperative BMI [27].

Another study used body mass density at 6 months as a postoperative outcome parameter. Weight and insulin-like growth factor 1 (IGF-1) combined significantly influenced body mass density at 6 months (p = 0.02), but insulin-like growth factor binding protein 3 (IGFBP-3) did not [28].

IGF-1 level at 1 month, as a postoperative outcome parameter, was associated with low preoperative BMI (p < 0.05) [29].

In 1 study, the postoperative outcome parameter used was functional outcome, which was defined as regaining prefracture level of activities of daily living (ADL) at 12 months or as regaining prefracture level of instrumental activities of daily living (IADL) at 12 months. Patients with a low serum albumin were less likely to regain their prefracture level of ADL at 12 months (OR = 3.4, 95% CI = 1.8-6.5, p < 0.001), whereas serum albumin was not predictive for recovery of IADL at 12 months [16].

One study used the same markers as the preoperative nutrition parameter and postoperative outcome parameter. However, weight, TSF, mid-arm circumference

(MAC), and MNA were not predictive of weight, TSF, MAC, and MNA 7 days after surgery [30].

DISCUSSION

Considering the relevance of the question, we were surprised by the small number of studies addressing the relationship between preoperative nutrition status and postoperative outcome in the elderly general surgery patient. Many studies did assess preoperative nutrition status and postoperative outcome without investigating their relationship. The 15 included articles are quite heterogeneous in the parameters used for preoperative nutrition status and postoperative outcome. This systematic review detected only 2 preoperative nutrition parameters to predict postoperative outcome in elderly general surgery patients: serum albumin and weight loss in the previous 6 months. These preoperative nutrition parameters will be discussed here.

In the selected articles, serum albumin is the most used preoperative nutrition parameter. Low serum albumin was a significant preoperative predictor of postoperative complications and postoperative mortality in most articles[16-19,21,23-25] but not in all [16,17,23]. Low serum albumin predicted prolonged LOS in all articles [16,18,23]. This might show that serum albumin can be a reliable predictor of postoperative outcome in elderly general surgery patients.

These findings are in concordance with the results from studies in the younger adult patient. In patients with hip fracture (aged >60 years), O'Daly et al[31] showed that preoperative low serum albumin negatively influenced 12-month survival after surgery. Gibbs et al. [32] also showed that serum albumin can be seen as a predictor of postoperative outcome being related to 30-day postoperative mortality. Lohsiriwat et al[33] and Kudsk et al. [34] found that low serum albumin is associated with the occurrence of postoperative complications.

These findings indicate that determining preoperative serum albumin has value in predicting postoperative outcome. However, it is questionable whether serum albumin is a good representative of nutrition status. In general, it is advocated that serum albumin should not be seen as a nutrition parameter but rather as a marker of inflammatory metabolism [35-39]. Nonetheless, serum albumin might be used to identify the sickest patients, who, as a consequence, are also at risk for nutrition deterioration [36].

In one study, ≥10% weight loss in the previous 6 months was predictive of postoperative complications [19]. This is in line with the study by Pronio et al[40], who even found that patients with a weight loss ≤10% in the previous 6 months, undergoing major abdominal surgery, had a significantly higher rate of postoperative complications compared with

patients with no weight loss in the previous 6 months. In contrast, Skipworth et al. [41] and Han-Geurts et al. [42] found that preoperative weight loss did not predict the occurrence of postoperative complications in nonelderly adult patients undergoing major surgery. Weight loss in the previous 6 months might be an indicator of postoperative outcome, but the current evidence is based on a single study and therefore considered marginal. The difficulty with assessing nutrition status is exemplified by the recommendations of European Society for Clinical Nutrition and Metabolism (ESPEN) and American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.) with respect to which screening tool may be used. ESPEN advocated the MNA as a nutrition screening tool and as an outcome predictor in the elderly patient. In addition, Murphy et al. [43] and Cohendy et al. [44] found that the MNA seems useful in the preoperative evaluation of nutrition status in elderly patients. However, the MNA is still not frequently used as a tool to predict outcome [45].

In a recent clinical guideline of A.S.P.E.N. on nutrition screening and assessment, the elderly are not mentioned separately but integrated in the adult population [39]. In another clinical guideline of A.S.P.E.N. on enteral and parenteral nutrition use, a special section on the elderly is found [46]. In both guidelines, nutrition screening is recommended but with different grades. The A.S.P.E.N. clinical guideline on nutrition screening and assessment does not recommend one assessment over the other [39]. However, the other guideline, recognizing the absence of a validated screening tool, suggests using the subjective global assessment (SGA) [46]. Scientifically, the value of the MNA, SGA, and other screening tools has been questioned by Jones [47]. Jones critically evaluated the methodology of published nutrition assessment and screening tools and concluded that none of these screening tools satisfied a set of criteria regarding scientific merit.

This systematic review shows that only 2 parameters, preoperative serum albumin and weight loss, have been linked to postoperative outcome in the elderly general surgery patient. Unfortunately, the evidence for weight loss is marginal. The evidence for serum albumin is more substantiated, although serum albumin cannot be considered a true nutrition parameter. Still, there is room for improvement when it comes to defining nutrition status and its role in predicting outcome in the elderly surgical patient.

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