Kılıç et al.
Ain-Shams Journal of Anesthesiology (2022) 14:83
https://doi.org/10.1186/s42077-022-00280-9

Ain-Shams Journal of Anesthesiology

ORIGINAL ARTICLE

Open Access

Comparison of malnutrition screening tests in predicting postoperative complications in elderly patients with femur fracture

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Abstract

Background: Malnutrition is an important and widespread problem in hospitalised elderly orthopaedic patients. It is an important predictor of morbidity and mortality and has been associated with an increased risk of complications. Although it is a common problem in the elderly, there is neither a universally accepted criterion for the diagnosis of malnutrition nor a screening tool accepted as the gold standard to detect patients at risk of malnutrition. There is still no consensus on which is the most recommended for screening hospitalised patients for nutritional risk. The aim of this study was to search body mass index (BMI) and commonly used nutrition screening tools to detect malnutrition and malnutrition-related complications in elderly femur fracture patients. One hundred nineteen patients of the American Society of Anesthesiologists status I–IV, aged ≥ 65 years undergoing hip surgery, were included in the study.

Results: Mini Nutritional Assessment Short Form (MNA-SF) and Subjective Global Assessment (SGA) have a moderate agreement in the diagnosis of malnutrition. There was a statistically significant relationship between malnutrition and the presence of complications according to MNA-SF. But there was no statistically significant relationship between malnutrition and the presence of complications according to SGA.

Conclusions: According to MNA-SF, there was no significant relationship between malnutrition and the presence of postoperative complications. However, MNA-SF has higher sensitivity than predicting postoperative complications according to SGA. Although both tests can be used for screening malnutrition in elderly patients, complications can be more predicted with the MNA-SF test.

Keywords: Malnutrition, Elderly, Femur fracture, Postoperative complications

Background

Malnutrition is an important and widespread problem in hospitalised elderly orthopaedic patients (Baek and Heo 2015; Crogan and Pasvogel 2003; Morley 2002; Kaiser et al 2011a; Ito et al 2010; Olofsson et al 2007). It is an important predictor of morbidity and mortality and has been associated with increased risk of complications such as higher rates of infection, increased length of stay (LOS), and readmission rate, hence increased medical costs, falls and fractures, increased incidence of pressure ulcers, and delayed healing of the wound (Baek and Heo 2015; Crogan and Pasvogel 2003; Kaiser et al 2011a; Olofsson et al 2007; Velasco et al 2011; Seiler 2001; Rubenstein et al 2001; Bell et al 2014; Winter et al 2013; Ozkalkanlı et al 2009; Koren-Hakim et al 2012; Poulia et al 2012). But it is often unrecognised and subsequently goes untreated (Morley 2002; Winter et al 2013; Kılıçturgay 1998). To overcome the problems of the definition of malnutrition and to identify the patients at malnutrition risk, numerous tools were applied for the screening and

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assessment of malnutrition have been introduced (Baek and Heo 2015; Kaiser et al 2011a; Seiler 2001; Rubenstein et al 2001; Bell et al 2014; Milne et al 2006; Bell et al 2013; Young et al 2013; Kaiser et al 2011b).

Although it is a common problem in the elderly, there is neither a universally accepted criterion for the diagnosis of malnutrition nor a screening tool accepted as the gold standard to detect patients at risk of malnutrition. There is still no consensus on which is the most recommended for screening hospitalised patients for nutritional risk (Crogan and Pasvogel 2003; Kaiser et al 2011a; Velasco et al 2011; Bell et al 2014; Milne et al 2006; Bell et al 2013; Young et al 2013; Gündoğdu 2006; Raslan et al 2010; Miller et al 2009). History, physical examination, and anthropometric measurements are essential parts of any nutrition assessment. However, these tools can be highly subjective in evaluating elderly patients (Gündoğdu 2006).

A screening tool should be simple, easy to apply, have high interrater reliability, not time-consuming, gentle, and non-invasive to patients and should not lead to pain and discomfort (Crogan and Pasvogel 2003; Young et al 2013; Kaiser et al 2011b; Tsai et al 2013; Marshall et al 2015).

The body mass index (BMI) (kg/m^2) is simple to perform and independent of other clinical and functional variables (Miller et al 2009; Ranhoff et al 2005; Isenring et al 2012). It is associated with postfracture complications, morbidity, and mortality among older adults (Miller et al 2009; Ranhoff et al 2005). But measuring weight and height for BMI can be time-consuming particularly in bedridden and immobile elderly patients (Kılıçturgay 1998; Kaiser et al 2011b).

The Mini Nutritional Assessment (MNA) which is one of the most widely used nutritional screening tools (Tsai et al 2013) is a short, valid nutritional screening tool that consists of eighteen items and evaluates the attribute scores based on dietetic, anthropometric, subjective, and global assessments (Morley 2002; Rubenstein et al 2001; Kaiser et al 2011b; Tsai et al 2013; Isenring et al 2012; Luis et al 2011). It is recommended for routine geriatric assessments by the European Society for Clinical Nutrition and Metabolism (ESPEN) (Winter et al 2013; Young et al 2013; Kaiser et al 2011b; Isenring et al 2012). But it is too long for a screener in a primary care setting (Morley 2002; Rubenstein et al 2001; Luis et al 2011). Therefore, Rubenstein and colleagues developed a six-question Mini Nutritional Assessment Short Form (MNA-SF) by identifying a subset of questions from the full MNA that has high sensitivity, specificity, and correlation to the full MNA (Winter et al 2013; Kaiser et al 2011b; Tsai et al 2013; Isenring et al 2012). It is easy to apply and does not require laboratory test results and anthropometric measures (Rubenstein et al 2001; Bell et al 2014; Formiga et al 2005).

Subjective global assessment (SGA) is a questionnaire developed by Detsky et al. in 1987 (Fig. 1), covering the patient's history (weight loss, changes in food intake, gastrointestinal symptoms, functional capacity, underlying diseases), physical examination (muscle, subcutaneous fat, edema, ascites), and the clinician's overall judgement of the patient status (Crogan and Pasvogel 2003; Seiler 2001; Isenring et al 2012).

The aim of this study was to search BMI and commonly used nutrition screening tools to detect malnutrition and malnutrition-related complications in elderly femur fracture patients.

Methods

This study was conducted after approval from the Institutional Ethical and Scientific Committee and with written informed consent from the patients. One hundered nineteen patients of the American Society of Anesthesiologists (ASA) status I–IV, aged $\geq$ 65 years undergoing hip surgery, were included in study. Patients were assessed in the preoperative period within 24 h after admission to the hospital. Age, ASA status, gender, and BMI were recorded, and two screening tests (SGA, MNA-SF) were applied.

All measurements, assessments, and screening tools were performed by a single trained anesthesiologist to exclude interobserver differences.

Body height was measured by a stadiometer (to the nearest 0.5 cm) in patients who could stand, and recumbent height was obtained in patients who were unable to stand. Bodyweight to the nearest 0.1 kg on a chair scale or a hoist with an attached weighing device was obtained for bedridden patients. The BMI was calculated as kg/m^2. Nutritional risks were evaluated using two nutritional screening tools: MNA-SF and SGA. All the evaluations were performed by the same investigator. The results were reorganised into two categories as patients at nutritional risk and patients with good nutritional status.

In the postoperative period, patients were followed until discharge from the hospital. Physicians were instructed to record all complications in the patient records. Patients were also visited daily by a single anesthesiologist, and complications were recorded. Postoperative complications (wound infection, sepsis, infection of the osteosynthesis material or prosthesis, need for intensive care unit therapy after the operation, cerebrovascular event, postoperative cognitive dysfunction, hypotension, upper respiratory tract infection, recurrent operation, thromboembolism, postoperative ileus, myocardial infarction, heart failure, decubitus), preoperative and postoperative LOS, and mortality were investigated.

SUBJECTIVE GLOBAL ASSESSMENT OF NUTRITIONAL STATUS
select appropriate category with a checkmark, or enter numerical value

A. HISTORY
1. Weight change: Normal weight = #__________ kg IBW = #__________ kg
Overall change in past 6 months = #__________ kg loss/gain Current weight = #__________ kg
% change in past 6 months = __________ % loss/gain %IBW = __________ %
Change in past 2 weeks: no change ↑ ↓ Amt = #___________ kg
2. Dietary intake change (relative to normal)
__________ No change __________ ↑'d intake __________ ↓'d intake
Duration of change = # __________ weeks
If intake ↓'d: Type of change __________ Suboptimal solid diet __________ Full liquid diet
__________ Hypocaloric liquids __________ Starvation
3. Gastrointestinal symptoms persisting for >2 weeks
_____ None _____ Nausea _____ Vomiting _____ Diarrhea _____ Anorexia
4. Functional Capacity
_____ No dysfunction (full capacity) _____ Dysfunction: duration = # __________ weeks
Dysfunction: _____ Working suboptimally _____ Ambulatory _____ Bedridden
Specific handicap(s):
____

5. Disease and its relation to nutritional requirements
Primary diagnosis:
____
Metabolic demand (stress) _____ None _____ Low _____ Moderate _____ High

B. PHYSICAL FINDINGS: 0 = normal 1+ = mild 2+ = moderate 3+ = severe
_____ loss of subcutaneous fat (triceps, chest) _____ ankle edema _____ ascites
_____ muscle wasting (quadriceps, deltoids) _____ sacral edema

C. SUBJECTIVE GLOBAL ASSESSMENT RATING (select one)

A Nourished
B Moderately malnourished
C Severely malnourished

Fig. 1 **A** Mild protein-energy malnutrition: in adults, with BMI < 18.5 kg/m^2 or weight loss (5–9%), with mild subcutaneous fat loss and/or mild muscle wasting. **B** Moderate protein-energy malnutrition: in adults, with BMI < 18.5 kg/m^2 or weight loss (5–9%), with moderate subcutaneous fat loss and/or moderate muscle wasting. **C** Unspecified severe protein-energy malnutrition: In adults, BMI < 18.5 kg/m^2 or weight loss (≥ 10%), with severe subcutaneous fat loss and/or severe muscle wasting

The statistical analysis was performed by SPSS 17.0 The primary outcome of the study that was used for the calculation of the sample size was to detect malnutrition by BMI and commonly used nutrition screening tools. The secondary outcome was to search for malnutrition-related complications. Categorical variables were described as frequency and percentage, and numerical variables were described as mean and standard deviation, or median and minimum-maximum values. The relationship between categorical variables was tested by the chi-square test. Mann-Whitney was used to compare the means of the independent groups, and the median test was used to compare the medians. Harmony between two different diagnosing malnutrition tests was tested by kappa statistic. Sensitivity, specificity, odds ratio of the nutrition tools, and anthropometric measure were also calculated. Statistical significance was set at < 0.05 for all tests.

Results

A total of 119 patients were enrolled in this study. Sixty-seven patients were female, and fifty-two patients were male. The mean age of the patients was 80.0 ± 7.4 years, and their BMI was 25.2 ± 4.8. Patient characteristics, ASA physical status, BMI, and preoperative and postoperative LOS were presented as classified according to the complication presence or absence in Table 1 and according to the assessment tools applied in Table 2, respectively. When we analysed the agreement between MNA-SF and SGA, the kappa value was 0.584. Both methods have a moderate agreement in the diagnosis of malnutrition (Table 3).

According to the MNA-SF malnutrition test, complication was determined in 53 patients with malnutrition and 23 patients without malnutrition. There was a statistically significant relationship between malnutrition

Table 1 Patients characteristics and complications

	Total ($N = 119$)	Complicatıons		
		Available ($n = 76$)	Not available ($n = 43$)	p
Age (mean ± SS)	80.0 ± 7.4	80.3 ± 7.7	79.6 ± 6.9	0.487
BMI (mean ± SS)	25.2 ± 4.8	25.5 ± 5.1	24.7 ± 4.0	0.479
Sex (*n*, %)				
Male	52 (43.7%)	37 (48.7%)	15 (34.9%)	0.145
Female	67 (56.3%)	39 (51.3%)	28 (65.1%)	
ASA (*n*, %)				
I	3 (2.5%)	1 (1.3%)	2 (4.7%)	**0.022***
II	87 (73.1%)	52 (68.4%)	35 (81.4%)	
III	29 (24.4%)	23 (30.3%)	6 (14.0%)	
Preoperative hospital stay (days) (median, min-max)	5 (1–21%)	5 (1–21%)	6 (1–12%)	0.629
Postoperative hospital stay (days) (median, min-max)	6 (2–60)	7.5 (3–60)	5 (2–40)	**< 0.001***

Table 2 Patients characteristics and malnutrition screening tests

	MNA-SF MALNÜTRİSYON			SGA MALNÜTRİSYON		
	Available ($n = 74$)	Not available ($n = 45$)	p	Available ($n = 57$)	Not available ($n = 62$)	p
Age (mean ± SS)	80.6 ± 7.7	79.1 ± 6.8	0.188	80.3 ± 8.2	79.8 ± 6.6	0.615
BMI (mean ± SS)	23.9 ± 4.1	27.4 ± 5.0	< 0.001	22.9 ± 3.3	27.3 ± 4.9	< 0.001
Sex (*n*, %)						
Male	32 (43.2%)	20 (44.4%)	0.898	26 (45.6%)	26 (41.9%)	0.686
Female	42 (56.8%)	25 (55.6%)		31 (54.4%)	36 (58.1%)	
ASA (*n*, %)						
I	1 (1.4%)	2 (4.4%)	0.134	1 (1.8%)	2 (3.2%)	0.933
II	51 (68.9%)	36 (80.0%)		43 (75.4%)	44 (71.0%)	
III	22 (29.7%)	7 (15.6%)		13 (22.8%)	16 (25.8%)	
Preoperative hospital stay (days) (median, min-max)	6 (1–21)	4 (1–17)	0.032	5 (1–21)	5 (1–17)	0.905
Postoperative hospital stay (days) (median, min-max)	6.5 (2–45)	6 (3–60)	0.690	7 (2–45)	6 (3–60)	0.420

Table 3 Agreement between MNA-SF and SGA tests

		MNA-SF Malnutrition			Kappa	p
		Not available	Available	Total		
SGA Malnutrition	Not available	41	21	62	0.584	< 0.001
	Available	4	53	57		
	Total	45	74	119		

and the presence of complications according to MNA-SF (Table 4).

According to the SGA malnutrition test, complication was determined in 39 patients with malnutrition and 37 patients without malnutrition. There was no statistically significant relationship between malnutrition and the presence of complications according to SGA (Table 5).

Discussion

In this study, we compare MNA-SF and SGA to determine the prevalence of nutritional risk and development of complications in elderly patients with femur fracture. BMI has a statistically significant difference in malnourished and nourished patients according to MNA-SF and SGA screening tools.

Past studies (Bell et al 2014; Miller et al 2009) reported that BMI can detect malnourished patients and can be used to predict postoperative morbidity and mortality. According to the World Health Organization (WHO), individuals with a BMI < 18.5 kg/m^2 are malnourished (Kaiser et al 2011a; Ozkalkanlı et al 2009), but on the other hand, the cutoff value for diagnosing malnutrition is < 20 kg/m^2 according to Deutsche Gesellschaft für Ernährungsmedizin (Kaiser et al 2011a; Bell et al 2013) and < 22 kg/m^2 according to Bell et al.'s study (Bell et al 2013).

On the other hand, some reports (Baek and Heo 2015; Winter et al 2013) stated that BMI has no statistically significant difference in malnourished and nourished patients. According to our results, BMI has a statistically significant difference in malnourished and nourished patients.

Tsai et al. (Tsai et al 2013) reported that a calculated MNA-SF score either with BMI or calf circumference was as effective as the full MNA in predicting malnutrition and mortality. On the contrary, Bell et al. (Bell et al 2014) stated that BMI usefulness is impacted by calculation errors in the elderly. It is not used in isolation to diagnose the nutrition status. So, a broad variety of screening tools have been validated to detect the nutrition status.

While a group of authors (Young et al 2013) compare SGA and MNA for evaluating the nutritional status, another group (Velasco et al 2011) compared Nutritional Risk Screening 2002 (NRS-2002), Malnutrition Universal Screening Tool (MUST), SGA, and MNA. They reported that MNA is the most time-consuming tool for nutritional evaluation. But they stated that NRS-2002 and

Table 4 Relationship between malnutrition and complication according to MNA-SF test

	Total ($n = 119$)	MNA-SF Malnutrıtıon		
		Available ($n = 74$)	Not available ($n = 45$)	p
Complications	76 (63.9)	53 (71.6%)	23 (51.1%)	0.024*
Pulmonary	33 (27.7%)	23 (31.1%)	10 (22.2%)	0.295
Cardiovascular	24 (20.2%)	18 (24.3%)	6 (13.3%)	0.147
Neurologic	28 (23.5%)	21 (28.4%)	7 (15.6%)	0.110
Gastrointestinal	6 (5.0%)	5 (6.8%)	1 (2.2%)	0.407
Urine	11 (9.2%)	8 (10.8%)	3 (6.7%)	0.531
Operation side	14 (11.8%)	11 (14.9%)	3 (6.7%)	0.178
Others	7 (5.9%)	4 (5.4%)	3 (6.7%)	> 0.999

Table 5 Relationship between malnutrition and complication according to SGA test

	Total ($n = 119$)	SGA Malnutrıtıon		
		Available ($n = 57$)	Not available ($n = 62$)	p
Complications	76 (63.9%)	39 (68.4%)	37 (59.7%)	0.321
Pulmonary	33 (27.7%)	15 (26.3%)	18 (29.0%)	0.741
Cardiovascular	24 (20.2%)	12 (21.1%)	12 (19.4%)	0.818
Neurologic	28 (23.5%)	16 (28.1%)	12 (19.4%)	0.263
Gastrointestinal	6 (5.0%)	5 (8.8%)	1 (1.6%)	0.103
Urine	11 (9.2%)	5 (8.8%)	6 (9.7%)	> 0.999
Operation side	14 (11.8)	10 (17.5)	4 (6.5)	0.061
Others	7 (5.9)	4 (7.0)	3 (4.8)	0.709

MUST are more rapid and require less examiner training than SGA and MNA, for nutritional evaluation.

Rubenstein et al. (Rubenstein et al 2001) reported that MNA-SF was developed to evaluate the nutritional status of elderly patients. It is easy to apply and does not require laboratory test results, anthropometric measures, and experience. In our study, we compared MNA-SF and SGA tools which are simple and accurately identify the patients with possible malnutrition. According to our results, the possibility of postoperative complications was found to be statistically significant only with the increase in the ASA status. The complication rate is directly proportional to the increase in the ASA status. According to our results, the MNA-SF test had a statistically significant relationship between malnutrition and complication; but according to SGA, there was no statistically significant relationship between malnutrition and complication.

Ozkalkanlı et al. (Ozkalkanlı et al 2009) stated that NRS 2002 predicted the development of complications better than SGA. Sacks et al. (Sacks et al 2000) reported that SGA is a simple, non-invasive, and cost-effective tool for assessing the nutritional status of geriatric residents in long-term care facilities and is also beneficial for identifying patients with increased risk of nutrition-associated complications. Contrary to these studies, others (Koren-Hakim et al 2012; Raslan et al 2010) stated that there is no statistical difference between malnutrition and complications in their studies. They stated that this could be due to their study model which was retrospective.

The most common complication according to our study was pulmonary complications (27.7%). However, the complication rate we have in our study was higher than in other studies. We can explain this high complication rate as our study was a prospective study, and it consisted of ≥ 65-years-old patients with high ASA risk status. Roche et al. (Roche et al 2005) assessed their lower rates as their study design was retrospective, and patients accepted to study were < 60 years old. According to our study, preoperative hospitalisation time is 5 (1–21) days. According to MNA-SF, the preoperative period of hospitalisation was statistically significant in patients with malnutrition, but there is no statistically significant difference according to SGA.

The presence of malnutrition according to MNA-SF and SGA does not make a statistically significant difference in terms of postoperative hospitalisation times. However, the postoperative hospital stay is more prolonged in complicated cases, and this difference is statistically significant.

Some researchers (Kaiser et al 2011a; Ito et al 2010; Grigg et al 2014) reported that malnutrition increased the length of hospital stay and increased the complication rate. Conversely, (Feldblum et al 2007) reported that malnutrition did not affect the length of hospital stay and complication rate.

Conclusions

According to MNA-SF, there was no significant relationship between malnutrition and the presence of postoperative complications. However, MNA-SF has higher sensitivity than predicting postoperative complications according to SGA. Although both tests can be used for screening of malnutrition in elderly patients, complications can be more predicted with the MNA-SF test.

Abbreviations

LOS: Length of stay; BMI: Body mass index; MNA: Mini Nutritional Assessment; ESPEN: European Society for Clinical Nutrition and Metabolism; MNA-SF: Mini Nutritional Assessment Short Form; SGA: Subjective Global Assessment; ASA: American Society of Anesthesiologists; WHO: World Health Organization; NRS-2002: Nutritional Risk Screening 2002; MUST: Malnutrition Universal Screening Tool.

Acknowledgements

This study was presented as an oral presentation in TARK 2016 Congress Istanbul, Turkey.

Authors' contributions

OK, FY, MYO, and TA reviewed the available literature, prepared the study design, reviewed and edited the final manuscript, and approved the final manuscript.

Funding

None.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The University of Health Sciences Izmir Bozyaka Training and Research Hospital Ethical Committee approved this study. The patients were informed about the study, and written informed consent was obtained.

Consent for publication

Written permission/consent of the patients for the purpose of publication in an educational medical journal was obtained from the patients.

Competing interests

The authors declare that they have no competing interests.

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Received: 11 February 2022 Accepted: 24 October 2022
Published online: 22 November 2022

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