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Mini Nutritional Assessment predicts gait status and mortality 6 months after hip fracture

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Abstract

The aim of the present study was to evaluate the Mini Nutritional Assessment (MNA), the Nutritional Risk Screening (NRS) 2002 and the American Society of Anesthesiologists Physical Status Score (ASA) as predictors of gait status and mortality 6 months after hip fracture. A total of eighty-eight consecutive patients over the age of 65 years with hip fracture admitted to an orthopaedic unit were prospectively evaluated. Within the first 72 h of admission, each patient's characteristics were recorded, and the MNA, the NRS 2002 and the ASA were performed. Gait status and mortality were evaluated 6 months after hip fracture. Of the total patients, two were excluded because of pathological fractures. The remaining eighty-six patients (aged 80·2 (SD 7·3) years) were studied. Among these patients 76·7 % were female, 69·8 % walked with or without support and 12·8 % died 6 months after the fracture. In a multivariate analysis, only the MNA was associated with gait status 6 months after hip fracture (OR 0·773, 95 % CI 0·663, 0·901; $P=0·001$). In the Cox regression model, only the MNA was associated with mortality 6 months after hip fracture (hazard ratio 0·869, 95 % CI 0·757, 0·998; $P=0·04$). In conclusion, the MNA best predicts gait status and mortality 6 months after hip fracture. These results suggest that the MNA should be included in the clinical stratification of patients with hip fracture to identify and treat malnutrition in order to improve the outcomes.

Key words: Hip fractures: Mini Nutritional Assessment: American Society of Anesthesiologists Physical Status Score: Nutritional Risk Screening 2002

The incidence of hip fractures has been rising in recent years, and there are expectations that it will continue to increase due to an ageing population[1–6]. According to Hu *et al.*[7], 1·5 million hip fractures occur annually worldwide, and this number may reach 2·6 million in 2025 and 4·5 million in 2050. Hip fractures have a great impact on patient independence, rising morbidity and mortality after surgery. Holt *et al.*[8] studied patients over 95 years old and showed that only 2 % of patients who survived after surgery and could walk before surgery without help recovered the same gait status. The difficulty in recovering previous gait status after hip surgery presents important limitations to these patients and increases the complexity of care for carers and relatives. Depending on the study, the prevalence of non-ambulatory patients ranges from 10 to 60 %[9].

It is well known that mortality rate after hip fracture is high. Malnutrition is one area receiving interest, mainly because it is a modifiable risk factor[10]. Identifying malnutrition is becoming widely accepted as a relevant procedure, which will help in providing better care to patients. Therefore, assessing malnutrition in older adults should lead to the integration of nutritional therapy within the standard care of patients with hip fracture.

Currently, several tools and scores are used to identify patients at a high risk of malnutrition and to predict complications and mortality. Among these instruments, the Mini Nutritional Assessment (MNA) and the Nutritional Risk Screening (NRS) 2002 are usually used in clinical practice. The MNA is the most used tool in the older adult to identify nutritional risk, and its results are associated with functional status and mortality in these patients; however, completing this

Abbreviations: ASA, American Society of Anesthesiologists Physical Status Score; MNA, Mini Nutritional Assessment; NRS, Nutritional Risk Screening; PT, prothrombin time.

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questionnaire is time consuming, and it is not applicable to patients with altered mental status[11,12]. For this reason, the European Society for Clinical Nutrition and Metabolism developed the NRS 2002. This assessment allows simple and rapid identification of patients who need nutritional therapy. It primarily reflects the severity of acute disease. Regardless of the lack of specificity for the older adult, the European Society of Parenteral and Enteral Nutrition recommends the use of the MNA for hospitalised aged patients and the NRS 2002 for older adult patients who are not hospitalised[12]. Few studies, though, have evaluated the relationship between these tools and mortality and gait status after surgery in patients with hip fractures[13–15].

Another commonly used assessment is the American Society of Anesthesiologists Physical Status Score (ASA). This assessment has been associated with mortality prediction in several studies; however, according to Michel *et al.*[16], there is no evidence that the ASA predicts functional recovery and dependency status after hip fracture surgery. Thus, the aim of the present study was to evaluate the MNA, the NRS 2002 and the ASA as predictors of gait status and mortality 6 months after hip fracture.

Experimental methods

The present study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human patients were approved by the Ethics Committee of our Institution. Written informed consent was obtained from all patients. A total of eighty-eight consecutive patients with hip fracture over the age of 65 years admitted to the orthopaedic unit from January to December 2010 were prospectively evaluated. The presence of a pathological hip fracture (fractures related to cancer) was an exclusion criterion. All patients were treated according to specific protocols depending on the type of fracture.

The Fisher and Belle formula was used to estimate the required sample size using the following variables: 30% prevalence of recovery of prefracture mobility in patients with hip fracture[9]; 95% CI; 10% sample error. The result was eighty-one patients[17].

Upon admission, patient demographic information including age and sex was recorded. All patients were evaluated and classified according to the MNA, the NRS 2002 and the ASA, and blood samples were taken within the first 72 h of the patient's admission after clinical stabilisation. The MNA and the NRS 2002 were performed by the same researcher and were answered by the patient; if the patient could not answer the questions, carers provided the responses. The ASA classification was performed by the anaesthesiology team. The fracture pattern (neck, trochanteric and subtrochanteric), time from admission to surgery, surgery duration and the length of hospital stay were also recorded.

The MNA covers eighteen items including anthropometric assessment (BMI, calf and upper-arm circumference), general assessment (medication, acute illness, psychological problems and mobility), nutritional assessment (fluid intake, number of daily meals and composition of food intake) as well as self-assessment of the nutrition and health status. The NRS 2002 consists of five items: age of the patient ≥ 70 years; BMI; appetite of the patient; accidental weight loss; severity of acute illness. The ASA score classification is divided into five levels: (1) a normally healthy patient; (2) a patient with mild systemic disease; (3) a patient with severe systemic disease that limits activity, but is not incapacitating; (4) a patient with an incapacitating systemic disease that is a constant threat to life; (5) a moribund patient who is not expected to survive 24 h with or without treatment.

All patients were followed for 6 months after the fracture. During this period, the patients received the nutritional standard care. Gait status and mortality were recorded. These outcomes were evaluated on the first day after surgery, at hospital discharge and at 15, 45, 90 and 180 d after the hospital discharge. Only the outcomes were registered after the hospital discharge. For the patients who died before 180 d after the discharge, we considered the gait status at the last report. Patients were classified according to gait status as ambulators (patients who walk with or without help, 0) or non-ambulators (patients who could not walk, 1).

Laboratory analysis

A haemogram was performed with a Coulter STKS haematological autoanalyser (Beckman). Total serum levels of C-reactive protein, albumin, glucose, creatinine and urea were measured using the dry chemistry method (Ortho-Clinical Diagnostics VITROS 950®; Johnson & Johnson). The prothrombin time (PT) and activated partial thromboplastin time were measured using manual methods.

Statistical methods

Data are expressed as means and standard deviations or medians (including the lower and upper quartiles). Statistical comparisons between the groups for continuous variables were performed using Student's t test for parameters with a normal distribution. If data were not normally distributed, comparisons between the groups were made using the Mann–Whitney U test. Fisher's test or the χ^2 test was used for all categorical data. Logistic regression was used to predict gait status 6 months after hip fracture because patients were not evaluated daily, and precise data on gait impairment were not available. In the logistic regression, the OR is an estimate of the increase or decrease in the odds for an outcome if the independent variable value is increased by one. In addition, a Cox regression model was used to predict mortality 6 months after hip fracture. The MNA, the NRS 2002 and the ASA scores, as continuous form, were tested as independent variables. For each of these variables, uni- and multivariate analyses were performed, adjusting for age, sex, time from admission to surgery and C-reactive protein. These variables were chosen because of their clinically important significance for mortality and gait status[5,18–20]. Data analysis was performed using SigmaStat software for Windows version 3.5 (Systat Software, Inc.). P values less than 0·05 were considered as statistically significant.

Table 1. Preoperative demographic and clinical data of eighty-six patients with hip fracture

(Mean values and standard deviations; medians with lower and upper quartiles; number of patients and percentages)

	Ambulator				
	No (*n* 26)		Yes (*n* 60)		
Variables	%	*n*	%	*n*	*P*
Age (years)					0·51
Mean	81·0		79·9		
SD	6·9		7·4		
Female	69·2	18	80·0	48	0·42
Fracture type					
Femoral neck	30·8	8	41·7	25	0·63
Trochanteric	61·5	16	51·7	31	
Subtrochanteric	7·7	2	6·7	4	
LOS (d)					0·97
Median	7·0		7·0		
Lower–upper quartiles	5·0–10·0		5·0–10·0		
Surgery time (min)					0·73
Median	70		70		
Lower–upper quartiles	60–90		50–90		
A–S time (min)					0·94
Median	5·5		5·0		
Lower–upper quartiles	4·0–8·0		4·0–7·5		
NRS 2002					0·46
Median	1·0		1·0		
Lower–upper quartiles	1·0–2·0		1·0–2·0		
ASA					0·12
Median	3·0		2·0		
Lower–upper quartiles	2·0–3·0		2·0–3·0		
MNA					<0·001
Mean	17·6		21·4		
SD	4·6		3·5		

LOS, length of hospital stay; A–S time, admission to surgery time; NRS 2002, Nutritional Risk Screening 2002; ASA, American Society of Anesthesiologists Physical Status Score; MNA, Mini Nutritional Assessment.

Results

Initially, eighty-eight consecutive patients were evaluated; two were excluded due to the presence of pathological fractures. Finally, eighty-six patients, with a mean age of 80·2 (SD 7·3) years, were included in the analysis. Among these patients, 76·7% were female, 68·8% were ambulators and 12·8% died 6 months after hip fracture. All patients underwent hip fracture surgery.

The demographic and clinical data are presented in Table 1. The majority of patients had trochanteric (54·6%) and femoral neck fractures (38·4%). The fracture type, clinical features and the length of hospital stay did not influence gait status.

The laboratory data are presented in Table 2. Non-ambulators had higher levels of PT, K, urea and creatinine when compared with ambulators 6 months after hip fracture. In the logistic regression analysis, only the MNA was associated with gait impairment 6 months after hip fracture (OR 0·773, 95% CI 0·663, 0·901; $P=0·001$). Interestingly, each one-point increase in the MNA score increased the chance of walking by 29% (Table 3). In the Cox regression analysis, the ASA and the NRS 2002 were not associated with mortality 6 months after hip fracture. Each one-point increase in the MNA reduced mortality risk by 15% (hazard ratio 0·869, 95% CI 0·757, 0·998; $P=0·04$; Table 4).

Discussion

The aim of the present study was to evaluate the MNA, the NRS 2002 and the ASA as predictors of gait status and mortality 6 months after hip fracture. The present data showed that only the MNA was predictive of gait status and mortality. In addition, each one-point increase in the MNA increased the probability of ambulatory status by 29% and reduced mortality risk by 15%.

Table 2. Laboratory data of eighty-six patients with hip fracture

(Mean values and standard deviations; medians with lower and upper quartiles)

	Ambulator				
	No (*n* 26)		Yes (*n* 60)		
Variables	Median	Lower–upper quartiles	Median	Lower–upper quartiles	*P*
Haematocrit (%)	34·5	29·2–36·1	36·8	30·4–39·2	0·17
Hb (g/l)	11·6	10·3–12·2	12·4	9·8–13·3	0·15
Platelets ($\times 10^3/\mu l$)	191	155–298	210	159–248	0·75
Leucocytes ($\times 10^3/\mu l$)	9053·8	3514·6	8423·4	3085·7	0·41
PT	1·09	1·03–1·16	1·05	1·00–1·09	0·04
APTT	1·11	1·00–1·24	1·03	0·93–1·15	0·07
CRP (mg/l)	64	37–141	49	34–69	0·15
Na (mmol/l)	138	135–141	139	137–140	0·90
K (mmol/l)	4·3	4·1–4·7	4·1	3·7–4·4	0·02
Mg (mmol/l)	0·78	0·74–0·82	0·82	0·70–0·86	0·38
Total Ca (mmol/l)					0·93
Mean		2·20		2·20	
SD		0·13		0·15	
Creatinine (mmol/l)	88·4	61·9–150·3	70·7	61·9–88·4	0·05
Urea (μmol/l)	10·19	8·35–17·03	8·18	5·93–11·36	0·02
Glycaemia (mmol/l)	6·83	5·16–8·05	6·66	5·33–8·27	0·99
Albumin (g/l)	3·2	2·8–3·3	3·3	2·9–3·6	0·10

PT, prothrombin time; APTT, activated partial thromboplastin time; CRP, C-reactive protein.

Table 3. Logistic regression for gait impairment prediction 6 months after hip fracture
(Odds ratios and 95 % confidence intervals)

	OR	95 % CI	*P*
NRS 2002	1·321	0·774, 2·254	0·31
NRS 2002*	1·249	0·686, 2·275	0·47
ASA	1·492	0·796, 2·794	0·21
ASA*	1·684	0·830, 3·416	0·15
MNA	0·785	0·680, 0·906	<0·001
MNA*	0·773	0·663, 0·901	0·001

NRS 2002, Nutritional Risk Screening 2002; ASA, American Society of Anesthesiologists Physical Status Score; MNA, Mini Nutritional Assessment.
* Adjusted for age, sex, time from admission to surgery and C-reactive protein.

The use of scores to predict outcomes is extremely important in clinical practice to identify patients at risk for complications and mortality[11]. Importantly, the ideal predictive tool must be simple, have a low inter-observer variation, be clinically validated and have clinically relevant outcomes[21]. Thus, comparing the ability of current assessments to predict gait status and mortality in patients with hip fracture is very relevant. Although the relationship between nutritional and functional status has already been demonstrated, a comparison among assessments used to predict gait status after surgery has not been well studied.

It is interesting to observe in the present study that there was no baseline demographic difference between ambulators and non-ambulators 6 months after fracture. In addition, only 30 % of the patients were not walking 6 months after hip fracture surgery. Maggi *et al.*[9] showed that a longer time between admission and surgery leads to decreased walking ability in patients with hip fracture. These authors have recommended that surgery should be performed in the first 48 h after hospital admission. The present data are different from those of Maggi *et al.*[9], probably, because of the delay in performing the surgery procedure (non-ambulators: 5·5 (4·0–8·0) d and ambulators: 5·0 (4·0–7·5) d).

PT values are an important variable related to surgery delay. Although the time between admission and surgery was the same for both groups in the present study, non-ambulators after surgery had higher values of PT than ambulators. Therefore, the present data suggest that PT might interfere with other determinants of patient mobility that are not associated with surgery delay. The increased PT could be due to a subclinical vitamin K deficiency or hepatic disease that could influence the outcomes[22,23]. Other variables that were related to mobility reduction were urea, creatinine and K. Although the median concentrations of these parameters stayed at normal levels, increased values were related to a decreased ability to walk 6 months after hip fracture, suggesting that patient's renal impairment at hospital admission could have a worse prognosis. It is known that bone remodelling (microarchitectural deterioration and increased fragility) may be present in patients with declining kidney function[24].

Considering the assessments used, only the MNA was related to gait status and mortality 6 months after hip fracture. Among the three assessments, though, the MNA is the most time consuming and depends on information provided by the patients, which sometimes could not be obtained from elderly patients due to the presence of dementia or delirium[9]. It is important to note that, in the present study, when the patient could not answer the questionnaire, the questions were answered by carers. Although simpler than the MNA, the NRS 2002 was not related to gait status or mortality. Thus, the present data suggest that the NRS 2002 is not a better choice for the clinical stratification of patients with hip fractures.

Other studies with geriatric patients compared the MNA with the NRS 2002 in relation to malnutrition risk, with conflicting results. In a study of 104 geriatric patients admitted to their service with acute problems, Drescher *et al.*[25] showed that the NRS 2002 was superior in predicting nutritional risks. However, Bauer *et al.*[11], in a study of 121 patients, showed that the MNA was superior in detecting malnutrition. In addition, according to these authors, the MNA was the first choice for geriatric hospital patients because of its association with relevant prognostic parameters.

The ASA is a simple and easy to use tool that is widely used to measure preoperative risk. Despite these advantages, Michel *et al.*[16] observed that the ASA classification was not an independent status predictor 1 year after hip fracture. In addition, the ASA was not associated with mortality in patients with hip fracture in the present study. This lack of association between the ASA classification and mortality was not shown by other studies on patients with hip fractures[26]. These differences in ASA performance may be due to the enormous inter- and intra-observer classification variation and different durations of patient follow-up among the studies.

Although the MNA was a good tool to predict prognosis, the present study has limitations. Gait status was not daily assessed, thus we could not know the precise moment of gait changes. Another limitation is that we cannot generalise the present results to other older adult population because of the patients' characteristics and the delayed time from admission to surgery.

In conclusion, the MNA best predicts gait status and mortality 6 months after hip fracture. These results suggest that the MNA should be included in the clinical stratification of

Table 4. Cox regression models for mortality prediction 6 months after hip fracture
(Hazard ratios and 95 % confidence intervals)

	Hazard ratio	95 % CI	*P*
NRS 2002	1·315	0·700, 2·472	0·40
NRS 2002*	1·256	0·654, 2·411	0·49
ASA	1·577	0·730, 3·410	0·25
ASA*	1·580	0·628, 3·975	0·33
MNA	0·892	0·793, 1·004	0·06
MNA*	0·869	0·757, 0·998	0·04

NRS 2002, Nutritional Risk Screening 2002; ASA, American Society of Anesthesiologists Physical Status Score; MNA, Mini Nutritional Assessment.
* Adjusted for age, sex, time from admission to surgery and C-reactive protein.

patients with hip fracture to identify and treat malnutrition in order to improve the outcomes.

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