Mini nutritional assessment, body composition, and hospitalisations in patients with chronic obstructive pulmonary disease

Barbara Benedika, Jerneja Farkasb, Mitja Kosnika, Sasa Kadiveca, Mitja Lainscakc,d,*

a University Clinic or Respiratory and Allergic Diseases Golnik, Golnik, Slovenia
b Chair of Public Health, Faculty of Medicine, University of Ljubljana, Ljubljana, Slovenia
c Division of Cardiology, University Clinic or Respiratory and Allergic Diseases Golnik, Golnik, Slovenia
d Applied Cachexia Research, Division of Cardiology, Charité – Campus Virchow-Klinikum, Berlin, Germany

Summary

Background: Limited information is available about Mini Nutritional Assessment (MNA) questionnaire in patients with chronic obstructive pulmonary disease (COPD). We have conceived this analysis to study the associations between MNA questionnaire, body composition, and rehospitalisations in patients with COPD.

Methods: This prospective study recruited control subjects and COPD patients for pulmonary function testing, nutritional assessment using MNA questionnaire, body composition measurement, and dyspnoea evaluation. We recorded hospitalisations during 6 months after discharge.

Results: Our sample included 22 healthy controls (71 ± 5 years, 59% men) and 108 COPD patients (71 ± 10 years, 75% men, 85% severe or very severe COPD). MNA score was significantly higher in control subjects than in COPD patients (27.0 ± 1.7 vs 21.2 ± 4.9, p < 0.001). MNA score decreased over GOLD stage (p = 0.02) and indicated malnutrition in 14% of patients, and further 55% were at risk of malnutrition. Body mass index but not body composition parameters was higher in control subjects when compared to COPD patients (29.1 ± 3.8 vs 27.0 ± 6.3, p = 0.041). A positive correlation between MNA score, body fat content (p = 0.001), and lean body mass (p < 0.001) was observed. During follow-up, 45 (41%) patients were rehospitalised. Malnourished patients had higher risk of rehospitalisation in univariate analysis (HR 2.62, 95% CI 1.13–6.07), which was maintained in an adjusted model (HR 2.93, 95% CI 1.05–7.32).

Conclusions: Malnutrition and risk of malnutrition was frequent, associated with lower body fat mass and lean body mass, and independently predicted hospitalisations at six months.

© 2011 Elsevier Ltd. All rights reserved.

Introduction

Reverse epidemiology is present in a variety of chronic disease where traditional risk factors like high body mass index confer prognostic benefit.1 Indeed, loss of body weight is a common and serious problem for patients with chronic obstructive pulmonary disease (COPD), that can lead to cachexia.2–4 Nutritional status can be assessed in various ways but body mass index (BMI), either as a single measure or part of composite score, remains most used in clinical practice.2–8 Other measures include determination of body composition or nutritional assessment but the available data, particularly about latter, remains scarce.9,10

Mini Nutritional Assessment (MNA) questionnaire is an established method to identify individuals either at risk of malnutrition or malnourished subjects.11 In patients with
COPD, risk of malnutrition is present in about half of patients and is associated with perception of dyspnoea\(^{12}\) and with deprived socioeconomic status.\(^{13}\) Most recent study\(^{14}\) demonstrated that nutritional status as assessed by MNA questionnaire is independently predicted by COPD severity and advanced age.

Little data is available about prognostic relevance of nutritional risk assessment beyond BMI. We have conceived this analysis to study the associations between MNA questionnaire, body composition, and rehospitalisations in patients with COPD.

**Methods**

**Study design and patients**

This was a prospective study which recruited patients from University Clinic of Respiratory and Allergic diseases Golnik. Study design was detailed elsewhere.\(^{15}\) In brief, consecutive patients, hospitalised due to acute exacerbation of COPD between December 2009 and January 2011, were eligible for the enrolment. Additionally, we required at least moderate airway obstruction according to Global initiative for chronic Obstructive Lung Disease (GOLD) guidelines.\(^{16}\) We excluded patients that were in unstable or terminal stages of disease other than COPD or if they were unable or unwilling to undergo study procedures. The control group consisted of 22 healthy volunteers aged \(\geq 65\) years and without history of chronic diseases, except controlled arterial hypertension. National Ethics Committee reviewed and approved the study protocol. Patients were given verbal and written information about the study and gave written informed consent before any study related procedure.

**Study procedures and measurements**

Demographic characteristics, patient history of chronic disease, and smoking status, were retrieved at patient interview during hospitalisation or from medical records. Routine measurements included pulmonary function (forced expiratory volume in 1st second - FEV1, and vital capacity - VC), body height, body weight, systolic and diastolic blood pressure and heart rate. Nutritional assessment using MNA questionnaire, body composition measurement, and dyspnoea evaluation were performed by same investigator one day before or on discharge day. Subjects from control group received same assessment during scheduled visit. Patients were regularly contacted during follow-up and returned for a visit at 6 months. Patients and/or relatives were reminded to attend the visit at phone contact within one week prior to scheduled visit date.

The Mini Nutritional Assessment (MNA\(^{\circ}\)) questionnaire

The MNA questionnaire is an internationally validated, two-step procedure that includes screening for risk of malnutrition and global assessment of the nutritional conditions.\(^{11}\) Patient total score can range from 0 to 30 points, and patients are classified as malnourished (\(\leq 17\) points), at risk of malnutrition (17.5-23.5), or well nourished (\(>23.5\)).

**Body composition evaluation by bioelectrical impedance analysis**

Bioelectrical impedance analysis (BIA) was performed using a tetra polar RJL Systems Quantum II (RJL Systems, Clinton Twp, MI, USA) with the emission of a low electrical current (500 to 800 mA and 50 kHz), and standard protocol was used.\(^{10}\) The patient was studied after 10 min rest in the supine position, without shoes and stockings. The patient’s upper and lower limbs were arranged at an angle of approximately 30\(^{\circ}\) from the midline. Electrodes were connected to the hands (wrist and middle finger) and feet (ankle and above the knuckle of the toe), after the areas were cleaned with alcohol. The patient’s right side was standardised for the test. The instructions for use of the equipment were obtained from the manufacturer. We evaluated body fat, lean body mass, and total body water.

**Dyspnoea evaluation**

Modified Medical Research Council (MMRC) Dyspnoea Scale was used to evaluate patient’s dyspnoea perception. MMRC is a simple self-administered 5-point scale that quantifies the effect of breathlessness on daily activities.\(^{17}\)

**Statistical analysis**

The primary outcome is rehospitalisation during 6 month follow-up, and was assessed at follow-up visit, during phone contact or from medical records. Secondary outcomes were MNA score and body composition parameters. Continuous variables are presented as mean values ± standard deviation. Categorical variables are presented as absolute numbers (%). Differences between the patient subgroups (e.g. per MNA risk assessment) were evaluated using the Student’s \(t\)-test, chi-squared test, Mann-Whitney U test, and analysis of variance (ANOVA) as appropriate. Kaplan-Meier survival curves were used to present occurrence of primary endpoints during follow-up. The difference between patient groups according to the MNA risk assessment was compared using the log-rank test. The relationship between primary endpoint and potential predictors was evaluated with Cox models of proportional hazards. Age, gender, GOLD stage, body fat mass, lean body mass, and MNA risk assessment were forced into univariate and adjusted multivariate model. We report hazard ratios (HR) and corresponding 95% confidence intervals (CI). SPSS 16.0 software (SPSS Inc., 2007, Chicago, IL, USA) and Prism 5 for Windows (GraphPad Software, Inc., San Diego, CA) was used for data presentation and statistical calculations. For all tests a \(p\) value of \(<0.05\) was considered statistically significant.

**Results**

**Patient characteristics**

Our sample included 22 healthy controls (71±5 years, 59\% men) and 108 COPD patients (71±10 years, 75\% men) - Table 1. Most patients had severe (42\%) or very severe COPD (43\%) and received following inhalation therapy: short acting beta agonists in 95\%, long acting beta agonists in 82\%, inhaled corticosteroids in 72\%, and tiotropium in 51\%.
Table 1
Baseline characteristics

<table>
<thead>
<tr>
<th>All subjects</th>
<th>Controls</th>
<th>Patients</th>
<th>p</th>
<th>Mini Nutritional Assessment</th>
<th>Well nourished</th>
<th>At risk of malnutrition</th>
<th>Malnourished</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>22</td>
<td>108</td>
<td></td>
<td></td>
<td>34</td>
<td>59</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Age [years]</td>
<td>71±5</td>
<td>71±10</td>
<td>0.95</td>
<td></td>
<td>68±10</td>
<td>71±10</td>
<td>75±17</td>
<td>0.08</td>
</tr>
<tr>
<td>Men</td>
<td>13 (59%)</td>
<td>81 (75%)</td>
<td>0.13</td>
<td></td>
<td>28 (82%)</td>
<td>42 (71%)</td>
<td>11 (73%)</td>
<td>0.48</td>
</tr>
<tr>
<td>Current or ex-smoker</td>
<td>0</td>
<td>99 (92%)</td>
<td>NA</td>
<td></td>
<td>33 (97%)</td>
<td>52 (88%)</td>
<td>14 (93%)</td>
<td>0.19</td>
</tr>
<tr>
<td>Pack-years</td>
<td>0</td>
<td>50±32</td>
<td></td>
<td></td>
<td>48±28</td>
<td>49±36</td>
<td>59±22</td>
<td>0.50</td>
</tr>
<tr>
<td>MMRC Dyspnoea Scale</td>
<td>1.4±0.6</td>
<td>3.4±1.1</td>
<td>&lt;0.001</td>
<td></td>
<td>3.1±0.9</td>
<td>3.3±1.2</td>
<td>4.0±0.9</td>
<td>0.037</td>
</tr>
<tr>
<td>GOLD stage</td>
<td>0</td>
<td>3.3±0.7</td>
<td></td>
<td></td>
<td>3.1±0.7</td>
<td>3.3±0.7</td>
<td>3.6±0.6</td>
<td>0.06</td>
</tr>
<tr>
<td>Forced expiratory volume in 1st second [%]</td>
<td>2787±866</td>
<td>943±461</td>
<td>&lt;0.001</td>
<td></td>
<td>1153±544</td>
<td>901±393</td>
<td>625±244</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Vital capacity [ml]</td>
<td>3627±1174</td>
<td>2251±861</td>
<td>&lt;0.001</td>
<td></td>
<td>2455±952</td>
<td>2231±826</td>
<td>1865±661</td>
<td>0.08</td>
</tr>
<tr>
<td>Tiffeneau index [%]</td>
<td>77±5</td>
<td>43±14</td>
<td>&lt;0.001</td>
<td></td>
<td>48±15</td>
<td>34±14</td>
<td>23±9</td>
<td>0.005</td>
</tr>
<tr>
<td>Systolic blood pressure [mmHg]</td>
<td>135±18</td>
<td>137±22</td>
<td>0.70</td>
<td></td>
<td>144±22</td>
<td>134±22</td>
<td>130±21</td>
<td>0.06</td>
</tr>
<tr>
<td>Diastolic blood pressure [mmHg]</td>
<td>78±11</td>
<td>79±13</td>
<td>0.66</td>
<td></td>
<td>84±11</td>
<td>78±14</td>
<td>75±13</td>
<td>0.07</td>
</tr>
<tr>
<td>Heart rate [beats per minute]</td>
<td>71±13</td>
<td>91±19</td>
<td>&lt;0.001</td>
<td></td>
<td>91±22</td>
<td>91±19</td>
<td>90±15</td>
<td>0.98</td>
</tr>
</tbody>
</table>

Data are presented as mean±standard deviation or number (%).

MMRC: Modified Medical Research Council; GOLD: Global Initiative for Chronic Obstructive Lung Disease.

**Nutritional risk assessment and body composition**

MNA score was significantly higher in control subjects than in COPD patients (27.0±1.7 vs 21.2±4.9, p<0.001). All control subjects were well nourished and none was at risk of malnutrition or malnourished. MNA score decreased over GOLD stage (p=0.02) and indicated malnutrition in 14% of patients (6%, 9%, and 21% in GOLD stage 2, 3, and 4 - p=0.17), and further 55% were at risk of malnutrition - Fig. 1 and Table 1. Perception of dyspnoea was more severe in malnourished patients.

Body mass index but not body composition parameters was higher in control subjects when compared to COPD patients (29.1±3.8 vs 27.0±6.3, p=0.041). Table 2 summarizes body composition parameters in patients divided by MNA risk assessment. Malnourished patients were leaner, had lower body mass, body fat mass, and lean body mass but higher body fat content when compared with well nourished patients or patients at risk for malnutrition. A positive correlation between MNA score, body fat mass (p=0.001), and lean body mass (p<0.001) was observed (Fig. 2).

**Prognosis**

During 180 days of follow-up, primary endpoint was met by 45 (41%) patients: 35% of well nourished patients, 39% of patients at risk for malnutrition, and 67% of malnourished patients (p=0.10). Nutritional status but not body composition and GOLD stage were associated with worse outcome (Fig. 3 and Table 3). Malnourished patients had higher risk of rehospitalisation in univariate analysis (HR 2.62, 95%CI 1.13-6.07), which was maintained in an adjusted model (HR 2.93, 95%CI 1.05-7.32).
Discussion

This prospective study is first to report about nutritional risk assessment, body composition parameters, and hospitalisations in COPD patients. Malnutrition was frequent, associated with lower body fat mass and lean body mass, and independently predicted hospitalisations at 6 months. Patients with chronic diseases, including COPD, are prone to body wasting, poor nutritional status, and cachexia. Little, however, is known about nutritional risk assessment using the MNA questionnaire. In a study of 32 COPD patients (71.8 ± 6.0 years, 31 men, FEV1 47 ± 13% predicted), 14 were characterised as at risk of malnutrition, which was independent of age and body mass index. The severity of dyspnoea as assessed by MMRC Dyspnoea Scale was significantly higher in patients at risk of malnutrition, which was independent of age and body mass index. The largest study (N = 460, 75 ± 5 years, 82% men) investigated the relations between age, COPD and nutritional status.
They concluded that severe COPD and advanced age are independent and likely concurrent conditions that can cause malnutrition. Additionally, they suggest that MNA questionnaire gives a valuable insight into nutritional status with important therapeutic implications.

We confirm many previous findings and provide additional insight into nutritional status assessment. We compared body composition in different nutritional states and demonstrated that malnourished patients have significantly higher body fat content but significantly lower body fat mass. This finding could be regarded as contradictory but it may well have a reasonable explanation. Over COPD continuum, initially reversible body mass loss is ensuing. As energy stores per weight unit in fat tissue are about twofold larger as in muscle tissue, and since physical activity, the main anabolic trigger is diminishing, skeletal muscle is depleting faster than fat tissue. This translates to different proportions between body compartments favouring higher body fat content. Such observations are shared with other chronic diseases characterised with body wasting and cachexia.18,19

From a global perspective, malnutrition is frequent finding in European hospitals and is associated with poor outcome.20 In this context, most important finding of this study is that malnutrition independently predicted hospitalisations 6 months after discharge. Body mass index, although known to be associated with mortality,5 and body composition parameters were not predictive of outcome. This, in turn, means that MNA questionnaire carries more messages for the clinicians who would like to prevent recurrent hospitalisations in COPD patients. Additionally, results of MNA questionnaire are easier to translate to clinical practice than results of body composition assessment. An important aspect is that malnutrition, as opposed to cachexia, is accessible to effective management.21 Nutritional interventions, combined with anabolic stimuli, can reverse nutritional status and reduce mortality risk.22

Limitations

This study needs to be interpreted with some caution. Sample size may be regarded as insufficient and mortality could be more objective outcome measure. Nonetheless, considering high event rate of 41% during 6 months of follow-up and significant hospitalisation burden, both for patient and health care system, renders hospitalisations as attractive target to focus on. This is particularly true in light of relatively optimal pharmacological therapy23 which however has no proven mortality benefit.16

Conclusions and clinical implications

Our and previous findings suggest that nutritional risk assessment should be part of routine practice in COPD management. It can guide self-care behaviour counselling, therapeutic education, specific nutritional interventions,24 training modalities,25 and pharmacological interventions.26 Particular attention needs to be given to malnourished patients who are at high risk of rehospitalisations, independent of their body size and composition. Future studies have to investigate whether malnutrition is associated with mortality and whether this effect is independent of other known outcome predictors.

Conflict of interest statement

The authors declare that they have no competing interest.

References

MINI NUTRITIONAL ASSESSMENT AND HOSPITALISATIONS IN COPD


21. Lainscak M, Filippatos GS, Gheorghiade M, Fonarow GC, Anker SD. Cachexia: common, deadly, with an urgent need for precise definition and new therapies. Am J Cardiol 2008;101:8E-10E.


