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Original article

The relationship between malnutrition risk and clinical outcomes in a cohort of frail older hospital patients

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SUMMARY

Background & aims: Malnutrition has an adverse effect on clinical outcomes and frail older people may be at greater risk of malnutrition. The purpose and aims of this study was to investigate the relationship between markers of malnutrition risk and clinical outcomes in a cohort of frail older hospital patients.
Methods: 78 frail older hospital patients had the following measurements recorded; length of stay (LOS), time to medical fitness for discharge (TMFFD), body mass index (BMI), malnutrition universal screening tool (MUST) and mini-nutritional assessment short-form (MNA-SF) scores, blood urea, C-reactive protein (CRP), albumin, CRP-albumin ratio; and bioelectrical impedance assessment (BIA) measurements (n = 66). Patients were grouped by mortality status 12 months post hospital admission. Grouping by albumin classification was performed (n = 66) whereby, <30 g/l indicated severe malnutrition, 30–34.9, moderate and >35, low. Receiver-operating characteristic (ROC) curve analysis was performed on variables as potential predictors of mortality.
Results: After 12 months, 31% (n = 24) of patients died. LOS was significantly greater in this group (25.0 ± 22.9 vs 15.4 ± 12.7d, P < 0.05). BMI (23.8 ± 4.9 vs 26.4 ± 5.5 kg/m^2); fat mass (FM) (17.2 ± 9.9 vs 25.5 ± 10.5 kg), fat mass index (FMI) (9.3 ± 4.1 vs 17.9 ± 2.4 kg/m^2); and MNA-SF score (6.6 ± 2.4 vs 8.6 ± 2.7) were significantly lower (P < 0.05), and urea significantly higher (11.4 ± 8.7 vs 8.8 ± 4.4 mmol/l, P = 0.05). Albumin was typically low across the entire group (30.5 ± 5.9 g/l) and a potential relationship was identified between albumin and MNA-SF score. MNA-SF, FM, and FMI were significant predictors of mortality outcome by ROC curve analysis, whereas MUST was a poor predictor.
Conclusion: This study highlights a potential relationship between indicators of malnutrition risk and clinical outcomes in frail older hospital patients which should be studied in larger cohorts with an aim to improve patient care.

1. Introduction

Frail older people may be admitted to hospital wards suffering from a range of acute and chronic disease/s, with signs and symptoms of physical and/or cognitive frailty and be on multiple medications. Identifying possible nutritional risk/malnutrition is important and may affect trajectory of health, morbidity, and mortality [1–4]. Different screening methods exist including the '*malnutrition universal screening tool*' (MUST) [1,5], the '*mini-nutritional assessment*' (MNA) [1,6–8] and the '*geriatric nutritional risk index*', (GNRI) [9]. In the United Kingdom (UK), the MUST is the standard routine method of screening in all hospital wards and care homes, although in reality there is no universal gold standard tool [4]. We showed recently in a cohort of frail older hospital patients that there is a significant discordance between MUST and 'MNA-short form' (MNA-SF) malnutrition screening categorisation [10]. The MUST predominantly categorized patients as 'low risk' (77%) and MNA-SF predominantly as 'at risk' (46%) and 'malnourished' (45%). Reliability assessment found poor reliability between the screening tools and bioelectrical impedance assessment (BIA) assessment was in general agreement with MNA-SF scoring patterns, especially in male patients. A potential body mass index (BMI) paradox was also highlighted whereby some patients who were 'at risk' or 'malnourished' by MNA-SF scores had normal BMI

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and depleted/borderline BIA measurements of fat free mass (FFM)/fat mass (FM) and specifically indices (FFMI and FMI, in kg/m^2). Potential reasons for the observed MUST-MNA-SF discordance include: the MUST uses World Health Organization (WHO) BMI grading criteria, and there maybe difficulty in obtaining accurate weight loss information in this patient group. Further, the MNA-SF has additional screening questions on 'mobility' and 'neuropsychological problems' which would create a tendency to score worse in a frail older patient group.

An important area to address which overlaps malnutrition is 'cachexia'/'cachexia-risk', as acute and chronic illness has a typical effect upon food intake (anorexia) and metabolism (e.g. hypermetabolism and raised protein breakdown), principally through actions of circulating proinflammatory cytokines [11,12]. Other measurable domains of nutritional status which are sensitive to malnutrition and inflammation include important blood markers such as albumin, which is utilised in the GNRI [9], and is a well known prognostic marker [13–16]. C-reactive protein (CRP) is another routine blood marker indicating inflammatory status and has known prognostic potential [17,18]. Recently, the CRP/albumin ratio has been used to better predict mortality risk in septic patients [19].

A better understanding of the relationship between malnutrition risk screening, body composition assessment and blood markers in heterogeneous groups of frail older hospital patients on clinical outcomes may improve coordinated hospital nutritional care in the UK.

This study was undertaken in a heterogeneous group of frail older adults admitted to wards specialising in elder care in the UK. We examined outcome of hospital admission, length of stay (LOS), time to medical fitness to discharge (TMFFD) and mortality at 12 months post admission and related them to inpatient measurements of MUST, MNA-SF and BIA. Further, examination was made of routine blood markers, urea, albumin, CRP, and the CRP/albumin ratio to investigate their importance in relation to malnutrition risk and outcomes.

2. Methods

2.1. Participants and study design

This cohort study was undertaken between September 2012 and May 2013 and recruits were from a purposive sampling from admissions to two hospital wards in Lincoln, UK specializing in care of frail older patients [10]. Full ethical approval was obtained from NHS Leicester, East Midlands Research Ethics Committee (ref: 12/EM/0186) prior to study commencement, ethical guidelines followed and informed consent sought from all patients. Exclusion criteria from the study were: patients unable or unwilling to give informed consent and patients who were nil by mouth or tube fed. BIA measures were contraindicated in patients with defibrillation or cardiac pacemaker devices. The aim was to recruit 100–150 patients in-line with other similar studies; however the exclusion criterion of ability to consent and designated study time restraints dictated the current number. Patients were followed from admission to 12 months post admission with outcomes recorded including: TMFFD, LOS in hospital (days), and deaths at 12 months. Blood measurements were also recorded where available.

3. Nutritional assessment

3.1. MUST tool and MNA-SF® screening

MUST and MNA-SF® screening was performed as described previously [10], whereby screening scores were converted into categories for nutritional status using MUST and MNA-SF® scoring criteria either 'low risk'/'normal' (0 points-MUST, 12–14 MNA-SF), 'medium risk/at risk' (1 point-MUST, 8–11 MNA-SF) and 'high risk'/'malnourished' (≥2 points-MUST, 0–7 MNA-SF).

3.2. Anthropometric measurements

Height (m) and weight (kg) measurements were performed as described previously [10].

3.3. Bioelectrical impedance measurements

BIA measurements were performed as described previously [10], using the Kyle et al. [20] equation for estimation of FFM (kg) and FM (kg) and index values, FFMI (kg/m^2) and FMI (kg/m^2), and compared to reference values [21].

3.4. Blood markers

Routine blood markers were collected and measured in-line with normal patient care in hospital. Ethical clearance was obtained to utilise these as part of the research study. Markers utilised and analysed included; urea, albumin, C-reactive protein (CRP) and the CRP-albumin ratio. Patients were also classified according to albumin level and 'malnutrition severity', using an adapted method from paper by Bouillanne et al. [9], i.e. <30 g/l: severe; 30–34.9 g/l: moderate; and >35 g/l low + absent combined.

3.5. Data analysis

Data is presented as mean average measurements ± standard deviation (SD) with a range (minimum–maximum) and [median] values. Data has been grouped into 'alive' and 'deceased' at 12 months post admission and where relevant into nutritional screening categories by albumin. Statistical analysis was performed using IBM SPSS Statistics, version 21, New York, USA. T-tests and Pearson correlations were used for normally distributed data and Mann-Whitney-U and Spearman correlations test for nonparametric data. ANOVA and Bonferronni post-hoc test were performed on more than two groups of data. Categorical differences were analysed using Chi-squared testing. Receiver-operator characteristic (ROC) curve analysis methods were performed on raw data of variables to evaluate their predictive performance on the prediction of mortality outcome in patients [22]. A P value of <0.05 was considered statistically significant.

4. Results

Data was recorded for 78 patients and followed up 12 months post admission. Within patient medical notes, blood markers were available for the following: albumin (n = 66 patients), urea (n = 76), CRP (n = 73), and CRP/albumin ratio (n = 65). Patients were grouped according to mortality status at 12 months and data is presented in Table 1. LOS and urea measurements were significantly higher in the deceased group; and BMI and MNA-SF score significantly lower. Patients had BIA measured (n = 66) as completed previously [10] and grouped by mortality status (Table 2). FM and FMI by BIA were found to be significantly lower in patients who died.

4.1. Classification by albumin level

Grouping patients by albumin level as a potential indicator of nutritional status is shown in Table 3. The relationship of albumin level against MNA-SF score is depicted in Fig. 1 with cut-off points shown. The scatter plot allows visualisation and stratification of

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