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Original article

Bedside measures of malnutrition and association with mortality in hospitalized adults☆

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SUMMARY

Background & aims: The impact of malnutrition on the outcomes of hospitalized adults in resource-limited settings such as sub-Saharan Africa (SSA) is not fully described. We aimed to determine the association between malnutrition and mortality in adults admitted to hospital in the resource-limited setting of Southwestern Uganda.

Methods: We performed a cohort study of adults admitted to the medical ward of Mbarara Regional Referral Hospital. Measures of nutritional status included: 1) body mass index (BMI), 2) the mini-nutritional assessment short form (MNA-sf), and 3) mid-upper arm circumference (MUAC). Subjects were followed until death or 30 days from admission. We used proportional hazards regression to assess associations between malnutrition and in-hospital and 30-day mortality.

Results: We enrolled 318 subjects. The prevalence of malnutrition was 25–59% depending on the measure used. In-hospital and 30-day mortality were 18% and 37% respectively. In the adjusted analysis, subjects with MNA-sf score 0–7 had a 2.7-fold higher risk of in-hospital mortality (95% CI: 1.3–5.9, $p = 0.011$) than those with a score of 8–14, and subjects with malnutrition determined by MUAC (<20 cm for males, and <19 cm for females) had a 1.8-fold higher risk of in-hospital mortality (95% CI: 0.98–3.4, $p = 0.06$) than those normally nourished. MNA-sf (HR 1.6, 95% CI: 1.02–2.6, $p = 0.039$) and MUAC (HR 1.6, 95% CI: 1.0–2.3, $p = 0.048$) were independently predictive of 30-day mortality. BMI <18.5 was not associated with in-hospital or 30-day mortality.

Conclusions: Malnutrition was common and simple measures of nutritional status predicted in-hospital and 30-day mortality. Further research is needed to understand the pathophysiology of malnutrition during acute illness and mitigate its effects.

1. Introduction

Slim disease was first described in Uganda in 1982 heralding the onset of the AIDS pandemic.[1] In 2005, 212 million people in sub-Saharan Africa (SSA) were estimated to be malnourished with the highest prevalence (37%) occurring in Southern Africa, followed by East Africa (35%).[2] Malnutrition and AIDS remain intrinsically linked, and wasted patients initiating antiretroviral therapy in SSA are at high risk of early death.[3–5] SSA is highly endemic for tuberculosis (TB) which, along with malnutrition and AIDS, also negatively affects body composition.[6]

Severe malnutrition leads to an immune suppressed state. As a consequence, malnourished patients are at higher risk for infectious complications.[7] For example, malnourished hospitalized patients are at higher risk for nosocomial bloodstream infections.[8] Despite the high prevalence of malnutrition, AIDS, and TB in SSA, little is known about the overall impact of malnutrition on the course of illness among adult inpatients in SSA.[9,10] A study from Burundi revealed that almost half of adult inpatients admitted to hospital had at least moderate malnutrition, and found that

Non-standard abbreviations: SSA, sub-Saharan Africa; TB, tuberculosis; MRRH, Mbarara Regional Referral Hospital; MUST, Mbarara University of Science and Technology; BMI, body mass index; MNA-sf, mini-nutritional assessment short form; MUAC, mid-upper arm circumference; HB, hemoglobin; MAP, mean arterial pressure; ART, antiretroviral therapy.

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decreased fat free mass and triceps skinfold thickness were predictive of early mortality but actual weight and body weight loss were not associated with mortality.[11]

To better understand the association between malnutrition and outcomes in hospitalized adult patients in SSA, we conducted a prospective observational study at the Mbarara Regional Referral Hospital (MRRH) in Southwestern Uganda. We measured malnutrition using three measures of nutritional status.

2. Methods

2.1. Study design and patient population

We performed a prospective observational cohort study on the adult medical ward of MRRH, a 350 bed government teaching hospital for the Mbarara University of Science and Technology (MUST) located about 280 km southwest of the capital city, Kampala. We consecutively enrolled subjects ≥18 years who were hospitalized for an acute medical illness between April and May 2011. Subjects that were unable to participate in the weighing process or those who declined participation were excluded. We defined the primary exposure as malnutrition at admission and the primary outcome as in-hospital mortality. Secondary outcomes included length of hospital stay, 30-day mortality, or being lost to follow up at 30 days post-admission. The Institutional Review Boards at MUST and the University of Virginia approved the study.

2.2. Measures of nutritional status

We assessed malnutrition using the mini-nutritional assessment short form (MNA-sf), mid-upper arm circumference (MUAC), and the body mass index (BMI). The MNA-sf is a scoring system that incorporates anthropometric measures, questions on food intake and weight loss; and questions on psychological stress and neuropsychiatric problems.[12] To obtain the MUAC, we first determined the midpoint between the acromial and olecranon processes with a flexible tape. We then measured the MUAC from this point using a non-stretchable MUAC tape to the nearest 100th of a centimeter. To obtain the BMI, we divided the square of the subjects' height (estimated from heel to occiput to the nearest 100th of a meter) by their dry weight (estimated to the nearest 10th of a kilogram). Weights were measured with a standing scale (SECA, Chino, California, USA) for subjects who could stand, and a wheelchair scale (SECA, Chino, California, USA) for those who could not, while heights were measured with a wall tape (SECA, Chino, California, USA) for subjects who could stand, and a flexible measuring tape (SECA, Chino, California, USA), for those who could not. Given their acute illness, subjects were measured once to minimize discomfort. We standardized weighing scales at the beginning of the study and calibrated them every two weeks using a third standing weighing scale.

2.3. Demographic, clinical, and laboratory-based measurements

We collected demographic information including age, sex, and educational status, and clinical information, including suspected TB, HIV status, and vital parameters using a pretested questionnaire. For each patient, we also obtained a complete blood count (Beckman Coulter, Villepinte, France), the HIV serostatus using a three-test algorithm (screening: Determine™, Abbott Laboratories, Abbott Park, IL; confirmation: Statpak, Chembio Diagnostics, Medford, NY; tie-breaker: Unigold, Trinity Biotech, Bray, Ireland), and serum albumin using the photometric colorimetric test (Human Diagnostics, Wiesbaden, Germany). Tests were performed at the Mbarara University Research Laboratory which participates in external quality assurance programs by the National Health Laboratory Service (Johannesburg, South Africa).

2.4. Outcome determination

We followed subjects in the hospital until either death or discharge, and established the vital status of discharged subjects at 30 days post-admission through mobile telephone calls and outpatient clinic appointments.

2.5. Statistical analyses

We summarized demographic and baseline clinical variables using median and interquartile range (IQR) for continuous variables, and proportions for binary and categorical variables. MNA-sf and MUAC were transformed into 2-level categorical variables (0–7 and 8–14 for MNA-sf; <20 cm for males and <19 cm for females for MUAC). The BMI was transformed into a 3-level categorical variable: low (<18.5 kg/m^2), normal (18.5–25 kg/m^2), and high (>25 kg/m^2). Serum albumin values <3.5 g/dl were considered abnormal. We assessed the association of malnutrition with in-hospital and 30-day mortality using Kaplan–Meier techniques and proportional hazards regression. In multivariable models, we included one measure of nutritional status at a time while adjusting for age, sex, education status, HIV status, suspected TB, temperature, hemoglobin (HB) and admission mean arterial pressure (MAP). HB and MAP were transformed into restricted cubic splines for the analysis because they showed non-linear relationships with mortality. Any missing data noted during analysis were cross-checked and obtained from patient notes. We estimated that a sample size of 318 patients was needed to detect a hazard ratio ≥1.7 for 30-day mortality comparing malnourished to normally nourished subjects. Data were analyzed using Stata 13 (Stata Corp, Texas, USA).

3. Results

We assessed 355 subjects and enrolled 318. We excluded 34 subjects who were <18 years and 3 who declined to participate. The median age was 37 (IQR 27–56) years (Table 1). Nearly half the subjects were HIV infected (144 of 318, 45%) and a similar proportion were diagnosed with suspected TB (133 of 318, 42%). The prevalence of malnutrition according to MUAC, BMI, and MNA-sf was 25%, 47%, and 59% respectively (Table 1). The in-hospital mortality was 18% (57 of 318) and increased to 37% (117 of 318) at 30 days from admission. For subjects discharged alive, the median length of hospital stay was 6 days (IQR 3–9).

3.1. Prediction of in-hospital mortality

The MNA-sf and MUAC were both associated with in-hospital mortality (Table 2). In the unadjusted analysis, subjects with a low MNA-sf score had a 2.7-fold higher risk of in-hospital mortality (95% CI: 1.4–5.4, $p = 0.005$) compared to those with high scores. Subjects with a low MUAC had a 2.0-fold higher risk of in-hospital mortality (95% CI: 1.2–3.5, $p = 0.010$) compared to those with a high MUAC. A low BMI was not associated with in-hospital mortality when compared to a normal BMI (HR 1.6, 95% CI: 0.92–2.9, $p = 0.098$). In the adjusted analysis, subjects with a low MNA-sf score had a 2.7-fold higher risk of in-hospital mortality (95% CI: 1.3–5.9, $p = 0.011$) than those with a high MNA-sf score. Subjects with a low MUAC had a 1.8-fold higher risk of in-hospital mortality (95% CI: 0.98–3.4, $p = 0.060$) than those with a high MUAC (Table 2). A low BMI was not associated with in-hospital mortality

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