An observational study of perioperative nutrition and postoperative outcomes in patients undergoing laparotomy at Queen Elizabeth Central Hospital in Blantyre, Malawi

Kondwani G.H. Katundu¹, Timothy W. Mutafya², Noel C. Lozani², Patrick M. Nyirongo², Molly E. Uebele³,
¹. Division of Physiology, College of Medicine, University of Malawi, Blantyre, Malawi
². College of Medicine, University of Malawi, Blantyre, Malawi
³. College of Medicine, University of Malawi, Blantyre, Malawi

Abstract

Background
Nutritional status in patients undergoing surgery can influence their immune function, tissue repair and, hence, clinical outcomes. This study aimed to assess the perioperative nutrition and postoperative outcome of patients undergoing laparotomy at a tertiary hospital in Malawi.

Methods
A total of 25 patients were included in this prospective, observational study. The Subjective Global Assessment was used to classify each patient according to nutritional status. Handgrip strength was measured for each patient preoperatively and at day 3 postoperatively. Anthropometric measurements were also done. Protein and energy requirements for each participant were estimated and compared to the quantities provided by the hospital diet. Patients were followed up until discharge and outcome variables which included length of hospital stay and wound dehiscence or infectious complications were recorded.

Results
Of the study participants, 20% were well-nourished, 52% were moderately malnourished and 28% were severely malnourished. The median handgrip strength decreased at day 3 postoperatively from the preoperative handgrip strength. Well-nourished patients had higher handgrip strength than malnourished patients both preoperatively and postoperatively. Total energy and protein provided by the hospital diet were significantly lower than the estimated requirements for the patients. Severely malnourished patients had increased median length of hospital stay and increased rate of postoperative complications. Preoperative and postoperative day 3 handgrip strength correlated negatively with the number of postoperative complications and length of hospital stay.

Conclusion
This study showed high rates of malnutrition and inadequate in-hospital nutritional support which were associated with poor clinical outcomes, especially in severely malnourished patients. Proper nutritional assessment and provision of adequate nutritional support should be reinforced in surgical patients to promote favourable clinical outcomes postoperatively. Further studies with larger sample sizes in other patient populations and hospitals in Malawi are required in this area.

Introduction
Malnutrition remains a challenge and is highly prevalent among in-patients¹². Globally, current data suggest that 19 to 59% of hospitalised adults have malnutrition, with the higher range in low-income and middle-income countries³⁻¹⁰. Malnutrition is of special importance for the surgical patient due to its influence on postoperative patient outcomes. The association between preoperative weight loss and surgical mortality was first documented in 1936 by Studley¹¹. Since then, considerable evidence has shown that preoperative malnutrition is associated with postoperative complications, including infection, delayed wound healing, and increased length of hospital stay¹². Furthermore, several studies have shown that treatment of severe malnutrition before surgery improves postoperative clinical outcomes¹³⁻¹⁵. Malnutrition refers to a state of inadequate or excess nutrition, with or without the presence of inflammation, which leads to changes in body composition and impaired physiologic function¹⁶. An individual who presents for surgical evaluation may have comorbidities that predispose to chronic disease-related malnutrition, such as HIV, organ failure, cancer, metabolic syndrome, and many other conditions characterised by persistent moderate inflammation¹⁷. Preoperative malnutrition could also result from simple starvation-related malnutrition, defined as chronic undernutrition in the absence of an inflammatory condition. Regardless of preoperative nutrition status, all patients are at an increased risk of acute disease-related malnutrition after surgery¹⁷. Any physiologic injury stimulates a metabolic stress response mediated by inflammatory cytokines and catecholamines. Collectively, these increase energy expenditure and muscle proteolysis in proportion to the severity of the injury¹⁸. Coupling this with decreased or restricted nutrient intake and decreased mobility postoperatively leads to rapid deterioration of lean body mass and function¹⁹. Thus, even a well-nourished or
over-nourished patient who undergoes a major surgery can develop severe acute disease-related malnutrition within as little as 10 days if not fed appropriately. Evidence-based recommendations are available to guide nutritional care in the perioperative period. Preoperative nutrition therapy recommendations are dependent on the patient’s nutritional status. As such, all patients should be screened for malnutrition risk prior to surgery and evaluated by a diettian if identified at high risk. If the patient is diagnosed with severe malnutrition and the surgical intervention is not emergent, the surgery should be postponed to 10 days while the patient is given appropriate nutritional support.

On the day of surgery, the European Society of Anesthesiology recommends that patients be allowed to eat solid food up to 6 hours before surgery. Intake of clear liquids is encouraged up to 2 hours before surgery, from which point the patient should take nothing by mouth. The Enhanced Recovery After Surgery (ERAS) protocol, which has repeatedly shown significant benefits for patients undergoing gastrointestinal surgery, includes preoperative carbohydrate loading with a clear liquid beverage to possibly reduce postoperative insulin resistance, nausea, and vomiting.

After surgery, most patients can resume a normal diet. There is no evidence that gastric decompression or fasting after surgery is beneficial. Rather, enteral feeding or a solid diet should commence within 24 hours. Due to the metabolic stress associated with surgery, surgical patients have increased protein and kilocalorie requirements after surgery. At least 60% of protein requirements should be met within 7 to 10 days to prevent complications of malnutrition. Thus, the European Society of Critical Care Medicine and Parenteral Nutrition guidelines state that all patients should be fed by mouth soon as possible, preferably within 24 hours, or initiated on enteral tube feeding if not anticipated to eat orally in 7 days. In cases of intestinal failure, parenteral nutrition could be initiated as soon as possible for a malnourished patient, or after 7 days for a well-nourished patient when oral or enteral nutrition does not seem feasible in the following 3-7 days.

Currently, there is paucity of data on the quality of nutrition care services offered to surgical patients in Malawi, against these evidence-based guidelines. Furthermore, there is dearth of data regarding the nutrition status of adult hospitalised patients in Malawi. Therefore, this prospective observational study was aimed at assessing the preoperative nutrition status and the currently available nutrition interventions for adult surgical patients undergoing laparotomy at a tertiary referral hospital in Malawi. The nutrition provided to patients by the hospital was evaluated for adequacy of protein and kilocaloric content, as surgical patients require increased intake of these nutrients to mitigate the catabolic effect of metabolic stress. The influence of these factors on postoperative outcomes was also investigated.

Methods Study population
This prospective observational study was conducted at Queen Elizabeth Central Hospital (QECH) in Blantyre, Malawi, and enrollment was done between July and September 2016. Adult patients admitted to the male and female surgical wards and scheduled for laparotomy were enrolled in the study. Because immunosuppression is one of the main drivers of malnutrition-related consequences, 28 participants with HIV infection and confirmed cancer diagnosis were excluded from the study. Participants aged 65 years and those who did not provide informed consent and also alcoholics (15%) and power of 80%, the sample size was calculated at 25 participants, to detect at least 20% prevalence of malnutrition in the study population. The study protocol was approved by the College of Medicine Research and Ethics Committee (MRB/08/16/02). Written informed consent was sought and provided by all the participants before their inclusion into the study. To ensure the protection of privacy and confidentiality of the information provided, study codes (and not names) were used on the data collection sheets for individual participants. Data that could identify the individual participants was securely stored and was only accessible to the study investigators.

Nutrition assessment
The Subjective Global Assessment (SGA) was used to assess and classify each patient’s nutritional status as severe malnutrition (SGA Class C), mild or moderate malnutrition (SGA Class B), or well nourished (SGA Class A). The SGA is a globally recognised, validated nutrition assessment tool that uses clinical history and physical exam to evaluate nutrition status and predict outcomes. SGA uses a scoring system based on the clinician’s subjective assessment (mild, moderate, or severe) of the patient’s reported dietary intake, weight changes, gastrointestinal symptoms and functional capacity along with the degree of metabolic stress in their diagnosis. Physical assessment. A registered dietitian trained medical students who were part of the study team how to use the SGA method. Handgrip dynamometry was used to assess functional capacity. Height and weight were measured preoperatively. The anthropometrics were used to calculate the body mass index (BMI). Postoperative protein and energy requirements for each participant were also estimated. Energy (kilocalorie) needs were estimated using the Harris-Benedict equation with an individualised stress factor of 1.2 or 1.3. Protein requirements were dosed between 1.2-1.5 grams/kg body weight. The specific stress factor and protein requirements were determined by an experienced registered dietitian, according to the severity of the surgery and other metabolic stressors.

Outcome monitoring
Patients were followed prospectively until discharge. Outcome variables including length of hospital stay and development of wound dehiscence or infectious complications were recorded. An infectious complication was considered when there was persistent fever (temperature >38°C) 72 hours after surgery. Lastly, handgrip strength was measured in all patients on day 3 postoperatively.

Menu analysis
The recipes for food provided to patients on a standard diet from the hospital kitchen were collected. The hospital menu was referenced and cross-checked with kitchen staff. Portion sizes are not standardised. Therefore, the researchers estimated the average portion sizes by observing the meal service. All the food served to one patient in one day was then analysed for protein and kilocaloric content using the Tanzania Food Composition Table. Since the menu changes during the same day to day, only one day’s menu was analysed.

Statistical analysis
Statistical analysis of the data was done using Stata version 12 (StataCorp, USA) and GraphPad Prism version 7.01 (GraphPad Software, Inc, USA). Normality for the data was assessed using the Shapiro-Wilks test. Descriptive statistics were expressed as median (IQR) for the continuous data. The Wilcoxon rank-sum test (or Mann-Whitney U-test) was used to test the equality of two medians, to investigate the differences in the measured variables. To test for differences between medians of the analysed variables at different time points, the Wilcoxon paired rank-sum test and the Friedman test (K-related samples) were used. To measure the associations between the variables, Spearman’s test of association was used. A p-value of <0.05 was considered statistically significant.

Results
A total of 34 patients were screened and 25 patients who fit the study criteria were included (see Figure 1). The characteristics of the study population are given in Table 1. The sample was well distributed between males and females. The major indication for laparotomy in the study sample was prostatectomy due to benign prostatic hypertrophy and intra-abdominal tumours that had not yet been diagnosed by histopathology. With regards to post-operative complications, 72% of the study participants either developed incisional wound infection or dehiscence. No deaths were recorded from the participants during the study period. According to the BMI classification of nutritional status, most of the patients (76%) had normal weight, only a few were overweight (6%) and none was underweight or obese (see Table 1).

Handgrip strength was assessed in this study to measure the functional capacity of the patients both preoperatively and day 3 postoperatively. Figure 2 shows a comparison of the handgrip strength between the two-time points. Notably, the median handgrip strength for the entire study group was 22.3 kg (20.33) preoperatively but decreased significantly to 18.4 kg (14.27) postoperatively (p<0.0001). Handgrip strength was then analysed by SGA categories (Figure 3). Notably, the handgrip strength was associated with SGA class, where class A had a higher median handgrip strength than classes B and C both preoperatively (class A 33 kg (25.25 - 40.4), class B 25.55 kg (21.85 – 34), class C 20 kg (16 – 22)) (p<0.0001) and postoperatively (class A 27 kg (16.3 – 39), class B 20 kg (17.25 – 27.75), class C 14 kg (12 – 15) (p<0.0004). The daily energy and protein requirement for each patient was calculated, according to both the basal physiological needs and the stress associated with surgery. The typical diet provided by the hospital was porridge with some sugar in the morning, rice and nsima (thick maize porridge) with beans, cabbage or both for lunch and supper.

The diet was analysed and an estimate of the total energy and protein provided through the diet was calculated. Figures 4 and 5 depict comparisons between the total energy requirements and what was administered in the hospital to patients against what was provided. Both the total energy (1279.8 kcal) and protein (31.54) provided by the

Table 1. Characteristics of the study population

| Characteristic              | Males | Females |
|----------------------------|-------|---------|
| Total                      | 15     | 10      |
| Age (years) median (IQR)   | 52     | 46      |
| SGA categories             |        |         |
| Class A (%)                | 9 (60%) | 0%      |
| Class B (%)                | 5 (33%) | 0%      |
| Class C (%)                | 1 (6%)  | 0%      |

Table 2. Characteristics of the study population

| SGA category | Male | Female | Total |
|--------------|------|--------|-------|
| Class A      | 9    | 0      | 9     |
| Class B      | 5    | 0      | 5     |
| Class C      | 1    | 0      | 1     |
| Total        | 15   | 10     | 25    |
hospital diet were statistically significantly lower than the estimated requirements (1564 kcal (1488 – 1809) and 72 g (60.52 – 81)) respectively (p<0.0001). According to the calculated estimates, none of the patients met their energy and protein requirements by the provided hospital diet alone. It should be noted, however, that none of the patients was provided with enteral or parenteral nutrition. Also, these calculations were based on a patient who solely depended on the nutritional support provided by the hospital, and hence no food items provided from other sources were included in the energy and protein analysis of this study. The proportion of postoperative complications in the study group was 72%. Of all these complications, 59% were observed in patients who were in SGA class C, while those of class B contributed 31% and only 10% SGA class A. The median length of hospital stay was 5 days (4 – 7). However, severely malnourished patients (SGA class C) had a median length of hospital stay of 8 days (7 - 9). Well-nourished patients (SGA class A) had a median length of stay of 4 days (4 – 6).

**Discussion**

To our knowledge, this is the first study to assess the nutritional status, nutritional interventions and outcomes in a subset of surgical patients undergoing laparotomy at a tertiary referral hospital in Malawi. The study has revealed that 80% of the patients had some degree of malnutrition with 28% severely malnourished. Considering that at least 39% of Malawian patients are food insecure and that patients at QECH are referred from district hospitals that serve rural communities, this result is not very surprising. Other studies from low-income settings in Africa have reported lower rates of in-hospital adult malnutrition. Uganda and Burundi reported rates of 47% and 59%, respectively. However, low-income regions within Brazil found 78% of adult inpatients, of which more than 50% were surgical patients who were malnourished. Multiple upper-middle income countries have found about 50% of adult inpatients as malnourished. Even in high-income settings, for example Australia and the United States of America, the rate of malnutrition in surgical inpatients may be as high as 48%-56.

The higher rate of malnutrition in the current Malawian population, where it correlates with mortality, although the use of BMI as a less sensitive tool for assessing malnutrition. In an attempt at QECH is to start the patient on a liquid diet only as soon as possible after surgery. In special cases, clinicians prescribe a high protein diet (HPD), which might include an egg and milk. However, HPD is rarely feasible for the kitchen to provide due to budgetary constraints. Otherwise, there are special nutritional interventions available. The analysis of the standard hospital diet in this study showed gross deficiencies in energy and protein requirements.

**Table 2. Association between handgrip strength and outcome variables**

| Handgrip strength v. complications | Handgrip strength v. hospital stay |
|------------------------------------|-----------------------------------|
| Study time                         | Spearman’s rho       | p-value |
|                                    | Spearman’s rho       | p-value |
| Preoperative                       | -0.46                | 0.02    |
| Day 3 postop                       | -0.49                | 0.01    |

**References**

- BMI is not useful because weight changes are rarely feasible for the kitchen to provide due to budgetary constraints. Otherwise, there are special nutritional interventions available. The analysis of the standard hospital diet in this study showed gross deficiencies in energy and protein requirements.
- Poor SGA class has also been associated with increased mortality in other studies. This finding draws attention to the critical importance of nutritional assessment by a trained professional prior to surgery. Currently, to our knowledge, there is no formal nutritional screening or assessment performed in adult inpatients at QECH. Consequently, patients who would benefit from 7-10 days of nutrition repletion before surgery are not identified. There are simple screening tools such as the Nutrition Risk Score 2002 (NRS 2002), Mini Nutrition Assessment (MNA) and the Malnutrition Universal Screening Tool (MUST) that could be implemented to identify patients at high risk of malnutrition for potential preoperative nutrition therapy.

In this study, handgrip strength was significantly lower at day 3 postoperatively than at preoperative assessment. This is an indication of a decline in functional capacity due to loss of lean body mass. Major surgery elicits metabolic responses associated with increased muscle proteolysis and increased energy expenditure that puts patients at risk of acute disease-related malnutrition, where even an excess of adipose tissue will not prevent catabolism of lean tissue. This catabolic state cannot be reversed via protein and energy intake; however, adequate provision slows lean body mass wasting, mitigates the inflammatory response, and, if provided enterally, maintains the integrity of the gastrointestinal tract as a major immune organ. Handgrip strength correlates highly with nutrition status in hospitalised patients, as is replicated in the present study. Moreover, this tool objectively captures a change in nutrition status faster than any anthropometric or laboratory marker. The present study showed that handgrip strength both preoperatively and postoperatively correlated negatively with the length of hospital stay and the rate of complications postoperatively. These results indicate that in-hospital decline in nutritional status was associated with increased risk of complications. These findings, therefore, call to the importance of both the optimal nutritional status of patients before surgery and appropriate nutritional interventions postoperatively. The goal of nutrition therapy after surgery is to ensure the preservation of lean body mass and immune function, which is essential for healing in these patients. For a patient who already exhibits severe muscle wasting, it is imperative that oral, enteral or parenteral nutrition support be initiated as soon as possible after surgery. Postoperatively, the usual practice at QECH is to start the patient on a liquid diet only after 24 hours and in the presence of bowel sounds. The diet is then gradually advanced to a regular solid diet. In special cases, clinicians prescribe a high protein diet (HPD), which might include an egg and milk. However, HPD is rarely feasible for the kitchen to provide due to budgetary constraints. Otherwise, there are special nutritional interventions available. The analysis of the standard hospital diet in this study showed gross deficiencies in energy and protein requirements.
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