

Association of preoperative nutritional status with early postoperative complications following Loop Ileostomy Closure surgery in a Bangladeshi tertiary care hospital

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ABSTRACT

Objective

Preoperative nutritional status is an important predictor of postoperative outcome in surgery. The aim was to investigate the association of preoperative nutritional status with short-term (up to 30 days) postoperative outcomes among Bangladeshi patients undergoing loop ileostomy closure (LIC).

Methods

A prospective observational study was conducted on 60 subjects [Median age 45 years; Males, 70%] undergoing LIC in a tertiary care public sector hospital after 8-24 weeks of Loop Ileostomy Surgery. Nutritional status was assessed by the Malnutrition Universal Screening Tool (MUST) as well as by Body Mass Index (BMI, Asian population criteria). Major systemic and surgery-related complications, along with Clavien-Dindo severity gradation, were the primary outcome variables.

Results

More than half (56.7%) of subjects suffered from undernutrition, of whom 21.7% had severe undernutrition (BMI <16.0). Using MUST, 56.7% showed a high undernutrition risk and 11.7% had moderate risk. As per Clavien-Dindo postoperative complication grading, 36.7% had no complications, 25% had Grade II complications, and 16.7% had Grade III complications. Mean BMI was significantly lower among patients with Grade II complications than among those without complications (16.77 ± 2.79 vs 19.39 ± 3.40 kg/m²; $p=0.019$). No MUST-Tool-based Undernutrition Risk Group showed any significant association with any of the Clavien-Dindo Complication Groups.

Conclusions

More than half of patients undergoing LIC in a tertiary public hospital in Bangladesh are underweight (with around one-fifth being severely underweight). Lower preoperative BMI is independently associated with postoperative complications in LIC surgery and may help identify patients requiring closer nutritional assessment.

Keywords

Loop ileostomy closure, Malnutrition, Body Mass Index, Postoperative complications, Clavien-Dindo Complication Grading.

INTRODUCTION

One of the important predictors of postoperative surgical outcome is the preoperative nutritional status¹. Malnutrition contributes to factors like infection susceptibility, delayed wound healing, and immunosuppression in a major way². Interest in the relationship between preoperative malnutrition and postoperative outcomes in various populations has been revived in recent years³⁻⁶. The interest in the relationship has been generated in elective major surgery in general⁷. Substantial variations have been observed in these studies regarding the burden and types of malnutrition, as well as regarding surgical outcomes. This, in turn, has affected the nature and extent of the association between postoperative morbidity or mortality and nutritional status among various groups and subgroups of patients.

Loop ileostomies are among the most common abdominal surgeries that are usually conducted to protect high-risk colorectal anastomoses temporarily [8]. However, a second operation is required to restore intestinal continuity, and considerable postoperative morbidity has been

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found to be associated with loop ileostomy closure⁹. The morbidity of ileostomy closure (IC) has been reported to vary from 3% to 30% [10-12] and its mortality has been shown to vary from 0 to 4%^{11, 13-14}. In order to improve surgical outcome, it has now become important to conduct further studies to investigate the association of various risk factors with IC-related complications¹⁵⁻¹⁹. Possible nutritional risk factors for postoperative complications after IC need to be identified in various settings. Studies investigating the association of preoperative nutritional status and postoperative complications, specifically in IC surgery, are extremely limited. The study of Baik and Bae²⁰ is, so far, the only study that has specifically addressed the association of postoperative outcome after IC with any nutrition-related risk. The Authors found that the strongest independent risk factor for IC complications is hypoalbuminemia, defined as serum albumin <3.5g/dl (preoperative serum albumin $p < 0.001$ OR, 7.248). Saha et al²¹ reported a significant association of preoperative hypoalbuminemia with postoperative mortality and it occurs in 2.5% of all mortality cases. Preoperative hypoalbuminemia as a potential risk factor for postoperative complications in colorectal surgery has been suggested by several other studies²²⁻²⁵.

The choice of appropriate markers for nutritional status and also the selection of comprehensive criteria for postoperative complications are among the major challenges in investigating the association between nutritional factors and IC-related postoperative complications. For other kinds of surgeries, traditionally, BMI-based anthropometric tools and compilation of various postoperative complications have been used to evaluate the association between these two variables. In recent years, the tools have been refined with the introduction of Clavien-Dindo criteria for grading postoperative surgical complications²⁶ and, also, the Malnutrition Universal Screening Tool (MUST) for grading the nutritional status among surgical patients²⁷. The association of IC-related postoperative outcomes and nutritional status needs to be investigated by using these tools.

Prioritized measures to reduce postoperative morbidity and mortality are necessary in Bangladesh. Perioperative nutritional assessment guidelines, based on locally generated evidence, may be an important step in this regard. The studies so far conducted in this field have considered the major surgeries (and mostly abdominal

surgeries) as a single group. The nutritional status as well as required intervention, however, may vary considerably among individual surgeries. Accordingly, there is a need for investigating individual major surgeries, as both the extent of the nutritional problem and the outcome of surgical intervention may be unique in different types of patients. Under this context, the present study was to investigate the association of preoperative nutritional status with short-term postoperative outcome among a group of Bangladeshi patients undergoing loop ileostomy closure (LIC).

METHODS

A prospective observational study was conducted on 60 subjects [age, median (range) 45¹⁴⁻⁷⁵ years; males 70%, Table 1] selected purposively from the Department of Surgery in the Rajshahi Medical College Hospital (a tertiary public sector hospital in Bangladesh). Participants were recruited between January 2022 and December 2023. All these patients underwent LIC after 8-24 weeks of Loop Ileostomy Surgery. The exclusion criteria included loop ileostomy with less than one month duration, lack of intestinal luminal patency on distal loopogram, presence of active tuberculosis evidenced by raised ESR or positive sputum culture in patients with intestinal tuberculosis, presence of active inflammatory bowel disease, preoperative steroid therapy or chemo-radiation within the last 6 weeks, and serum albumin <2.5gm/dl (as per practice of the hospital for not doing surgery below this level).

The independent variables included nutritional status assessed by the Malnutrition Universal Screening Tool (MUST) as well as by Body Mass Index (BMI). Major systemic and surgery-related complications, along with severity gradation by Clavien-Dindo classification, were the primary outcome variables. Data were collected by an Interviewer-administered questionnaire and also from medical records, as relevant. Postoperative complications occurring within 30 days after LIC (defined as early/ short-term) were recorded. Preoperative BMI-based and MUST Tool-based nutritional assessment and Clavien-Dindo complication grading were done following standard criteria. The criteria for the Asian population were followed for the BMI-based nutritional status grading.

Data were analyzed by uni-, bi-, and multivariate statistical tests, as relevant, using SPSS software for Windows, v26.0. The chi-square test was used to assess

the statistical differences between the proportions of different categorical variables. To express continuous variables, mean ($\pm$ SD) was used for normally distributed data and median (min-max) for nonparametric data. Comparisons between Pre-Post, as well as comparisons between other groups, were done by appropriate parametric (Student's t-test) or nonparametric (Mann-Whitney U-test) tests. Multivariate analysis (Binary logistic regression) was also done to assess the independent association of nutritional status-related variables with specific outcomes. For binary logistic regression, postoperative outcomes were dichotomised as no complication/Grade I versus Grade II–III complications.

The Protocol was approved by the Institutional Review Board of the Rajshahi Medical College (Ref: RMC/IRB/2024/154, dated 19.09.2024). All patients or legal guardians (when applicable) were briefed about the study and informed written consent was obtained. Confidentiality and privacy were maintained throughout the study.

RESULTS

The subjects had a Median (min-max) BMI value of 18.2 (11.7–27.1). Only 30% of the overall subjects were within the ideal (for the Asian population) BMI range of 18.5–22.9 (Table 1A). More than half (56.7%) of the total subjects suffered from undernutrition; of them, 21.7% had severe undernutrition (BMI <16.0).

More than half (56.7%) of the subjects showed a High risk for undernutrition when calculation of the risk was calculated based on the MUST Tool (Table 1B). At the other end of the spectrum, about one-third (31.7%) of the subjects showed Low undernutrition risk. A relatively small proportion (11.7%) of the total subjects had moderate undernutrition risk.

Among the primary diseases (Table 2), Carcinoma of Rectum was found to have the highest proportion (33.3%), followed by Carcinoma of Colon (18.3%) and Traumatic Ileal Perforation (18.3%). Malignant diseases constituted 52% of the diseases, as compared to the 48% constituted by benign diseases.

As shown in Table 3, 35% of the subjects developed no complications during the follow-up period. Among the complications, wound infection was the highest one, with 23.3% of the total subjects. This was followed by anastomotic leakage, which developed among 15% of the subjects.

As per the Clavien-Dindo postoperative complication grading, 36.7% of the subjects had no complications (Table 4). Of the total subjects, 16.7% had Grade III complications, 25% had Grade II complications, and 21.7% had Grade I complications.

As shown in table 5, the Mean ($\pm$ SD) BMI of the subjects with Clavien-Dindo No-complication group was 19.39($\pm$ 3.40) and the corresponding values in the Grade I group (n=13) were 19.75 ($\pm$ 4.09). The Mean ($\pm$ SD) BMI of the subjects with the Clavin-Dindo Complication Grade II (n=15) was 16.77 ($\pm$ 2.79), which was significantly lower (p=0.019) as compared with 19.39 ($\pm$ 3.40) in the No-complication group (n=22). There was also a significant (p=0.04) difference between the Mean ($\pm$ SD) BMI values of the No-complication group I (n=35) and Grade II-III (n=25) groups.

No MUST-based Undernutrition Risk Group showed any significant association with any of the Clavien-Dindo Complication Grades (Table 6).

The serum levels of albumin did not differ significantly between any of the two groups based on Clavien-Dindo Complication Grades (Data not shown). Also, no two groups differed significantly regarding the Total Lymphocyte Count (Data not shown).

In binary logistic regression analysis, BMI showed a significant independent association (p=0.017) with Clavien-Dindo postoperative complication after adjustment for the effects of confounding variables like age, gender, serum albumin, and TLC (Table 7A). The MUST SCORE-based undernutrition also showed a tendency (p= 0.07) for such an association (Table 7B).

Table 1A. BMI distribution of the subjects among females and males (n=60)

BMI Range	n (%)	Risk Group	Total, n (%)
< 16.0	13 (21.7)	Low	19 (31.7)
16.1–18.4	21 (35.0)	Moderate	7 (11.7)
18.5–22.9	19 (30.0)	High	34 (56.7)
23.0–27.4	7 (13.30)	Total	60 (100)
>27.4	0 (0)		
Total	60 (100)		

Table 1B. Distribution of subjects according to undernutrition risk based on MUST Tool (n=60)

Table 2. Primary disease and its benign-malignant distribution among the study subjects (n=60)

Primary Disease	No	Percentage
Carcinoma of rectum	20	33.3%
Carcinoma of colon	11	18.3%
Traumatic Ileal perforation	11	18.3%
Typhoid Ulcer perforation	8	13.3%
Tubercular Ulcer perforation	6	10.0%
Strangulated Inguinal hernia	3	5.0%
Traumatic Caecal perforation	1	1.7%
<i>Benign-malignancy distribution</i>		
Benign	29	48%
Malignant	31	52%

Table 3. Postoperative complications after loop ileostomy closure (n=60)

Complication	No	Percentage
No complication	22	36.7%
Wound infection	14	23.3%
Anastomotic leakage	9	15.0%
Bowel obstruction	6	10.0%
Bleeding	2	3.3%
Miscellaneous	8	13.4%

Table 4. Distribution of subjects according to Clavien-Dindo Postoperative Complication Grading (n=60)

Grade	n (%)
No complication	22 (36.7)
Grade I	13 (21.7)
Grade II	15 (25.0)
Grade III	10 (16.7)
Grade IV	0 (0)
Grade V	0 (0)
Total	60 (100)

Table 5. BMI of the study subjects according to Clavien-Dindo Complication Grades (n=60)

Grade	BMI, M±SD
No complication (n=22)	19.39±3.40
I (n=13)	19.75±4.09
No complication & Grade I (n=35)	19.52±3.61
II (n=15)	16.77±2.79
III (n=10)	19.10±2.42
I-III (n=38)	18.40±3.37
II-III (n=25)	17.70±2.85
<i>t/p values</i>	
No complication vs Gr I	0.28/ 0.78
No complication vs Gr II	2.47/0.019
No complication vs Gr III	0.24/0.81
No complication vs Gr I-III	1.14/0.26
No complication & Gr I vs Gr II-III	2.10/0.04

Data were expressed as Mean±SD. The differences between the Groups were explored using an Unpaired t-test. A p-value <0.05 was considered Significant.

Table 6. Distribution of Clavien-Dindo Complication Grades with MUST-based undernutrition risk (n=60)

Complication Grade	Undernutrition Risk			χ ² /p among 3 Risk Groups
	Low, n (%)	Moderate, n (%)	High, n (%)	
No complication (n=22)	9 (47)	3 (42)	10 (29)	6.0/0.53
I (n=13)	4 (21)	2 (29)	7 (21)	
II (n=15)	2 (11)	2 (29)	11 (32)	
III (n=10)	4 (21)	0 (0)	6 (18)	
Total	19 (100)	7 (100)	34 (100)	

Data were expressed as numbers (%). χ²-test was used to test the differences between the two groups. A p-value <0.05 was considered Significant.

Table 7. Association of BMI and MUST SCORE-based undernutrition risk with the Clavien-Dindo postoperative complication grading among LIC subjects (n=60)

A. Association of BMI with Clavien-Dindo Postoperative Complications Grading among LIC Subjects

Variables	Regression Coefficient (B)	OR [Exp(B)]	95% CI	p-value
Age	0.043	1.044	1.001-1.089	0.055
Gender	0.154	1.166	0.328-4.148	0.812
BMI	-0.248	0.781	0.638-0.956	0.017
Serum albumin	-0.185	0.831	0.251-2.757	0.762
TLC	0.000	1.000	0.999-1.001	0.854
Constant	2.715	15.107		0.300

Binary logistic regression analysis was done with Clavien-Dindo Postoperative Complication as the dependent variable and age, gender, Serum Alb, and TLC as independent variables.

B. Association of MUST SCORE-Based Undernutrition Risk with Clavien-Dindo Postoperative Complications Grading among LIC Subjects

Variables	Regression Coefficient (B)	Exp(B)	95%CI	p-value
Age	0.032	1.032	0.992-1.073	0.114
Gender	0.180	1.197	0.351-4.081	0.774
Serum albumin	-0.443	0.642	0.201-2.051	0.455
TLC	0.000	1.000	0.999-1.001	0.985
MUST SCORE-Based Undernutrition Risk	1.121	3.069	0.910-10.353	0.071
Constant	-0.894	0.409		0.738

Binary logistic regression analysis was done with Clavien-Dindo Postoperative Complication as the dependent variable and age, gender, S Alb, and TLC as independent variables.

DISCUSSION

The relationship between preoperative malnutrition and the postoperative outcome is a matter of considerable importance which has been explored in studies on various populations involving major abdominal surgery³⁻⁶ as well as elective major surgery in general⁷. The nature and extent of the association between postoperative morbidity-mortality and preoperative nutritional status among various groups and subgroups of patients have been found to be variable. This is due to the substantial ethnicity- and facility-related variations observed regarding the burden and types of malnutrition, as well as the nature of the surgical outcome. The nutritional status during the preoperative period has been shown to have an association with the outcome of loop ileostomy closure^{20, 28}. The present study was designed to explore the association of preoperative nutritional status with short-term postoperative outcomes in the case of loop ileostomy closure surgery in a Bangladeshi tertiary care setting.

In the present study, there seems to be a wide variation in the anthropometry-assessed nutritional status (BMI range, 11.7-27.1) of the subjects (Table 1A); however, the mean (18.7) and median (18.2) BMI values indicate that most of the subjects are clustered around the undernutrition to normonutrition range. The frequency distribution showed that the majority (56.7%) of the subjects suffer from undernutrition and about one-fifth of them suffer from severe undernutrition. Among the subjects, only 30% have BMI values in the normal range. In a South Korean group of subjects undergoing LIC surgery, Baik and Bae²⁰ reported 10.5% of subjects with undernutrition, 39.8% of subjects with normonutrition, 24.3% of subjects with overweight, and 25.4% of subjects with obesity. The overnutrition proportion in the present study is only 13.3%, which is much lower than that found in the other study. Mohil et al²⁸ reported a mean ($\pm$ SD) of 18.5 ($\pm$ 2.5) BMI among subjects after 6 weeks of ileostomy. It needs to be noted that the grouping of BMI-based nutritional status was done in this study following the World Health Organization (WHO) Asian guideline. 20 As per that guideline, the groups are as follows: underweight, <18.5 kg/m²; normal, 18.5-22.9 kg/m²; overweight, 23.0-27.4 kg/m²; and obese, >27.0 kg/m². The upper-level cut-off value of normal BMI (22.9) in our study is thus lower than that (25.0) used for Caucasians. The proportions, accordingly, may not be directly comparable with many

other studies. Still, the trend for a higher degree of undernutrition may be evident in this study.

The MUST Tool is now suggested to be used for assessing nutritional status in surgical patients (Balakrishnan, 2023)²⁷. When using the MUST tool to assess undernutrition risk, the majority of the subjects (56.7%, Table 1B) are found to be at high risk of undernutrition. Low risk is present in only about one-third of the patients. Using the BMI (Asian guideline) tool, Baik and Bae²⁰ found 10.5% undernutrition among their patients. Irrespective of the issue of the surgical outcome, the finding of such a high risk of undernutrition in settings of the present study, suggests that special initiatives are needed to improve nutrition among post-ileostomy patients.

The Clavien-Dindo grading is most commonly used to grade post-surgical complications²⁶ and it was used in the present study. The findings show that around one-third of the subjects showed no complications and around one-fourth suffered from mild (Grade I) complications after IC surgery. However, the findings of Grade II and Grade III complications among 25% and 16.7% of patients need attention from the care providers. A previous report²⁰ on patients undergoing ileostomy closure surgery has shown that, in a South Korean setting, 23.7% of subjects with IC develop postoperative complications, with Grade I being the most common (15.8%). Grade II-IV complications were found to occur among 9.5% of subjects in that study.

BMI is the most commonly used anthropometric marker to assess nutritional status. Subjects with Group II Complications had significantly lower BMI as compared to the No Complication Group (BMI, $M \pm SD$, 19.39 ± 3.40 vs 16.77 ± 2.79 , $p=0.019$). All the complication groups could not be analysed separately due to a lack of power (resulting from a low number of patients in some subgroups). Comparison of the combined Complication Groups 0-I with Groups II-III also showed a significantly lower BMI value in the latter (19.52 ± 3.61 vs 17.70 ± 2.85 , $p=0.04$). There is a lack of consensus regarding the optimum cut-off values to diagnose and classify under-, normo- and over-nutrition. Using the Asian Guideline for classifying nutritional status, Baik and Bae²⁰ found no association of post-IC complications with BMI.

WHR is known to be more specific for central obesity (in contrast to BMI which measures generalized obesity) and its association with the complications was also

explored by group difference analysis. No association of the complications with central obesity was found in this study.

The issue of the best tool to assess undernutrition in surgical conditions is still not fully settled. The MUST tool is now widely recommended for the assessment of preoperative nutritional status²⁸. In the present study, the MUST-graded status of nutrition showed a strong trend to become significantly associated with the post-IC complication grades (Table 7B); however, the p -value (0.07) remained just outside the limit of significance, probably due to the small sample size. Vasilopoulos et al²⁹ suggested the Mini-Nutritional Assessment (MNA) as a proper tool to assess preoperative nutritional status among patients undergoing ileostomy closure. From the present study, it seems that clinically relevant information may be provided by a simple BMI-based assessment (with population-specific criteria) of the nutritional status of a post-ileostomy patient before IC.

Baik and Bae²⁰ have suggested that hypoalbuminemia may be a marker of undernutrition in subjects undergoing IC and a significant association with postoperative complications is present. No such association, however, was found in the present study. It seems that a single malnutrition marker may not be appropriate for all levels of undernutrition in the post-ileostomy subjects.

In conclusion, the majority of patients approaching a Bangladeshi tertiary care public hospital for loop ileostomy closure (IC) suffer from undernutrition and about one-fifth of the patients have severe malnutrition. As assessed by Clavien-Dindo grading, about 40% of post-IC patients may have Grade II to Grade III short-term complications. Lower preoperative BMI is independently associated with postoperative complications in LIC surgery and may help identify patients requiring closer nutritional assessment.

This study was limited by its single-centre design, relatively small sample and limited statistical power, purposive recruitment, and potential residual confounding. Exclusion of patients with severe hypoalbuminaemia (serum albumin <2.5 g/dL, as per practice of the hospital for not doing surgery below this level), may also have influenced the observed association with serum albumin. Larger multicentre studies are required to confirm the present findings.

Credit authorship contribution statement

N Anuvab: Conception and design of study, Acquisition of data (laboratory or clinical), Data analysis and/or interpretation, Drafting of manuscript and/or critical revision, Approval of final version of manuscript; **CK Kundu:** Conception and design of study, Data analysis and/or interpretation; **MH Showrov:** Conception and design of study, Data analysis and/or interpretation; **MB Islam:** Conception and design of study, Drafting of manuscript and/or critical revision, Approval of final version of manuscript; **HNM Shafiquzzaman:** Acquisition of data (laboratory or clinical), Drafting of manuscript and/or critical revision, Approval of final version of manuscript; **Madu Mita:** Data analysis and/or interpretation, Drafting of manuscript and/or critical revision, Approval of final version of manuscript.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Ethical Approval

The Protocol was approved by the Institutional Review Board of the Rajshahi Medical College (Ref:

RMC/IRB/2024/154, dated 19.09.2024). All patients or legal guardians (when applicable) were briefed about the study and informed written consent was obtained. Confidentiality and privacy were maintained throughout the study. The study has been conducted in accordance to the ethical standards laid down in the 1964 Declaration of Helsinki, revised in the year 2000.

Funding

The study was supported by a Research Grant from the Pothikrit Foundation, Dhaka, Bangladesh (Grant No: PF/RG/2024/12).

Conflict of Interest

There is no conflict of interest in the present study involving any Author.

Acknowledgements

We are grateful to Prof Dr Md Jawadul Haque, Former Professor & Chair of the Department of Community Medicine, RMCH and Former Dean of the Faculty of Public Health, Rajshahi Medical University, for his valuable advice during the conduct of the study. The cooperation of the subjects under the study is gratefully acknowledged.

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