



Original Article

Postoperative Immunonutrition and Outcomes Following Gastrointestinal Anastomosis: A Nonrandomized Comparative Investigation

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ABSTRACT

Introduction: Immunonutrient supplementation has been evaluated for reducing postoperative morbidity after gastrointestinal surgery. This study compared outcomes following gastrointestinal anastomosis in patients given postoperative immunonutrition or conventional care.

Methods: A hospital based nonrandomized interventional comparison was conducted in Guwahati, India, from June 2017 to May 2018. Eighty patients were selected through a systematic allocation process, with 40 in each group. Immunonutrition was administered parenterally until oral feeding and then orally through postoperative day 7. The individual patient grand chart was independently analysed. Binary outcomes were assessed with Fisher exact tests and continuous outcomes with Welch tests.

Results: Anastomotic leakage occurred in 4 of 40 patients (10.0%) receiving immunonutrition and 13 of 40 (32.5%) controls (risk ratio 0.31, 95% confidence interval 0.11 to 0.86; P=0.0269). Wound infection occurred in 5 (12.5%) versus 14

(35.0%) patients (risk ratio 0.36, 95% confidence interval 0.14 to 0.90; P=0.0339). Mean hospitalization was 8.93 versus 10.45 days (P=0.0116). Postoperative serum albumin was higher in the supplemented group. The two clinical complication comparisons did not retain statistical significance after correction for six outcomes. **Conclusion:** Postoperative immunonutrition was associated with favourable unadjusted outcomes in this small nonrandomized cohort. The findings were exploratory and require confirmation in adequately controlled studies.

Keywords: Gastrointestinal anastomosis; Immunonutrition; Postoperative complications; Anastomotic leak; Surgical wound infection; Length of stay.

INTRODUCTION

Gastrointestinal anastomosis is a common component of operations undertaken for intestinal perforation, obstruction and

malignancy. Postoperative recovery may be complicated by anastomotic leakage, wound infection, intra-abdominal sepsis, pulmonary infection and prolonged hospitalization. These outcomes are influenced by the underlying disease, physiological reserve and nutritional state. Major abdominal surgery also produces a catabolic and inflammatory response that can

aggravate postoperative nutritional deficits. Contemporary surgical nutrition guidance emphasizes early restoration of oral or enteral feeding when clinically feasible and targeted nutritional support for patients at risk of undernutrition [1].

Immunonutrition refers to nutritional formulations enriched with substrates such as arginine, omega-3 fatty acids, nucleotides and glutamine, used individually or in varying combinations. The proposed clinical benefit extends beyond provision of calories and protein. These compounds may modify inflammatory signaling, immune cell activity and tissue repair. The magnitude of any clinical effect is not uniform across nutritional regimens or operation types. A 2024 synthesis of randomized trials in upper gastrointestinal cancer surgery reported a reduction in infectious complications with perioperative immunonutrition, although treatment composition and timing differed between the included trials [2]. A subsequent umbrella review found similar directions of association for wound infection, anastomotic leakage and hospital stay, with heterogeneity across pooled analyses [3].

Most of this evidence comes from elective oncological resections. Patients undergoing emergency surgery for perforation or obstruction may differ in contamination burden, operative urgency, baseline nutritional status and postoperative feeding tolerance. The control intervention also matters. An immune-enriched formulation may appear more beneficial against routine hospital feeding than against an isocaloric and isonitrogenous supplement. In a multicentre randomized colorectal surgery trial conducted within an enhanced recovery pathway, immunonutrition was associated with fewer infectious complications but did not shorten hospital stay [4]. These differences complicate extrapolation to heterogeneous gastrointestinal surgical populations.

This study compared outcomes after gastrointestinal anastomosis among patients receiving immunonutrition or conventional care in a tertiary hospital in Assam. Recorded endpoints were anastomotic leakage, surgical wound infection, abdominal abscess, respiratory infection, other complications, mortality, serum albumin and duration of hospitalization.

PATIENTS AND METHODS

Setting and design

This hospital based interventional comparative investigation included patients undergoing gastrointestinal anastomosis in the Department of General Surgery, Gauhati Medical College and Hospital, Guwahati, from 1 June 2017 to 31 May 2018. Treatment groups were formed by systematic patient selection and allocation rather than a random-number sequence or lottery. The study is therefore reported as a nonrandomized comparison. The Institutional Ethics Committee of Gauhati Medical College and Hospital approved the proposal at its meeting on 25 May 2017 (reference MC/190/2007/Pt-I/EC/55). Written informed consent was obtained before participation. The study was not registered in a public clinical trial registry.

Participants and allocation

During the study period, 243 patients underwent gastrointestinal anastomosis. Forty-one were excluded because of protocol criteria or refusal of consent, leaving 202 potentially eligible patients. The exclusions comprised American Society of Anesthesiologists physical status IV to VI, repeat laparotomy, immunosuppression, acute or chronic renal failure, age below 12 years and pregnancy. Elective and emergency operations were eligible. The original protocol described allocation of every fourth patient to conventional care and every fifth patient to immunonutrition, until 40 participants were included in each group. The final analysed sample was 80 patients. Individual selection and overlap handling for the numbered allocation sequence were not documented further; the grand chart identifies patients 1 to 40 as the immunonutrition group and 41 to 80 as the conventional care group, as confirmed by the investigator.

Sample size calculation

Sample size was estimated using the formula for comparing two independent proportions, $n = (Z\alpha + Z\beta)^2 \times [p_1(1 - p_1) + p_2(1 - p_2)] / (p_1 - p_2)^2$. Expected postoperative infectious complication rates were drawn from the trial by Aanandhi and John [5]: 53.3% after conventional nutritional management ($p_1 = 0.533$) and 26.6% with glutamine supplementation ($p_2 = 0.266$). A one-sided 5% significance level ($Z\alpha = 1.645$) and 80% power ($Z\beta = 0.84$) gave a calculated minimum of 38.5 patients per group, rounded up to 39. Forty patients were included in each group to allow for possible attrition; the planned total sample size was 80. Under these assumptions, 40 patients per group provide approximately 81% power to detect the anticipated difference. The one-sided assumption applied only to sample size planning; outcome comparisons were tested two-sided.

Interventions

Patients in the intervention group received parenteral immunonutrient supplementation postoperatively until oral intake was permitted. Oral immune-enriched supplementation was then administered twice daily and continued through postoperative day 7. The original Methods specifically describe an oral formulation containing glutamine, arginine and

omega-3 fatty acids. The investigator subsequently identified Glutabest L-alanyl-L-glutamine infusion, Glutabest oral glutamine sachets and Nestlé IMPACT Advanced Recovery as relevant formulations. The records do not establish the administered daily quantities or whether the two oral formulations were used together; no dose or concurrent administration schedule has been inferred. Patients in the conventional care group received maintenance intravenous dextrose and saline until oral feeding was feasible. Nasogastric tube removal and initiation of oral feeding followed clinical recovery and the appearance of bowel sounds. Other perioperative treatments were not standardized or recorded in the supplied master chart.

Clinical outcomes and measurements

The recorded outcomes were anastomotic leakage, wound infection, intra-abdominal abscess, respiratory tract infection, other noninfectious postoperative complications, death and length of hospital stay. Clinical suspicion of an anastomotic leak was assessed with imaging when indicated. Intra-abdominal abscess was identified through clinical examination and ultrasonography or computed tomography, with procedural confirmation when applicable. Wound infection was defined in the original protocol by purulent wound discharge with a positive bacterial culture. Respiratory infection was evaluated clinically and by abnormal chest radiographic findings. Other noninfectious events included postoperative hemorrhage, thromboembolic complications, cardiac failure, atelectasis, ileus and wound dehiscence. Serum albumin was recorded preoperatively and on postoperative days 2 and 6. The supplied grand chart contained demographic characteristics, body weight, presence of comorbidity, the operation performed and the listed outcomes. Time to individual complications, severity grading and postdischarge events were not available.

Statistical analysis

In the original study, data were entered into Microsoft Excel and analysed using SPSS version 20.0.1 and GraphPad Prism version 5. For manuscript preparation, the patient-level grand chart was independently recoded and reanalysed; this chart was designated as the source of truth where its values conflicted with the historical Results chapter. Continuous data are presented as mean and standard deviation. Categorical data are presented as count and percentage. Two-sided Fisher exact tests were used for the six postoperative binary outcome comparisons, with unadjusted risk ratios and 95% confidence intervals. Welch independent-samples t tests were used for comparisons of serum albumin, age, weight and duration of hospitalization, with 95% confidence intervals for the mean differences. A Holm adjustment was applied as a sensitivity analysis across the six binary clinical outcomes because no single primary endpoint was identified prospectively in the available documents. Results with unadjusted P values below 0.05 are distinguished from multiplicity-adjusted results. The investigation was exploratory and no multivariable case-mix adjustment was attempted because of the small sample and limited clinical covariates.

Manuscript preparation disclosure

The authors acknowledge the use of AI for formatting, reviewing and editing of the manuscript.

RESULTS

Patient selection and baseline profile

During the study period, 243 patients underwent gastrointestinal anastomosis. Forty-one were excluded under the eligibility criteria or declined consent. Of 202 eligible patients, 80 were selected through the documented systematic sampling approach and allocated equally to immunonutrition or conventional postoperative management. The remaining 122 eligible patients were not sampled. The grand chart contains analysable entries for all 40 patients in each group and no missing values for the reported outcomes (Figure 1).

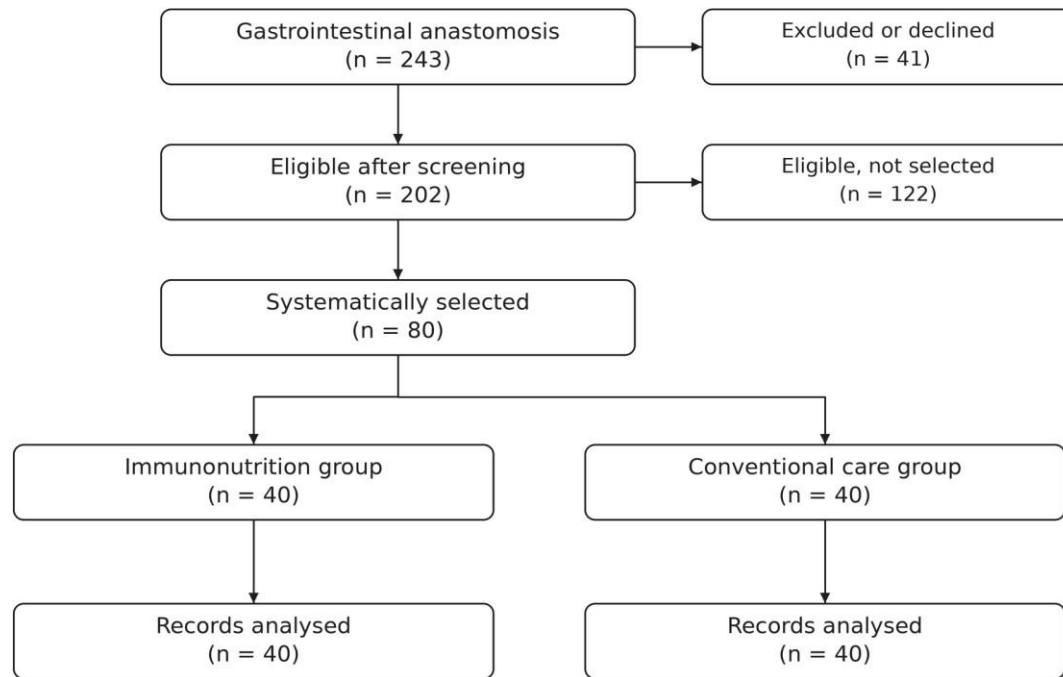


Figure 1. Study selection, group allocation and inclusion in the analysis. Reasons for exclusion were not available separately.

The mean age was 46.30 years (SD 15.64) in the intervention group and 45.23 years (SD 14.83) in the control group; ages ranged from 21 to 71 years in both groups. Women accounted for 23 of 40 (57.5%) intervention patients and 19 of 40 (47.5%) controls. Mean body weight was 66.38 kg (SD 10.00) and 67.12 kg (SD 10.90), respectively. Recorded comorbidity was present in 11 (27.5%) and 13 (32.5%) patients. Preoperative serum albumin was 3.47 g/dL (SD 0.53) and 3.45 g/dL (SD 0.65), respectively (Table 1).

Table 1. Baseline demographic and clinical characteristics

Characteristic	Immunonutrition (n = 40)	Conventional (n = 40)
Age, years, mean (SD)	46.30 (15.64)	45.23 (14.83)
Women, n (%)	23 (57.5)	19 (47.5)
Men, n (%)	17 (42.5)	21 (52.5)
Body weight, kg, mean (SD)	66.38 (10.00)	67.12 (10.90)
Recorded comorbidity, n (%)	11 (27.5)	13 (32.5)
Preoperative albumin, g/dL, mean (SD)	3.47 (0.53)	3.45 (0.65)

SD, standard deviation. All values were independently recalculated from the 80 records in the grand chart.

Diagnostic and operative case mix

The cohort included patients with intestinal perforation, sigmoid volvulus, gastrointestinal growth or malignancy and several other obstructive conditions. Intestinal perforation was the recorded indication for 18 (45.0%) intervention patients and 14 (35.0%) controls. Sigmoid volvulus accounted for 6 (15.0%) and 8 (20.0%) patients, respectively. The operative procedures also varied. Sigmoid resection with colostomy was recorded in 6 and 8 patients; right hemicolectomy in 5 and 5; left hemicolectomy in 4 and 3 and gastrojejunostomy in 1 and 4, respectively. The remaining procedures comprised several forms of bowel resection and anastomosis and other operations (Table 2).

Table 2. Recorded indications and operative procedures

Category	Immunonutrition, n (%)	Conventional, n (%)
Indication / diagnosis		
Intestinal perforation (including traumatic)	18 (45.0)	14 (35.0)
Sigmoid volvulus	6 (15.0)	8 (20.0)
Malignancy or gastrointestinal growth	11 (27.5)	8 (20.0)

Category	Immunonutrition, n (%)	Conventional, n (%)
Obstructed inguinal hernia	2 (5.0)	3 (7.5)
Benign gastric outlet obstruction	1 (2.5)	4 (10.0)
Other stricture, obstruction or intussusception	2 (5.0)	3 (7.5)
Operative procedure		
Sigmoid resection with colostomy	6 (15.0)	8 (20.0)
Right hemicolectomy	5 (12.5)	5 (12.5)
Left hemicolectomy	4 (10.0)	3 (7.5)
Gastrojejunostomy	1 (2.5)	4 (10.0)
Other recorded procedures	24 (60.0)	20 (50.0)

The diagnosis categories were grouped descriptively from chart terminology; they are not histopathological classifications. Diagnosis and procedure groups each sum independently to 40 per treatment arm.

Postoperative clinical outcomes

Anastomotic leakage was recorded in 4 of 40 (10.0%) patients receiving immunonutrition compared with 13 of 40 (32.5%) controls. The absolute difference was 22.5 percentage points in favour of the intervention group; the unadjusted risk ratio was 0.31 (95% CI 0.11 to 0.86; two-sided Fisher exact $P = 0.0269$). Wound infection occurred in 5 (12.5%) intervention patients and 14 (35.0%) controls, also an absolute difference of 22.5 percentage points (risk ratio 0.36, 95% CI 0.14 to 0.90; $P = 0.0339$). These are nominal comparisons without adjustment for differences in operative case mix (Table 3).

Intra-abdominal abscess affected 3 (7.5%) intervention patients and 4 (10.0%) controls ($P = 1.0000$). Respiratory infection was recorded in 3 (7.5%) versus 10 (25.0%) patients ($P = 0.0661$). Other noninfectious complications occurred in 8 (20.0%) versus 11 (27.5%) patients ($P = 0.6001$). Two patients (5.0%) in the intervention group and one (2.5%) in the control group died during hospitalization ($P = 1.0000$). The relative frequencies of the six recorded postoperative endpoints are depicted in Figure 2. After applying Holm adjustment to these six comparisons, the adjusted P values were 0.1612 for anastomotic leakage and 0.1695 for wound infection. None of the six outcomes met the adjusted 0.05 threshold.

Table 3. Recorded postoperative complications and mortality

Outcome	Immunonutrition n (%)	Conventional n (%)	RR (95% CI)	Fisher P
Anastomotic leak	4 (10.0)	13 (32.5)	0.31 (0.11 to 0.86)	0.0269*
Wound infection	5 (12.5)	14 (35.0)	0.36 (0.14 to 0.90)	0.0339*
Intra-abdominal abscess	3 (7.5)	4 (10.0)	0.75 (0.18 to 3.14)	1.0000
Respiratory infection	3 (7.5)	10 (25.0)	0.30 (0.09 to 1.01)	0.0661
Other noninfectious events	8 (20.0)	11 (27.5)	0.73 (0.33 to 1.62)	0.6001
In-hospital death	2 (5.0)	1 (2.5)	2.00 (0.19 to 21.18)	1.0000

RR, unadjusted risk ratio for immunonutrition relative to conventional care; CI, confidence interval. Fisher exact P values are two-sided and unadjusted. * Nominally significant at $P < 0.05$ before multiplicity adjustment. Neither binary complication comparison retained significance after Holm correction.

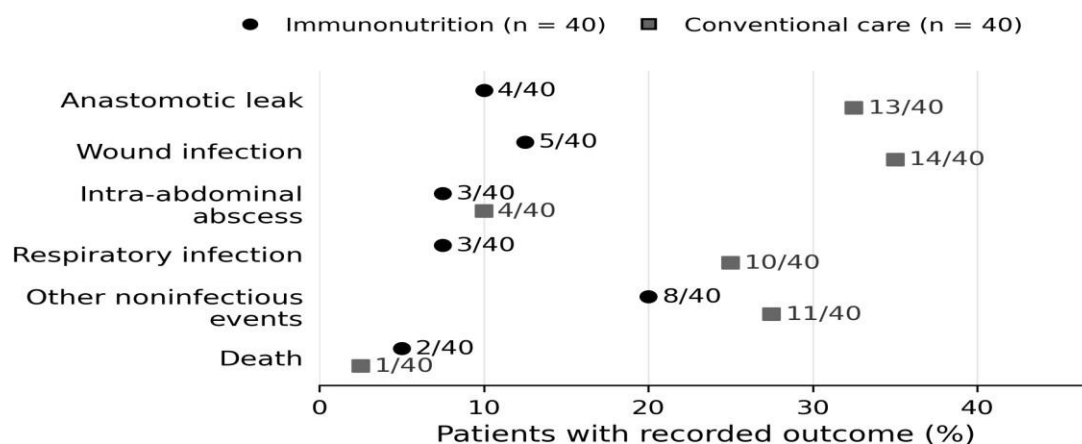


Figure 2. Absolute frequencies of recorded postoperative outcomes. Numerators are shown next to each plotted value; the denominator is 40 in each group.

Serum albumin and duration of hospitalization

Mean serum albumin was nearly identical at baseline: 3.47 g/dL (SD 0.53) in the intervention group versus 3.45 g/dL (SD 0.65) in controls. On postoperative day 2, the corresponding means were 3.47 g/dL (SD 0.62) and 3.05 g/dL (SD 0.65), with a between-group difference of 0.42 g/dL (95% CI 0.14 to 0.71; Welch P = 0.0039). On day 6, the means were 3.65 g/dL (SD 0.48) and 3.03 g/dL (SD 0.47), with a difference of 0.62 g/dL (95% CI 0.40 to 0.83; P < 0.001) (Table 4, Figure 3). The group means are descriptive measurements across the three time points; no paired longitudinal comparison is claimed.

Mean hospital stay was 8.93 days (SD 2.56; range 6 to 16) in the intervention group and 10.45 days (SD 2.72; range 7 to 19) in the control group. The mean difference was -1.53 days (95% CI -2.70 to -0.35; Welch P = 0.0116). Median stays calculated from the grand chart were 8 and 10 days, respectively. These unadjusted comparisons do not account for diagnosis, procedure or early in-hospital death.

Table 4. Serum albumin and length of hospital stay

Variable	Immunonutrition mean (SD)	Conventional mean (SD)	Difference (95% CI)	Welch P
Preoperative albumin, g/dL	3.47 (0.53)	3.45 (0.65)	0.03 (-0.24 to 0.29)	0.8508
Albumin, postoperative day 2, g/dL	3.47 (0.62)	3.05 (0.65)	0.42 (0.14 to 0.71)	0.0039*
Albumin, postoperative day 6, g/dL	3.65 (0.48)	3.03 (0.47)	0.62 (0.40 to 0.83)	<0.001*
Hospital stay, days	8.93 (2.56)	10.45 (2.72)	-1.53 (-2.70 to -0.35)	0.0116*

Differences are intervention minus control; CI, confidence interval; SD, standard deviation. All P values are unadjusted. * P < 0.05 (unadjusted, two-sided Welch test).

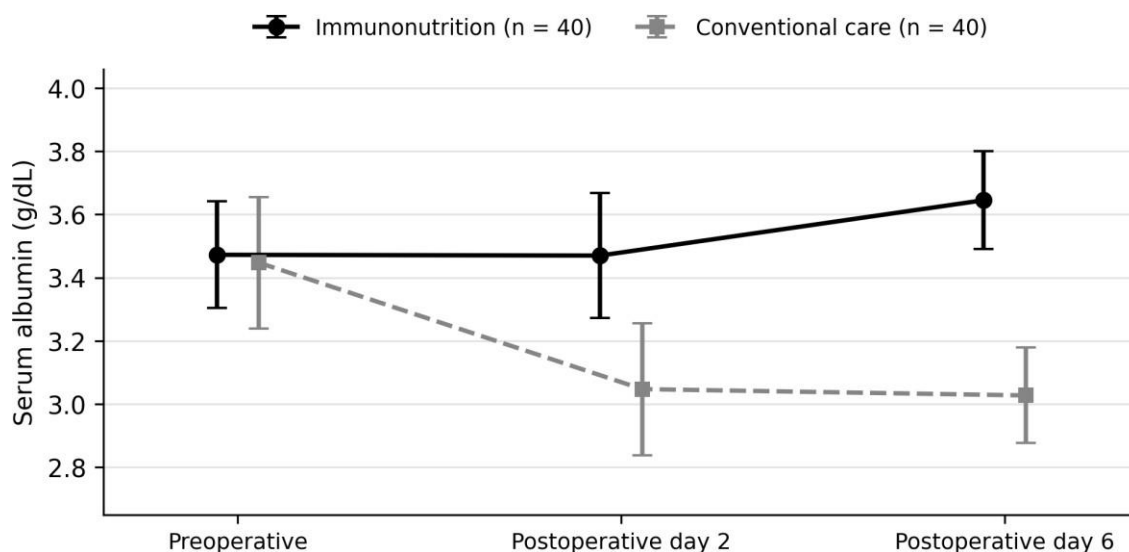


Figure 3. Mean serum albumin at the three recorded measurement times in each group. Error bars indicate 95% confidence intervals for the group means.

DISCUSSION

The present study found lower recorded rates of anastomotic leakage and wound infection in the immunonutrition group, accompanied by higher postoperative serum albumin concentrations and a shorter mean hospital stay. The proportions for other clinical complications and death did not show clear between-group differences. The two principal complication comparisons met a conventional unadjusted P-value threshold, but neither did so after adjustment for the six assessed clinical outcomes. The findings should therefore be interpreted as exploratory associations within a small nonrandomized intervention cohort rather than definitive evidence of treatment efficacy.

Anastomotic leakage is a clinically important endpoint because its occurrence can prolong hospitalization and prompt additional interventions. An early postoperative randomized trial in gastric cancer patients reported a leakage rate of 3.7% with immunonutrition against 7.3% with standard nutrition [6]. A broader synthesis of randomized studies across

gastrointestinal and head and neck cancers also suggested fewer infectious complications and anastomotic leaks with immunonutrition, although different operations and supplementation strategies were combined [7]. The direction of the present association is consistent with that evidence. Its magnitude cannot be directly compared with the pooled estimates because this cohort contained both malignant and nonmalignant conditions, several operation types and patients who underwent emergency surgery. The source dataset did not permit assessment of surgical contamination, anastomotic technique or postoperative hemodynamic status, which could influence leakage independently of nutritional supplementation.

The recorded difference in wound infection was also in the direction reported in an enhanced recovery colorectal surgery trial, where the immune-enriched group had fewer infectious complications than the standard high-calorie supplement group [4]. A 2024 systematic review of gastric cancer surgery evaluated similar comparisons between immune-enriched and standard enteral regimens [8]. The context is not uniform. In a multicentre randomized colorectal cancer trial comparing postoperative immune-enriched feeding with an oligomeric high-protein supplement, surgical site infections and length of stay did not differ materially between groups [9]. Another colorectal surgery randomized trial reported no additional clinical benefit from preoperative immunonutrition compared with standard oral nutrition [10]. These discrepant findings suggest that the nutritional content of the comparator and the clinical context are important when evaluating apparently favourable immunonutrition effects.

Respiratory infection occurred less frequently in the intervention cohort numerically, but the two-sided Fisher exact test did not establish a difference at the 0.05 threshold. The frequency of intra-abdominal abscess, other noninfectious complications and death was not distinguishable statistically between groups. A 2025 meta-analysis restricted to minimally invasive major abdominal surgery found no clear reduction in infectious complications, mortality or hospitalization with immunonutrition and rated much of the evidence as very uncertain [11]. The present cohort was not a minimally invasive surgery trial, but that analysis reinforces the need to avoid broad claims of benefit across all surgical settings. The mortality comparison in this investigation was particularly imprecise because only three deaths occurred.

Mean postoperative albumin concentrations were higher in the supplemented group on days 2 and 6 despite similar preoperative values. A randomized colorectal cancer nutrition study reported favourable changes in selected biochemical and anthropometric measurements with perioperative supplementation but did not identify a corresponding reduction in postoperative complications or hospital stay [12]. Serum albumin is also influenced by inflammation, redistribution of fluid and underlying illness; it cannot be treated as a direct measurement of immune competence or nutritional recovery. No detailed inflammatory profile, fluid-balance record or longitudinal nutritional assessment was available here to clarify the mechanisms underlying the observed group difference.

The intervention group had a mean hospital stay approximately 1.5 days shorter than the control group. Procedure-specific randomized-trial synthesis in pancreaticoduodenectomy has reported a reduction in postoperative hospitalization with perioperative immunonutrition [13]. Evidence from a network meta-analysis of gastrointestinal cancer trials has also suggested that both postoperative and combined perioperative regimens may reduce infectious complications and length of stay compared with standard feeding [14]. Hospital stay is nevertheless sensitive to operative indication, discharge practices, postoperative recovery and local resource constraints. The present dataset contains diagnostic and procedural labels but no reliable classification of operative urgency, severity of illness or discharge readiness. The observed difference should not be interpreted as proof that supplementation caused earlier discharge.

Indian findings are mixed. In a pilot study from Kochi, Pavithran et al. (2024) followed 15 patients after gastrointestinal resection and reported changes in muscle and inflammatory measures after immunonutrition; hospital stay did not differ significantly [15]. Goyal et al. (2024) studied 150 Indian patients after gastrectomy or colectomy, but compared two parenteral nutritional preparations rather than immunonutrition with standard care; hospital stay and nutritional outcomes were comparable [16]. A 2025 Indian consensus supported individualized perioperative nutrition and noted disagreement concerning the value of adding postoperative immunonutrients [17]. In oral cancer surgery, Vaishampayan et al. (2025) reported fewer wound problems and shorter hospitalization with immunonutrition, but this non-gastrointestinal population limits comparability [18]. A closer Indian gastrointestinal cancer study by Raghavendra and Raghupathi (2019) found no significant reduction in wound infection, anastomotic leakage or length of stay with glutamine [19]. Our favourable findings cannot be generalized across Indian surgical populations.

International findings also differ. Tang et al. (2023) propensity-matched 342 patients per group after colorectal cancer surgery and reported postoperative infections in 10.5% with parenteral glutamine compared with 28.9% of controls, together with fewer anastomotic leaks and a shorter hospital stay [20]. The direction resembles our results, but residual confounding and exclusion of emergency operations limit comparison. Yu et al. (2024), in a randomized trial of 112 patients

with gastric cancer cachexia, reported fewer infectious complications after preoperative immunonutrition ($P = 0.040$), indicating a possible role for nutritional risk and timing [21]. Conversely, Sakhri et al. (2026) found no significant advantage in wound infection or hospital stay in a pilot trial of 35 gastrointestinal cancer patients receiving perioperative arginine and omega-3 supplements [22]. Comparison diets, procedures, nutritional risk and doses differ between trials. The control-group anastomotic leak rate of 32.5% in our cohort also merits caution: treatment allocation was not randomized and factors such as operative urgency, contamination and anastomotic technique were not available for adjustment.

The study has several limitations relevant to surgical practice. Patient selection and treatment assignment followed a systematic numbering approach without true randomization. This introduced potential selection and allocation bias, and no blinding or allocation concealment was documented. Sample size planning assumed a one-sided difference in an overall infectious complication rate; it was not designed to ensure adequate power for every individual complication tested with two-sided comparisons. The population was clinically heterogeneous. The study did not record a validated nutritional risk score, comprehensive comorbidity severity, urgency category or consistent details of the anastomotic site. The exact administered quantities of the named supplements were also unavailable. These limitations restrict reproducibility, causal interpretation and application to a particular nutritional formula. Multiple clinical endpoints were analysed without a clearly prespecified primary outcome, and the nominally significant complication comparisons did not survive multiplicity adjustment. Follow-up was restricted to the documented inpatient postoperative course, so events after discharge were not assessed. The observations reflect clinical care from 2017 to 2018 and should be interpreted against current guidance without implying that later recommendations governed care at the time. Trial registration was not completed before or after participant enrolment; this limits transparency and may affect eligibility for publication under prospective trial registration policies.

The strength of this reanalysis lies in its use of the individual patient grand chart rather than acceptance of unverified historical summary tables. Discrepant complication counts were corrected consistently, and relative risks with confidence intervals now accompany the categorical comparisons. Future evaluation would be better served by prospective random allocation or carefully controlled cohort methods, a defined primary endpoint, clearly specified products and doses, stratification by operative urgency and anastomosis type and standardized follow-up. The present results provide hypothesis-generating local observations but do not establish a general recommendation for routine postoperative immunonutrition after every gastrointestinal anastomosis.

CONCLUSION

Postoperative immunonutrient supplementation was associated with fewer recorded anastomotic leaks and wound infections, higher postoperative serum albumin concentrations and shorter hospitalization in this single-centre cohort of 80 patients undergoing gastrointestinal anastomosis. The clinical complication differences were nominally significant before correction for multiple comparisons but were not significant after adjustment. Nonrandomized allocation, varied surgical indications and incomplete intervention-dose records limit causal inference. Larger studies with defined nutritional regimens and prespecified primary outcomes are required before routine use can be recommended for this heterogeneous surgical population.

Statements and Declarations

Ethics approval: The study was approved by the Institutional Ethics Committee of Gauhati Medical College and Hospital, Guwahati (Reference No. MC/190/2007/Pt-I/EC/55). Approval was granted at the committee meeting held on 25 May 2017, before commencement of the study.

Consent to participate: Written informed consent was obtained from all participants before enrolment in the study. Consent for publication: Not applicable. The manuscript presents anonymized and aggregated patient data without identifiable personal information.

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Competing interests: The authors declare that they have no financial or nonfinancial competing interests related to this study.

Authors' contributions: Dr Bhaskarjyoti Malakar contributed to study conception, protocol development, patient enrolment, data collection, data analysis and manuscript preparation. Dr Sanjay Talukdar provided academic supervision, contributed to study design and interpretation of findings and critically reviewed the manuscript for important intellectual content. Both authors reviewed and approved the final manuscript and accept responsibility for its scientific content.

Data availability: The patient-level data are not publicly available to protect participant confidentiality. De-identified data may be made available by the corresponding author upon reasonable request, subject to institutional permissions and applicable ethical requirements.

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Originality and author approval: The authors confirm that the manuscript represents original research, has not been published previously and is not under consideration for publication elsewhere. Both authors have reviewed and approved the manuscript for submission.

Trial registration: Not registered.

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