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CASE REPORT

Stepwise Multimodal Medical Nutrition Therapy, 1:1:1 Supplemental Parenteral Bridging, and Early Oligomeric Oral Supplementation in Locally Advanced cT4bN1bMx Rectal Adenocarcinoma Post-Diverting Colostomy: A Case Report

Noveria Ginting[1*], Ni Made Dwi Asti Lestari[1]

[1]Clinical Nutrition Department, Bali Mandara Public Hospital, Denpasar, Indonesia

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***Corresponding author**
Noveria Ginting
E-mail: noveriaginting@yahoo.com

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ABSTRACT

Background: Locally advanced rectal adenocarcinoma (cT4bN1bMx) with distal bowel obstruction causes systemic inflammation, anorexia, and postoperative catabolism after diverting colostomy, while normal body mass index (BMI) and albumin can mask malnutrition risk.

Objective: To describe the stepwise nutrition prescription from the day of colostomy (T_0) to postoperative day 3 (T_3) against ESPEN reference intervals.

Methods: This single-patient case report (CARE guideline) describes a 71-year-old woman (62.0 kg, 158.0 cm, BMI 24.84 kg/m^2, blood pressure 144/65 mmHg, leukocytes 14.97 × 10^3/μL, albumin 4.0 g/dL) with a 2.7 cm cT4bN1bMx rectal adenocarcinoma invading the uterine fundus and small bowel. Intake was compared with ESPEN intervals (1,550–1,860 kcal/day; > 62.0–93.0 g/day protein).

Results: After diverting colostomy (T_0), clear liquids on postoperative day 1 (T_1; 450 kcal/day, 0.0 g protein) were bridged with 1:1:1 supplemental parenteral nutrition (5% dextrose : 10% Kalbamin : 20% SMOFlipid; 650 kcal/day, 25.0 g amino acids; total 1,100 kcal/day; non-protein calorie-to-nitrogen [NPC:N] ratio 250.00:1). The prescription advanced through T_2 (1,450 kcal/day, 60.0 g protein; NPC:N 126.04:1) to the full target on postoperative day 3 (T_3: 1,800 kcal/day [29.03 kcal/kg/day] and 80.0 g/day protein [1.29 g/kg/day; 12.80 g N/day; NPC:N 115.63:1]) with a soft diet plus 2 × 200 kcal/day oligomeric oral nutritional supplements (oral energy +300.00%, total energy +63.64%, protein +220.00%). No adverse events were recorded.

Conclusion: A stepwise parenteral-to-oligomeric oral transition reached the prescribed energy and protein targets within 72 hours after colostomy. GLIM, sarcopenia, stoma-output, and refeeding-electrolyte surveillance is advisable; one case cannot establish causality.

1. Introduction

Colorectal adenocarcinoma is a major oncological and public health problem. It ranks as the third most commonly diagnosed malignancy and the second leading cause of cancer-related death worldwide.[1,2] According to Global Cancer Observatory (GLOBOCAN) surveillance, colorectal cancer caused approximately 930,000 deaths in 2020, or 9.4% of global cancer mortality.[1,3] Later GLOBOCAN updates agree. Incidence and mortality keep rising in transitioning economies through 2040 and 2045.[4,5] In Indonesia, national health surveys and tertiary hospital registries show a parallel shift. Several factors drive it. They are rapid urbanization, sedentary lifestyles, a dietary transition toward ultra-processed foods and high-temperature cooked red meats, and insufficient fiber intake from fruits and vegetables. National Basic Health Research (Riskesdas) surveillance recorded a rise in overall national cancer prevalence from 1.40‰ in 2013 to 1.79‰ in 2018 (1,017,290 individuals).[6,7] Dharmais National Cancer Hospital ranked colorectal malignancy fourth, at 9.88%. Presentation is often late. Recent Indonesian clinicopathological cohorts from Pontianak and Makassar found many patients at an advanced local or regional stage, with stenosing rectosigmoid or rectal tumors complicated by hematochezia, severe dyschezia and acute-on-chronic large bowel obstruction.[8,9]

Rectal adenocarcinoma arises within the distal 15 cm of the large intestine, above the dentate line. The narrow bony pelvis constrains it anatomically. Locally advanced tumors (staged as cT4b under the American Joint Committee on Cancer [AJCC] 8th Edition classification) therefore tend to invade or adhere to neighboring pelvic viscera. These include the uterine fundus, posterior vaginal wall, urinary bladder, presacral fascia and anterior small bowel loops. From a clinical nutrition and metabolic perspective, the picture is serious. Locally advanced rectal carcinoma causes a profound dual-hit catabolic state before any surgery.[10] First comes obstruction. Luminal narrowing and a painful anorectal mass provoke progressive dyschezia, tenesmus and food-related abdominal distress. Oral caloric and protein intake then falls, willingly or not, over the preceding weeks. Second comes inflammation. The tumor microenvironment and the obstructed mucosal barrier release pro-inflammatory cytokines, principally interleukin-6 (IL-6), interleukin-1β (IL-1β) and tumor necrosis factor-α (TNF-α). These trigger hypothalamic melanocortin-mediated anorexia, hepatic acute-phase protein reprioritization, insulin resistance, lipolysis and ubiquitin–proteasome-mediated skeletal muscle proteolysis. In geriatric oncology patients aged 70 years and older, the catabolic course often appears as masked malnutrition or normal-weight sarcopenia. Nothing looks wrong. The body mass index appears normal (BMI 18.50–24.99 kg/m^2) and baseline serum albumin is preserved (≥ 3.5 g/dL). Yet acute negative energy-nitrogen balance and progressive loss of functional lean body mass go unnoticed.[11]

Patients with locally advanced cT4b rectal adenocarcinoma and symptomatic distal obstruction often need urgent surgical decompression with a diverting colostomy. The procedure prevents stercoral perforation, relieves tenesmus and provides a safe anatomical bridge to later neoadjuvant chemoradiotherapy or multivisceral pelvic resection. It also places an acute neuroendocrine-metabolic surgical stress response on a nutritionally vulnerable geriatric host.[12,13] Catecholamines, cortisol and glucagon surge after surgery. They accelerate hepatic gluconeogenesis and mobilize skeletal muscle amino acids, predominantly glutamine and branched-chain amino acids (BCAAs), to supply acute-phase reactants, leukocyte proliferation and mucocutaneous stomal wound healing. Delayed nutritional support, or support limited to protein-free clear fluids such as sugar water and clear fruit juice, leaves nitrogen catabolism unopposed. Enterocyte barrier integrity suffers. Gastrointestinal motility recovers late. The risk of surgical site infection and of anastomotic or stomal complications rises. The opposite error is just as dangerous. Overly aggressive caloric loading with hypertonic dextrose, after weeks of pre-admission anorexia, can precipitate life-threatening refeeding syndrome. This syndrome is marked by intracellular shifts of phosphate (PO_4^{3-}), potassium (K^+) and magnesium (Mg^{2+}), together with stress hyperglycemia and fluid overload.[14]

To resolve this perioperative dilemma, the European Society for Clinical Nutrition and Metabolism (ESPEN) guidelines for cancer (2021) and for surgery (2021 and 2025 updates) advocate early, individualized medical nutrition therapy (MNT).[11–13] The targets are 25–30 kcal/kg/day of energy and > 1.0 to 1.5 g/kg/day of protein. Early oral feeding is preferred whenever the patient is hemodynamically stable and conscious. Oral nutritional supplements (ONS) or supplemental parenteral nutrition (SPN) are added when early oral intake does not reach at least 50–60% of calculated requirements. Despite these recommendations, a gap remains. Clinical reports from resource-constrained and tertiary hospitals in Southeast Asia seldom audit prescribed against actual caloric, protein and non-protein calorie-to-nitrogen (NPC:N) trajectories across the immediate post-colostomy transition. This case report documents, in quantitative detail, a stepwise hybrid MNT protocol. On Postoperative Day 1 (T_1), trophic clear fluids were combined with a balanced 1:1:1 supplemental parenteral bridge (5% dextrose [D5%] : 10% crystalline amino acids [Kalbamin] : 20% four-oil ω-3-enriched lipid emulsion [SMOFlipid]). By Postoperative Day 3 (T_3), the patient had progressed rapidly to a soft solid diet and semi-elemental oligomeric peptide ONS (2 × 200 kcal/day). A comprehensive perioperative metabolic, refeeding-risk and stomal homeostasis evaluation accompanied the protocol. The patient was geriatric, with locally advanced cT4bN1bMx rectal adenocarcinoma. Accordingly, this case report aimed to quantify the longitudinal caloric, protein, nitrogen and NPC:N kinetic trajectories of perioperative MNT from operative colostomy (T_0) through Postoperative Day 3 (T_3). It also had two further aims. The first was to benchmark their concordance against ESPEN 2021/2025 reference intervals. The second was to record the tolerance of the regimen and to outline points for post-colostomy nutritional management.

2. Methods

2.1. Study Design and Setting

This was a single-patient (n = 1) case report with a longitudinal, descriptive record of nutritional intake. It evaluated the perioperative clinicopathological profile, macronutrient escalation kinetics, nitrogen balance optimization and metabolic safety of medical nutrition therapy. The patient was geriatric, with locally advanced rectal adenocarcinoma after diverting colostomy. The study took place at the Clinical Nutrition Department and Digestive Surgery Inpatient Service of Bali Mandara Public Hospital, Denpasar, Bali, Indonesia. Reporting followed the EQUATOR Network CARE guidelines for case reports. Daily changes were described, without inferential testing, in caloric density (kcal/kg/day), protein provision (g/kg/day), elemental nitrogen delivery (g N/day) and non-protein calorie-to-nitrogen (NPC:N) ratios across four sequential perioperative observation epochs (T_0, T_1, T_2 and T_3).

2.2. Participant and Baseline Diagnostic Workup

The participant was a 71-year-old Indonesian female admitted through the Emergency Department of Bali Mandara Public Hospital. She had a 30-day (1-month) history of a painful perianal mass, progressive dyschezia, intermittent bright red hematochezia, decreased appetite (anorexia) and generalized physical weakness. She also had uncontrolled essential hypertension. Eligibility for intensive perioperative medical nutrition therapy and longitudinal tracking required three things. The first was a histologically or radiologically staged locally advanced rectal malignancy that needed surgical colostomy decompression. The second was intact baseline neurological consciousness (Glasgow Coma Scale [GCS] 15), which permitted early postoperative oral feeding trials. The third was complete baseline anthropometric, hematological, hepatorenal and contrast-enhanced abdominal computed tomography (CT) staging before nutritional escalation. Weight and height were measured at baseline. Body weight (BW = 62.0 kg) and stature (HT = 158.0 cm = 1.58 m) came from calibrated hospital scales and a stadiometer. They gave Quetelet's body mass index (BMI = BW / HT^2 = 62.0 / 2.4964 = 24.84 kg/m^2) and the modified Broca ideal body weight (IBW = [HT_{cm} − 100] − 0.10 × [HT_{cm} − 100] = 52.20 kg). Venous blood was drawn before surgery at admission (T_0). It quantified the leukocyte count (WBC), erythrocyte count (RBC), hemoglobin (HGB), platelet count (PLT), serum albumin, blood urea, serum creatinine (SCr), random blood glucose (GDS), aspartate aminotransferase (AST/SGOT) and alanine aminotransferase (ALT/SGPT). Contrast-enhanced abdominal-pelvic CT defined the craniocaudal length of the primary tumor, adjacent visceral invasion, regional lymphadenopathy and the AJCC 8th Edition TNM stage.

2.3. Observation Protocol, Interventions, and Comparative Framework

Perioperative clinical and nutritional trajectories were tracked across four consecutive epochs. T_0 (Operative Day 0) covered emergency admission, baseline staging and creation of the diverting colostomy by the consultant digestive surgeon. The patient was nil per os (NPO) during the surgical window. Intravenous fluid resuscitation used Ringer's Lactate 2,000 mL/24 hours (83.33 mL/hour). Intravenous ceftriaxone 1 × 2 g/day, metronidazole 3 × 500 mg/day, omeprazole 2 × 40 mg/day and ondansetron 3 × 8 mg/day were given alongside. T_1 (Postoperative Day 1 [POD 1]) began with the surgical clear fluid test diet (6 × 50 mL = 300 mL/day). The Clinical Nutrition Department escalated it to oral sugar water 3 × 100 mL (300 kcal/day) plus clear fruit juice 3 × 100 mL (150 kcal/day). At the same time, supplemental parenteral nutrition was given as a bridge. It comprised 5% dextrose (D5%), 10% crystalline L-amino acid solution (Kalbamin) and 20% four-oil intravenous lipid emulsion (SMOFlipid: 30% soybean oil, 30% medium-chain

triglycerides, 25% olive oil, 15% ω-3 fish oil) in a strict 1:1:1 volume ratio. In T_2 (Postoperative Day 2 [POD 2]), dietary texture advanced stepwise to filtered semi-liquid porridge. An initial semi-elemental oligomeric oral nutritional supplement (1 × 200 kcal) was added, and the 1:1:1 parenteral nutrition was tapered. In T_3 (Postoperative Day 3 [POD 3]), the patient moved to a full soft solid hospital diet ('makan lunak') supplemented with oligomeric peptide milk ('susu oligo') at 2 × 200 kcal/day (400 kcal/day). Parenteral nutrition was stopped completely.

To judge the physiological adequacy and guideline compliance of the index protocol, all prescribed and delivered macronutrient parameters from T_0 through T_3 were benchmarked against two sources. These were the 2021 ESPEN Practical Guideline on Clinical Nutrition in Cancer and the 2021/2025 ESPEN Guidelines on Clinical Nutrition in Surgery. For the patient's actual admission body weight of 62.0 kg, the ESPEN reference energy interval (25.0–30.0 kcal/kg/day) corresponded to 1,550.0 to 1,860.0 kcal/day. The reference protein interval (> 1.00 to 1.50 g/kg/day) corresponded to > 62.0 to 93.0 g/day (9.92–14.88 g N/day). Baseline hemodynamics were evaluated first, by computing Pulse Pressure (PP = SBP − DBP = 144 − 65 = 79.0 mmHg) and Mean Arterial Pressure (MAP = DBP + [PP / 3] = 91.33 mmHg). Hepatorenal indices came next. They were Blood Urea Nitrogen conversion (BUN = Urea / 2.14 = 11.21 mg/dL), the Urea-to-Creatinine ratio (24 / 0.90 = 26.67), the CKD-EPI 2021 estimated glomerular filtration rate (eGFR = 68.35 mL/min/1.73 m^2) and the De Ritis transaminase ratio (AST / ALT = 20 / 14 = 1.43). Four further frameworks were applied to the baseline clinical picture. They were the Global Leadership Initiative on Malnutrition (GLIM) phenotypic and etiologic criteria, geriatric sarcopenia risk indicators, diverting colostomy fluid-electrolyte balance and refeeding syndrome prophylaxis standards.

2.4. Descriptive Kinetic Analysis

Kinetics were described longitudinally. This single-patient (n = 1) report used descriptive arithmetic on the nutrition prescription from T_0 through T_3, without inferential statistics. Four analytic steps were taken. First, baseline laboratory parameters were standardized as exact multiples of the Upper Limit of Normal (× ULN) or Lower Limit of Normal (× LLN). Second, serial macronutrient changes between T_1 (initial hybrid nutrition) and T_3 (full oral target attainment) were quantified with the exact percentage delta formula, $\Delta\% = [(T_n - T_1) / T_1] \times 100\%$. Daily escalation velocity ($\Delta/\Delta t$ in kcal/day^2 or g/day^2) accompanied it. Third, protein-energy proportionality at each active feeding epoch was quantified through elemental nitrogen conversion (N [g] = Protein [g] / 6.25), Non-Protein Calories (NPC [kcal] = Total kcal − [Protein (g) × 4 kcal/g]) and the Non-Protein Calorie-to-Nitrogen ratio (NPC:N = NPC / N). The ratio was benchmarked against the optimal surgical anabolic utilization window of 100:1 to 130:1. Fourth, tolerability was recorded descriptively as the occurrence of nausea, vomiting, ileus, phlebitis, and clinical signs of refeeding syndrome or hepatorenal toxicity.

2.5. Ethical Approval

All clinical, anthropometric, biochemical, radiological and nutritional evaluations took place at Bali Mandara Public Hospital, Denpasar, Bali, Indonesia, under strict institutional confidentiality safeguards. Formal ethical clearance was granted. CMHC Research Center, Ethics Committee, Indonesia, approved the study (Protocol Approval Number: 2026/0527). The study followed the ethical standards of the 1964 Declaration of Helsinki and its subsequent amendments. It also followed the privacy mandates of the International Committee of Medical Journal Editors (ICMJE). Written informed consent was obtained. The patient and her legal family representative gave it for medical nutrition therapy, clinical data analysis and anonymized scientific publication.

3. Results

3.1. Baseline Clinical Presentation, Anthropometric Stratification, Laboratory Profile, and Contrast-Enhanced CT Pelvic Staging (cT4bN1bMx) at Admission (T_0)

A 71-year-old Indonesian female presented to the Emergency Department of Bali Mandara Public Hospital (T_0). She complained of a palpable perianal lump and of progressively painful, difficult defecation (dyschezia and partial obstipation) for approximately 30 days (1.0 month) before admission. Episodes of bright red rectal bleeding (hematochezia) interrupted this period. Over the same 30 days, her appetite fell sharply (anorexia) and she grew progressively weak (fatigue). She reported no episodes of nausea or vomiting. Her past medical history included chronic essential hypertension, which had remained pharmacologically uncontrolled before presentation. On initial examination at T_0 she looked clinically weak ('tampak lemas'), yet she was fully alert and oriented (compos mentis; Glasgow Coma Scale [GCS] score 15: $E_4V_5M_6$). Arterial blood pressure was 144/65 mmHg. This is isolated systolic hypertension (+20.00% above the 120 mmHg normal systolic threshold; 1.20× ULN) with a clearly widened pulse pressure (PP = 144 − 65 = 79.0 mmHg; +97.50% above the physiological 40.0 mmHg reference, 1.98× normal). The Mean Arterial Pressure was preserved (MAP = 65 + [79.0 / 3] = 91.33 mmHg). The heart rate was regular at 80 beats/min (0.80× ULN) and the core body temperature was afebrile at 36.2°C (−0.82% below 36.5°C). Baseline anthropometry recorded an actual body weight of 62.0 kg and a standing height of 158.0 cm (1.58 m). The resulting Body Mass Index (BMI) was 24.84 kg/m^2 (62.0 / 2.4964 = 24.84 kg/m^2), which is 0.99× the WHO adult normal upper boundary of 24.99 kg/m^2 and 118.77% of her modified Broca ideal body weight of 52.20 kg.

Preoperative hematological and biochemical profiling at emergency admission (T_0) showed leukocytosis. The white blood cell (WBC) count was 14.97 × 10^3/μL (reference interval 4.00–10.00 × 10^3/μL; +49.70% above ULN, 1.50× ULN). This reflects tumor-associated systemic inflammation and obstructive mucosal bacterial translocation across the ulcerated rectal neoplasm.[15–18] Despite 1 month of intermittent bright red hematochezia, red blood cell indices stayed within physiological reference limits. The erythrocyte count (RBC) was 5.11 × 10^6/μL (reference 4.00–5.20 × 10^6/μL; 0.98× ULN), hemoglobin (HGB) was 13.3 g/dL (reference 12.0–16.0 g/dL; +10.83% above LLN, 1.11× LLN), and the platelet count (PLT) was 225 × 10^3/μL (reference 150–400 × 10^3/μL; +50.00% above LLN, 1.50× LLN; platelet-to-leukocyte ratio = 15.03). Baseline visceral and metabolic chemistry gave a serum albumin of 4.0 g/dL (reference 3.5–5.0 g/dL; +14.29% above LLN, 1.14× LLN; albumin-to-leukocyte ratio = 0.27 g·μL/dL·10^3). Blood urea was 24 mg/dL (reference 15–40 mg/dL; 0.60× ULN), equal to a Blood Urea Nitrogen [BUN] of 11.21 mg/dL, and serum creatinine (SCr) was 0.90 mg/dL (reference 0.50–1.10 mg/dL; 0.82× ULN). Together they yield a physiological Urea-to-Creatinine ratio of 26.67 (BUN-to-Creatinine ratio = 12.46) and a CKD-EPI 2021 estimated glomerular filtration rate (eGFR) of 68.35 mL/min/1.73 m^2 (KDIGO Stage G2, mildly decreased renal function). Glycemic and hepatobiliary integrity at baseline

were confirmed by a random blood glucose (GDS) of 85 mg/dL (reference 70–140 mg/dL; 0.61× ULN), aspartate aminotransferase (AST/SGOT) of 20 U/L (reference < 32 U/L; 0.63× ULN) and alanine aminotransferase (ALT/SGPT) of 14 U/L (reference < 31 U/L; 0.45× ULN; De Ritis AST/ALT ratio = 1.43). Contrast-enhanced abdominal-pelvic computed tomography (CT) showed an enhanced solid malignant lesion in the rectosigmoid/rectum, 2.7 cm in craniocaudal length. The lesion was radiologically inseparable from the uterine fundus and adherent anteriorly to adjacent small bowel loops. Multiple paracolic and presacral lymphadenopathies were present, the largest node measuring 0.9 × 1.0 cm (cross-sectional area 0.90 cm^2). These findings established a definitive clinical TNM stage of cT4bN1bMx rectal adenocarcinoma, as detailed in Table 1.

Table 1. Baseline Demographic, Anthropometric, Hemodynamic, Contrast-Enhanced Abdominal CT Staging (cT4bN1bMx), and Laboratory Parameters at Emergency Admission (T_0) Relative to Reference Intervals.

Clinical / Diagnostic Domain & Parameter	Measured Value at Admission (T_0)	Normal Reference Interval	Standardized Ratio & Percentage Deviation	Pathophysiological & Nutritional Interpretation
Age, Sex & Chief Oncological Presentation	71-year-old Female; anal lump, dyschezia & bright red hematochezia (30 days)	Asymptomatic / intact anorectal canal	Duration = 30.0 days (1.0 month pre-admission)	Symptomatic distal malignant rectal obstruction with acute 1-month anorexia and fatigue
Neurological Status & Systemic Comorbidity	Alert / Compos Mentis (GCS 15: $E_4V_5M_6$); Uncontrolled Hypertension	GCS 15; BP < 120/80 mmHg	100.00% intact sensorium; chronic vascular stiffness	Eligible for early post-colostomy oral feeding under ESPEN surgical safety criteria
Arterial Blood Pressure (SBP / DBP)	144 / 65 mmHg (PP = 79.0 mmHg; MAP = 91.33 mmHg)	SBP 90–120 mmHg; DBP 60–80 mmHg; PP ~40 mmHg	SBP 1.20× ULN (+20.00%); PP 1.98× normal (+97.50%)	Isolated systolic hypertension and widened pulse pressure secondary to arterial stiffness
Heart Rate (HR) & Core Body Temperature	HR = 80 beats/min; Temperature = 36.2°C	HR 60–100 beats/min; Temp 36.5–37.5°C	HR 0.80× ULN (normal); Temp −0.82% below 36.5°C	Hemodynamically stable without systemic septic tachycardia or febrile response
Anthropometry: Weight, Height & BMI	Weight = 62.0 kg; Height = 158.0 cm (1.58 m); BMI = 24.84 kg/m^2	WHO Normal: 18.50–24.99 kg/m^2; Geriatric cutoff ≥ 22.00 kg/m^2	0.99× WHO ULN; 118.77% of Broca IBW (52.20 kg)	Normal-range BMI masking 1-month anorexia-induced catabolism and potential sarcopenia
Leukocyte Count (WBC)	14.97 × 10^3/µL	4.00–10.00 × 10^3/µL	1.50× ULN (+49.70% above upper reference limit)	Tumor-driven systemic inflammatory response and obstructive mucosal bacterial translocation
Erythrocyte Count (RBC) & Hemoglobin (HGB)	RBC = 5.11 × 10^6/µL; HGB = 13.3 g/dL	RBC 4.00–5.20 × 10^6/µL; HGB 12.0–16.0 g/dL	RBC 0.98× ULN; HGB 1.11× LLN (+10.83% above LLN)	Preserved oxygen-carrying capacity despite intermittent 1-month bright red hematochezia
Platelet Count (PLT) & PLT-to-WBC Ratio	225 × 10^3/µL (PLT/WBC ratio = 15.03)	150–400 × 10^3/µL	1.50× LLN (+50.00% above lower reference limit)	Adequate primary hemostasis for diverting colostomy without reactive thrombocytosis
Serum Albumin & Albumin-to-WBC Index	4.0 g/dL (Albumin/WBC index = 0.27 g·µL/dL·10^3)	3.5–5.0 g/dL	1.14× LLN (+14.29% above lower reference limit)	Preserved hepatic visceral protein pool (half-life ~20 days); does not exclude acute malnutrition
Renal Function: Blood Urea, Creatinine & eGFR	Urea = 24 mg/dL (BUN = 11.21 mg/dL); SCr = 0.90 mg/dL; eGFR = 68.35 mL/min/1.73 m^2	Urea 15–40 mg/dL; SCr 0.50–1.10 mg/dL; eGFR ≥ 60	Urea 0.60× ULN; SCr 0.82× ULN; Urea/SCr = 26.67	KDIGO G2 preserved renal clearance supporting safe 1.29 g/kg/day (80.0 g/day) protein target
Random Blood Glucose (GDS) & Transaminases	GDS = 85 mg/dL; AST (SGOT) = 20 U/L; ALT (SGPT) = 14 U/L	GDS 70–140 mg/dL; AST < 32 U/L; ALT < 31 U/L	GDS 0.61× ULN; AST 0.63× ULN; De Ritis = 1.43	Euglycemic baseline and intact hepatocellular function for parenteral D5% and SMOFlipid clearance
Contrast-Enhanced Abdominal CT & AJCC Stage	Enhanced solid rectal lesion (2.7 cm), invades uterine fundus & anterior small bowel; paracolic/presacral nodes (0.9 × 1.0 cm)	Uninvolved rectal wall (0.0 cm mass; node < 0.5 cm)	Primary length = 2.7 cm; Max node = 0.9 × 1.0 cm (0.90 cm^2); Stage cT4bN1bMx	Locally advanced multivisceral rectal adenocarcinoma requiring diverting colostomy and intensive MNT

Abbreviations: ALT (SGPT), alanine aminotransferase; AST (SGOT), aspartate aminotransferase; BMI, body mass index; BP, blood pressure; BUN, blood urea nitrogen; CT, computed tomography; DBP, diastolic blood pressure; eGFR, estimated glomerular filtration rate (CKD-EPI 2021); GCS, Glasgow Coma Scale; GDS, random blood glucose; HGB, hemoglobin; HR, heart rate; IBW, ideal body weight; LLN, lower limit of normal; MAP, mean arterial pressure; MNT, medical nutrition therapy; PLT, platelet count; PP, pulse pressure; RBC, red blood cell count; SBP, systolic blood pressure; SCr, serum creatinine; ULN, upper limit of normal; WBC, white blood cell count.

3.2. Urgent Diverting Colostomy, Perioperative Pharmacotherapy, and Postoperative Day 1 Trophic Clear Liquids With 1:1:1 Supplemental Parenteral Bridging (T_0 to T_1)

To decompress the distal malignant rectal obstruction and prevent impending stercoral perforation, the consultant digestive surgeon performed an urgent diverting colostomy at T_0, with balanced perioperative hemodynamic and antimicrobial coverage.[19,20] The baseline surgical protocol had four parts. The first was continuous intravenous fluid resuscitation with Ringer's Lactate (IVFD RL) at 2,000 mL/24 hours (83.33 mL/hour), supplying 260 mmol/day Na^+, 218 mmol/day Cl^-, 8 mmol/day K^+, 3 mmol/day Ca^{2+} and 56 mmol/day lactate. The second was dual bactericidal antimicrobial therapy, intravenous ceftriaxone 1 × 2 g/day (2,000 mg/day) and intravenous metronidazole 3 × 500 mg/day (1,500 mg/day), which targets Gram-negative enteric bacilli and obligate colonic anaerobes. The third was intravenous omeprazole 2 × 40 mg/day (80 mg/day) for stress-related mucosal disease prophylaxis. The fourth was intravenous ondansetron 3 × 8 mg/day (24 mg/day) for selective 5-hydroxytryptamine-3 ($5\text{-}HT_3$) antiemetic protection. Figure 1 presents a visual synthesis of the patient's baseline clinical phenotype (Panel A), the contrast-enhanced CT anatomical schematic of the 2.7 cm cT4bN1bMx tumor invading the uterine fundus and anterior small bowel, with the diverting colostomy bypass (Panel B), the geriatric BMI stratification that shows the masked malnutrition

paradox (Panel C), and the standardized baseline laboratory profile relative to reference limits (Panel D).

Once the diverting colostomy was created, the Clinical Nutrition Department set an individualized medical nutrition therapy (MNT) target anchored to the 2021/2025 ESPEN Cancer and Surgical Guideline equations for an actual body weight of 62.0 kg. The energy reference window was 25.0–30.0 kcal/kg/day (1,550.0–1,860.0 kcal/day) and the protein reference window was > 1.00–1.50 g/kg/day (> 62.0–93.0 g/day).[11–13,21–26] The controlled target prescription was 1,800 kcal/day (29.03 kcal/kg/day). This is 116.13% of the 1,550 kcal/day ESPEN lower bound and 96.77% of the 1,860 kcal/day upper bound. The protein target was 80.0 g/day (1.29 g/kg/day, equivalent to 12.80 g N/day), or 129.03% of the 62.0 g/day ESPEN minimum threshold and 86.02% of the 93.0 g/day maximum anabolic target. On Postoperative Day 1 (T_1), oral feeding started with the digestive surgeon's clear fluid test diet (6 × 50 mL = 300 mL/day). The clinical nutrition team advanced it to oral sugar water 3 × 100 mL (3 × 100 kcal = 300 kcal/day of simple carbohydrates and 0.0 g protein) plus clear fruit juice 3 × 100 mL (150 kcal/day and 0.0 g protein). The initial oral clear liquid intake was therefore 600 mL/day, delivering 450 kcal/day (7.26 kcal/kg/day; 25.00% of the 1,800 kcal target) and 0.0 g/day of oral protein (0.00% of the 80.0 g target). A 1:1:1 supplemental parenteral nutrition (SPN) bridge was given concurrently at T_1. It was meant to prevent unopposed skeletal muscle proteolysis during the protein-free clear liquid phase while avoiding early enteral overload. The bridge comprised 250 mL of D5% (12.5 g dextrose = 50 kcal), 250 mL of Kalbamin 10% (25.0 g crystalline amino acids = 100 kcal; 4.00 g N) and 250 mL of SMOFlipid 20% (50.0 g four-oil lipid emulsion = 500 kcal, including 7.5 g ω-3 fish oil). The bridge added 650 kcal/day (10.48 kcal/kg/day). It also added 25.0 g/day of amino acids (0.40 g/kg/day). Combined T_1 intake reached 1,100 kcal/day (17.74 kcal/kg/day; 61.11% of target) and 25.0 g/day protein (31.25% of target; NPC:N ratio = 250.00:1), as detailed in Table 2.

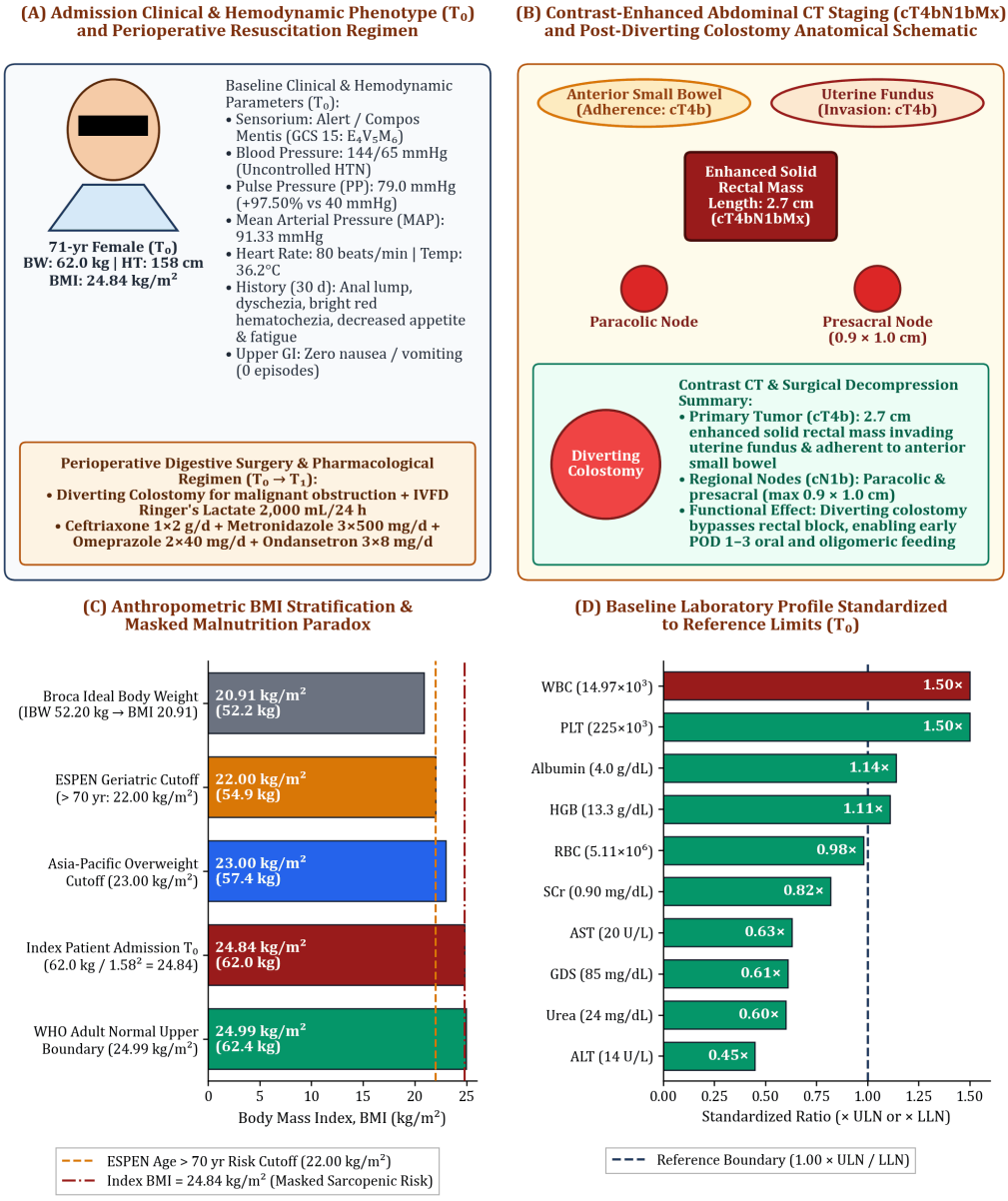


Figure 1. Baseline Clinical Phenotype, Contrast-Enhanced Abdominal CT cT4bN1bMx Pelvic Staging Schematic (2.7 cm Rectal Mass Invading Uterine Fundus & Adherent to Anterior Small Bowel With 0.9 × 1.0 cm Paracolic/Presacral Nodes and Diverting Colostomy), Geriatric Anthropometric Stratification (BMI 24.84 kg/m², and Standardized Admission Laboratory Profile (T_0).

3.3. Stepwise Oral Escalation to Soft Solid Diet and Oligomeric ONS (2 × 200 kcal/day), Nitrogen Balance Restoration, and NPC:N Convergence (T_1 to T_3)

Across Postoperative Days 2 and 3 (T_2 to T_3), gastrointestinal motility and colostomy patency recovered smoothly. There was no nausea, vomiting, abdominal distension or peristomal mucocutaneous complication.[27–31] On Postoperative Day 2 (T_2), oral feeding advanced from clear fluids to a filtered semi-liquid porridge diet (750 kcal/day, 26.0 g/day protein). An initial serving of semi-elemental oligomeric peptide milk (1 × 200 kcal/day, 14.0 g/day hydrolyzed whey protein) was added. The oral route thus yielded 950 kcal/day (15.32 kcal/kg/day) and 40.0 g/day protein (0.65 g/kg/day), while the 1:1:1 parenteral infusion was tapered to 500 kcal/day and 20.0 g/day amino acids. The hybrid T_2 regimen delivered a combined 1,450 kcal/day (23.39 kcal/kg/day; 80.56% of the 1,800 kcal target; $\Delta\%[T_1 \rightarrow T_2]$ = +31.82%) and 60.0 g/day of protein (0.97 g/kg/day; 9.60 g N/day; 75.00% of the 80.0 g target; $\Delta\%[T_1 \rightarrow T_2]$ = +140.00%). The daily caloric deficit fell from −700 kcal/day at T_1 to −350 kcal/day at T_2. The Non-Protein Calorie-to-Nitrogen (NPC:N) ratio improved by −49.58%, from 250.00:1 (1,000 non-protein kcal / 4.00 g N) to 126.04:1 (1,210 non-protein kcal / 9.60 g N). On Postoperative Day 3 (T_3), the patient tolerated a full soft solid hospital diet ('makan lunak': 1,400 kcal/day, 52.0 g/day protein = 8.32 g N/day). It was fortified with oligomeric oral nutritional supplements ('susu oligo') at 2 × 200 kcal/day (400 kcal/day, 28.0 g/day hydrolyzed oligopeptide protein = 4.48 g N/day). Parenteral nutrition could be stopped completely (0 kcal/day SPN). By T_3 (72 hours post-colostomy), the target was met. The patient reached 100.00% of her prescribed nutritional target, 1,800 kcal/day (29.03 kcal/kg/day) and 80.0 g/day of protein (1.29 g/kg/day; 12.80 g N/day), entirely by the oral route. This is a net oral caloric surge of $\Delta\%(T_1 \rightarrow T_3)$ = +300.00% (450 to 1,800 kcal/day; velocity +675.0 oral kcal/day^2). The total combined caloric increase was $\Delta\%(T_1 \rightarrow T_3)$ = +63.64% (1,100 to 1,800 kcal/day; velocity +350.0 kcal/day^2), as illustrated in Figure 2.

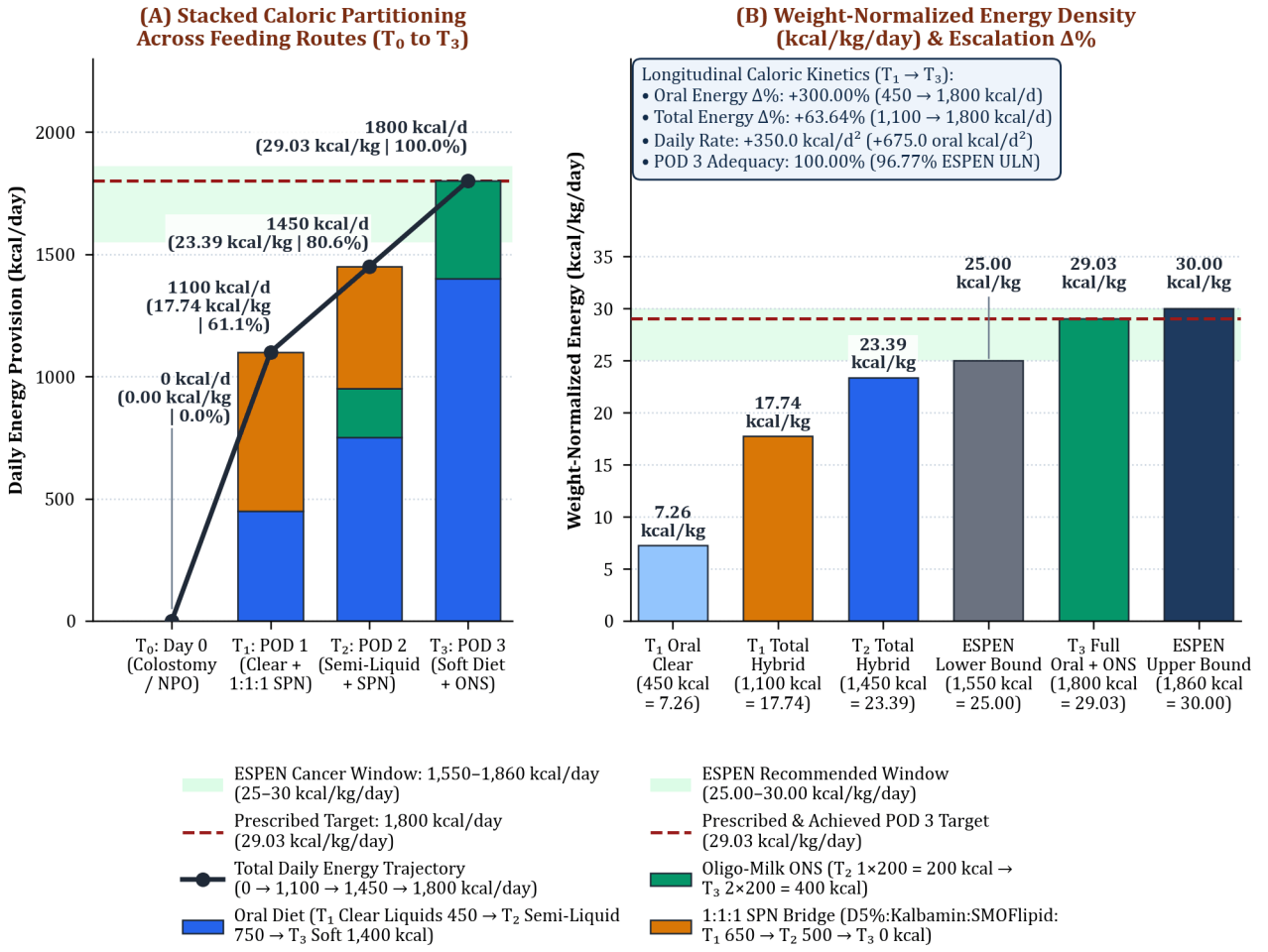


Figure 2. Longitudinal Perioperative Caloric Escalation Trajectory Across Observation Epochs (T_0 to T_3): Stacked Partitioning of Oral Clear Liquids, 1:1:1 Supplemental Parenteral Nutrition (D5% : Kalbamin 10% : SMOFlipid 20%), Soft Diet, and Oligo-Milk ONS (2 × 200 kcal/day) Relative to the ESPEN 25–30 kcal/kg/day Reference Window (1,550–1,860 kcal/day) and Prescribed 1,800 kcal/day (29.03 kcal/kg/day) Target.

Table 2. Longitudinal Perioperative Medical Nutrition Therapy (MNT) Escalation Trajectory Across Observation Epochs (T_0 to T_3) Versus ESPEN Guideline Reference Windows (62.0 kg Actual Body Weight).

Nutritional & Kinetic Parameter	T_0: Day 0 (Operative Colostomy & Resuscitation)	T_1: POD 1 (Trophic Clear Fluids + 1:1:1 SPN Bridge)	T_2: POD 2 (Stepwise Semi-Liquid + Tapered SPN & ONS)	T_3: POD 3 (Soft Solid Diet + Oligo-Milk ONS 2 × 200 kcal)	ESPEN Reference Window & Longitudinal Trajectory (Δ%)
Primary Feeding Route & Clinical Regimen	NPO during diverting colostomy; IVFD Ringer's Lactate 2,000 mL/24 h	Surgical clear fluid (6 × 50 mL) → Sugar water 3 × 100 mL + Clear juice 3 × 100 mL + 1:1:1 SPN	Filtered semi-liquid porridge diet + Oligomeric ONS (1 × 200 kcal) + tapered 1:1:1 SPN	Full soft solid hospital diet ('makan lunak') + Oligo-milk ONS 2 × 200 kcal (SPN weaned)	Stepwise transition from hybrid SPN bridge to 100% oral/enteral route within 72 hours

Nutritional & Kinetic Parameter	T_0: Day 0 (Operative Colostomy & Resuscitation)	T_1: POD 1 (Trophic Clear Fluids + 1:1:1 SPN Bridge)	T_2: POD 2 (Stepwise Semi-Liquid + Tapered SPN & ONS)	T_3: POD 3 (Soft Solid Diet + Oligo-Milk ONS 2 × 200 kcal)	ESPEN Reference Window & Longitudinal Trajectory (Δ%)
Oral / Enteral Energy Delivery (kcal/day)	0 kcal/day (0.00 kcal/kg/day)	450 kcal/day (7.26 kcal/kg/day: 300 kcal sugar water + 150 kcal clear juice)	950 kcal/day (15.32 kcal/kg/day: 750 kcal semi-liquid + 200 kcal ONS)	1,800 kcal/day (29.03 kcal/kg/day: 1,400 kcal soft diet + 400 kcal oligo-milk ONS)	ESPEN: 1,550–1,860 kcal/day; Oral Δ%(T_1→T_3) = +300.00% (+675.0 kcal/day^2 velocity)
Supplemental Parenteral Energy (1:1:1 D5:Kalbamin:SMOFlipid)	0 kcal/day (crystalloid hydration only)	650 kcal/day (10.48 kcal/kg/day: 50 kcal D5% + 100 kcal Kalbamin + 500 kcal SMOFlipid)	500 kcal/day (8.06 kcal/kg/day: tapered 1:1:1 parenteral infusion)	0 kcal/day (0.00 kcal/kg/day; parenteral nutrition completely discontinued)	SPN bridged 59.09% of energy at T_1 and 34.48% at T_2 before complete weaning at T_3
Total Combined Energy Intake (kcal/day & kcal/kg/day)	0 kcal/day (0.00 kcal/kg/day)	1,100 kcal/day (17.74 kcal/kg/day)	1,450 kcal/day (23.39 kcal/kg/day)	1,800 kcal/day (29.03 kcal/kg/day)	Prescribed: 1,800 kcal/day (29.03 kcal/kg/day); Total Δ%(T_1→T_3) = +63.64% (+350.0 kcal/day^2)
Caloric Adequacy vs Prescribed (1,800 kcal) & ESPEN Bounds	0.00% of target (deficit = −1,800 kcal/day)	61.11% of target (70.97% of 1,550 kcal LLN; deficit = −700 kcal/day)	80.56% of target (93.55% of 1,550 kcal LLN; deficit = −350 kcal/day)	100.00% of target (116.13% of 1,550 kcal LLN; 96.77% of 1,860 kcal ULN)	Eliminated −700 kcal/day energy deficit between T_1 and T_3 without overfeeding (> 30 kcal/kg)
Oral / Enteral Protein Delivery (g/day & g/kg/day)	0.0 g/day (0.00 g/kg/day)	0.0 g/day (0.00 g/kg/day; sugar water & clear juice contain 0 g protein)	40.0 g/day (0.65 g/kg/day: 26.0 g semi-liquid diet + 14.0 g oligomeric ONS)	80.0 g/day (1.29 g/kg/day: 52.0 g soft solid diet + 28.0 g oligo-milk ONS)	Oral protein progressed from 0.0 g/day at T_1 to 80.0 g/day at T_3 (+100.00% of target)
Parenteral Amino Acid Delivery (Kalbamin 10%, g/day)	0.0 g/day (0.00 g/kg/day)	25.0 g/day (0.40 g/kg/day; 4.00 g N/day from 250 mL Kalbamin 10%)	20.0 g/day (0.32 g/kg/day; 3.20 g N/day from tapered Kalbamin 10%)	0.0 g/day (0.00 g/kg/day; parenteral amino acids discontinued)	Prevented complete protein starvation on POD 1 when clear liquids provided 0.0 g protein
Total Combined Protein & Nitrogen Delivery (g/day & g N/day)	0.0 g/day (0.00 g/kg/day; 0.00 g N/day)	25.0 g/day (0.40 g/kg/day; 4.00 g N/day)	60.0 g/day (0.97 g/kg/day; 9.60 g N/day)	80.0 g/day (1.29 g/kg/day; 12.80 g N/day)	ESPEN: > 62.0–93.0 g/day (1.0–1.5 g/kg/day); Total Protein Δ%(T_1→T_3) = +220.00%
Protein Adequacy vs Prescribed (80.0 g) & NPC:N Ratio	0.00% of target (deficit = −80.0 g/day)	31.25% of target (40.32% of 62.0 g LLN); NPC:N = 250.00 : 1	75.00% of target (96.77% of 62.0 g LLN); NPC:N = 126.04 : 1	100.00% of target (129.03% of 62.0 g LLN; 86.02% of 93.0 g ULN); NPC:N = 115.63 : 1	Converged NPC:N ratio from 250.00:1 (T_1) to optimal surgical anabolic window 115.63:1 (T_3)
Gastrointestinal Tolerance & Stoma Function	Acute distal rectal obstruction relieved by diverting colostomy	Zero nausea/vomiting (0 episodes); clear fluids tolerated; viable stoma mucosa	Active bowel sounds; flatus & initial semi-formed colostomy effluent; no distension	Full tolerance of soft diet + 2 × 200 kcal oligo-milk; functional colostomy without ileus	100% GI tolerance across T_1–T_3 with zero refeeding or anastomotic/stomal complications

Abbreviations: Δ%, percentage delta change calculated as [(T_n − T_1)/T_1] × 100%; ESPEN, European Society for Clinical Nutrition and Metabolism; GI, gastrointestinal; IVFD, intravenous fluid drip; LLN, lower limit of normal (25 kcal/kg/day = 1,550 kcal/day; 1.0 g protein/kg/day = 62.0 g/day); MNT, medical nutrition therapy; N, elemental nitrogen (protein [g] / 6.25); NPC:N, non-protein calorie to nitrogen ratio; NPO, nil per os; ONS, oral nutritional supplement; POD, postoperative day; SPN, supplemental parenteral nutrition; ULN, upper limit of normal (30 kcal/kg/day = 1,860 kcal/day; 1.5 g protein/kg/day = 93.0 g/day).

Prescribed nitrogen provision and macronutrient proportions converged across the 72-hour postoperative observation window; nitrogen balance itself was not measured.[32–37] Suppose the patient had received only the T_1 oral clear liquid regimen (sugar water 3 × 100 mL + clear juice 3 × 100 mL = 450 kcal/day, 0.0 g protein). Elemental nitrogen delivery would then have stayed at 0.00 g N/day. The NPC:N ratio would have been mathematically infinite (450 non-protein kcal / 0.00 g N = ∞), with unmitigated catabolic nitrogen wasting. The 250 mL of Kalbamin 10% (25.0 g amino acids = 4.00 g N/day) in the 1:1:1 SPN bridge set an initial T_1 nitrogen floor of 4.00 g N/day. It capped the T_1 NPC:N ratio at 250.00:1 (total calorie-to-nitrogen ratio = 275.00:1). Oral semi-liquid protein and oligomeric peptide ONS were then introduced stepwise at T_2 (60.0 g protein = 9.60 g N/day), followed by a full soft solid diet plus 2 × 200 kcal oligomeric ONS at T_3 (80.0 g protein = 12.80 g N/day). Total daily protein and nitrogen delivery thus rose by +220.00% between T_1 and T_3 (+27.50 g protein/day velocity; +4.40 g N/day velocity). At T_3, protein accounted for exactly 320.0 kcal/day (17.78% of total energy). Non-protein calories accounted for 1,480.0 kcal/day (82.22% of total energy: 1,020.0 kcal carbohydrate [56.67%] and 460.0 kcal lipid [25.56%]). This brings the NPC:N ratio to 115.63:1 (1,480.0 kcal / 12.80 g N; −53.75% reduction from T_1), within the 100:1 to 130:1 window cited by the authors, and the total calorie-to-nitrogen ratio to 140.63:1 (1,800.0 kcal / 12.80 g N; −48.86% reduction from T_1), which lies outside that window, as illustrated in Figure 3.

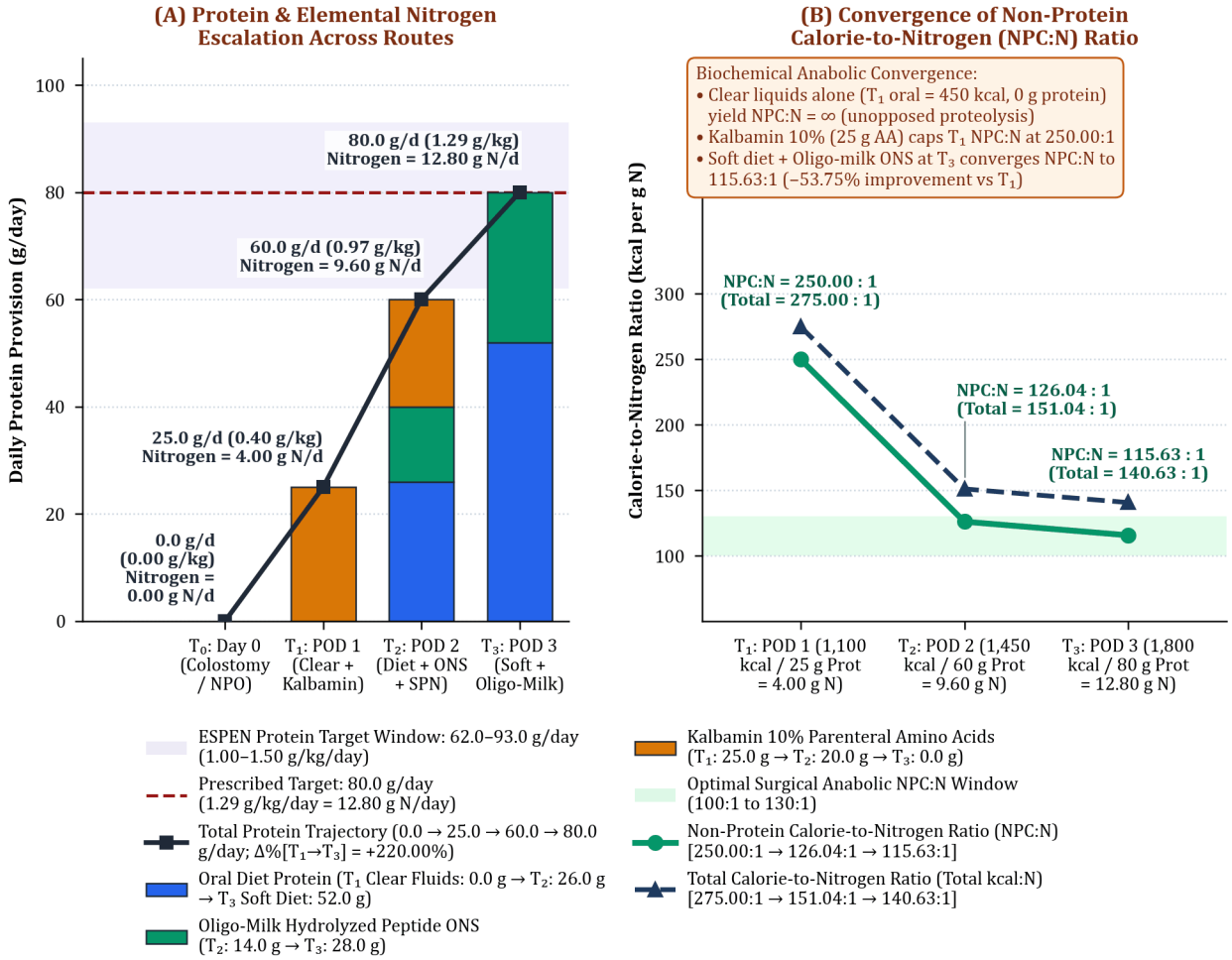


Figure 3. Longitudinal Protein and Elemental Nitrogen Restoration Trajectory (0.0 → 25.0 → 60.0 → 80.0 g/day; Δ%[T_1→T_3] = +220.00%; 12.80 g N/day on POD 3) and Convergence of the Non-Protein Calorie-to-Nitrogen (NPC:N) Ratio From 250.00:1 (T_1) and 126.04:1 (T_2) to the Optimal Anabolic Ratio of 115.63:1 (T_3).

3.4. Biochemical Partitioning of the 1:1:1 Supplemental Parenteral Regimen and Tolerance

Table 3 summarizes the composition and role of the parenteral, enteral/oral and pharmacological components from T_0 through T_3.[38–44] The 1:1:1 supplemental parenteral nutrition bridge at T_1 consisted of 250 mL D5% : 250 mL Kalbamin 10% : 250 mL SMOFlipid 20% (750 mL total volume). Its D5% supplied 12.5 g of anhydrous D-glucose (50.0 kcal; osmolarity ~252 mOsm/L). This is intended to prevent starvation ketosis and to avoid hyperglycemic excursions in a patient whose baseline random blood glucose was euglycemic at 85 mg/dL. Kalbamin 10% delivered 25.0 g of crystalline L-amino acids enriched in branched-chain amino acids (leucine, isoleucine and valine; 100.0 kcal; 4.00 g N; osmolarity ~880 mOsm/L). The aim was to stimulate mammalian target of rapamycin complex 1 (mTORC1)-dependent protein synthesis in the healing colostomy mucocutaneous margins. SMOFlipid 20% provided 50.0 g of a composite four-oil lipid emulsion (500.0 kcal; osmolarity ~380 mOsm/L). It contained 30% refined soybean oil (15.0 g essential linoleic and α-linolenic long-chain triglycerides), 30% medium-chain triglycerides (15.0 g caprylic/capric fatty acids that undergo rapid carnitine-independent mitochondrial β-oxidation), 25% refined olive oil (12.5 g oleic monounsaturated fatty acids resistant to lipid peroxidation) and 15% purified fish oil (7.5 g ω-3 eicosapentaenoic acid [EPA] and docosahexaenoic acid [DHA]), fortified with α-tocopherol. These components are expected to supply anti-inflammatory lipid mediators; any effect on the baseline leukocytosis (WBC 14.97 × 10^3/μL) was not assessed. On Postoperative Day 3 (T_3), the 2 × 200 kcal/day oligomeric oral nutritional supplement supplied 28.0 g/day of enzymatically hydrolyzed whey di- and tripeptides. These are absorbed directly across the apical enterocyte membrane through the proton-coupled oligopeptide transporter 1 (PEPT1), which minimizes luminal osmotic load and pancreaticobiliary secretory demand.

Table 3. Biochemical Composition, Macronutrient Partitioning, and Pharmacological Integration of the Perioperative Multimodal Regimen (1:1:1 D5% : Kalbamin 10% : SMOFlipid 20%, Oral/Oligomeric Diet, and Digestive Surgery Protocol).

Therapeutic Component & Modality	Dosage, Volume Ratio & Administration Schedule	Macronutrient & Active Biochemical Composition	Caloric & Nitrogen Contribution (Per Regimen Unit)	Physiological, Immunometabolic & Surgical Rationale
D5% (5% Dextrose Intravenous Solution — SPN Component 1)	Ratio 1 part in 1:1:1 SPN (250 mL/day at T_1; 500 mL per standard unit)	50 g/L anhydrous D-glucose (12.5 g dextrose per 250 mL; 25.0 g per 500 mL); ~252 mOsm/L	50 kcal per 250 mL (100 kcal per 500 mL); 0.0 g protein (0.0 g N)	Provides basal obligate central nervous system and erythrocyte glucose while preventing stress hyperglycemia (baseline GDS = 85 mg/dL)

Therapeutic Component & Modality	Dosage, Volume Ratio & Administration Schedule	Macronutrient & Active Biochemical Composition	Caloric & Nitrogen Contribution (Per Regimen Unit)	Physiological, Immunometabolic & Surgical Rationale
Kalbamin 10% (Crystalline Amino Acid Solution — SPN Component 2)	Ratio 1 part in 1:1:1 SPN (250 mL/day at T_1; 500 mL per standard unit)	100 g/L essential & non-essential L-amino acids (BCAA-enriched: leucine, isoleucine, valine; 16.0 g N/L); ~880 mOsm/L	25.0 g amino acids (100 kcal; 4.00 g N) per 250 mL; 50.0 g (200 kcal; 8.00 g N) per 500 mL	Counteracts acute postoperative skeletal muscle proteolysis and supports stomal mucocutaneous wound healing during POD 1–2
SMOFlipid 20% (4-Oil Intravenous Lipid Emulsion — SPN Component 3)	Ratio 1 part in 1:1:1 SPN (250 mL/day at T_1; 500 mL per standard unit)	200 g/L lipids: 30% soybean oil (LCT), 30% MCT, 25% olive oil (MUFA), 15% ω-3 fish oil (EPA/DHA) + α-tocopherol; ~380 mOsm/L	50.0 g lipids (500 kcal, incl. 7.5 g ω-3 fish oil) per 250 mL; 100.0 g (1,000 kcal) per 500 mL	Delivers dense non-glucose energy and anti-inflammatory ω-3 resolvins/protectins to attenuate systemic leukocytosis (WBC 14.97 × 10^3/μL)
Oral Clear Liquid Phase (T_1: Sugar Water + Clear Juice)	Surgical 6 × 50 mL → Sugar water 3 × 100 mL + Clear juice 3 × 100 mL (600 mL/day)	Simple disaccharides/monosaccharides (~112.5 g carbohydrate/day), water, and trace potassium/citrate; 0.0 g protein; 0.0 g lipid	450 kcal/day (300 kcal sugar water + 150 kcal clear juice); 0.0 g protein (0.0 g N)	Stimulates early vagal cephalic-enteric reflexes and brush-border trophic integrity; requires SPN protein bridging on POD 1
Oligo-Milk ONS (T_2–T_3: Semi-Elemental Oligomeric Formula)	1 × 200 kcal at T_2 → 2 × 200 kcal/day (400 kcal/day) at T_3 alongside soft diet	Hydrolyzed whey oligopeptides/di- and tripeptides (PEPT1 transporter substrate), MCT/vegetable oil blend, maltodextrin, vitamins & trace elements	400 kcal/day and 28.0 g/day hydrolyzed protein (4.48 g N/day) at T_3 (14.0 g per 200 kcal serving)	Rapid luminal absorption via H^+-coupled oligopeptide transporter (PEPT1) with minimal pancreatic/biliary digestive work and low stoma residue
Soft Solid Hospital Diet ('Makan Lunak' at T_3)	3 main meals + 2 structured snacks on POD 3 (T_3)	Low-fiber, low-saturated-fat, easily digestible complex carbohydrates (~215 g), high-biological-value protein (52.0 g), and moderate fat (~36 g)	1,400 kcal/day and 52.0 g/day protein (8.32 g N/day); combined with ONS = 1,800 kcal & 80.0 g protein	Restores physiological mastication, gastrocolic motility, and complete oral nutritional autonomy (29.03 kcal/kg/day; 1.29 g protein/kg/day)
IVFD Ringer's Lactate (Perioperative Crystalloid Resuscitation)	2,000 mL / 24 hours (83.33 mL/hour continuous IV infusion)	Na^+ 130 mmol/L (260 mmol/d), Cl^- 109 mmol/L (218 mmol/d), K^+ 4 mmol/L (8 mmol/d), Ca^{2+} 1.5 mmol/L (3 mmol/d), Lactate 28 mmol/L (56 mmol/d)	0 kcal/day; 2,000 mL balanced extracellular fluid and electrolyte replacement	Maintains intravascular volume, renal perfusion (SCr 0.90 mg/dL), and acid-base buffering across colostomy creation and early stoma output
Ceftriaxone + Metronidazole (Dual Antimicrobial Prophylaxis/Therapy)	Ceftriaxone 1 × 2 g/day IV (2,000 mg/d) + Metronidazole 3 × 500 mg/day IV (1,500 mg/d)	3rd-generation cephalosporin (Gram-negative bacilli) + nitroimidazole (obligate colonic anaerobes including Bacteroides fragilis)	0 kcal/day; targeted bactericidal synergy across obstructed colorectal lumen	Controls bacterial translocation and surgical site infection risk associated with baseline leukocytosis (WBC 14.97 × 10^3/μL) and T4b tumor
Omeprazole + Ondansetron (Mucosal Protection & Antiemetic Regimen)	Omeprazole 2 × 40 mg/day IV (80 mg/d) + Ondansetron 3 × 8 mg/day IV (24 mg/d)	H^+/K^+-ATPase proton pump inhibitor + selective 5-HT_3 serotonin receptor antagonist	0 kcal/day; pro-absorptive upper GI pharmacotherapy	Prevents perioperative stress ulceration and postoperative nausea/vomiting (PONV = 0 episodes), directly enabling early POD 1–3 oral escalation

Abbreviations: 5-HT_3, 5-hydroxytryptamine type 3; BCAA, branched-chain amino acids; DHA, docosahexaenoic acid; EPA, eicosapentaenoic acid; GDS, random blood glucose; GI, gastrointestinal; IV, intravenous; IVFD, intravenous fluid drip; LCT, long-chain triglycerides; MCT, medium-chain triglycerides; MUFA, monounsaturated fatty acids; N, elemental nitrogen; ONS, oral nutritional supplement; PEPT1, proton-coupled oligopeptide transporter 1; POD, postoperative day; PONV, postoperative nausea and vomiting; SCr, serum creatinine; SPN, supplemental parenteral nutrition; WBC, white blood cell count.

Tolerance of the multimodal regimen was recorded descriptively across T_0 through T_3.[45–49] There were no episodes of postoperative nausea or vomiting, no paralytic ileus, no catheter phlebitis and no clinical manifestation of refeeding syndrome or hepatorenal toxicity. Parenteral nutrition was weaned once 1,800 kcal/80.0 g oral intake was reached. Figure 4 shows the energy partitioning of the 1:1:1 supplemental parenteral regimen and of the POD 3 full oral diet.

3.5. Perioperative Metabolic, Refeeding, and Stomal Homeostasis Assessment and Global Literature Benchmarking (2021–2026)

Table 4 summarizes three core perioperative metabolic and pathophysiological domains that govern nutritional recovery in geriatric cT4bN1bMx rectal cancer after diverting colostomy.[50–52] The first domain was malnutrition risk under the Global Leadership Initiative on Malnutrition (GLIM) framework. Admission body weight (62.0 kg), height (158.0 cm), BMI (24.84 kg/m^2) and serum albumin (4.0 g/dL) were all within reference intervals. Yet 30 days of obstructive dyschezia, hematochezia and anorexia, a locally advanced cT4bN1bMx pelvic malignancy and systemic leukocytosis (WBC 14.97 × 10^3/μL; 1.50× ULN; Albumin-to-WBC ratio = 0.27 g·μL/dL·10^3) fulfilled both GLIM etiologic criteria (reduced food intake/assimilation and severe disease burden/inflammation). The risk of normal-BMI geriatric sarcopenia is therefore high. Opportunistic third lumbar vertebra (L3) CT Skeletal Muscle Index (SMI) morphomics and bedside handgrip dynamometry are warranted. The second domain was refeeding risk during caloric escalation from 0 kcal/day (T_0) to 1,100 kcal/day (T_1), 1,450 kcal/day (T_2) and 1,800 kcal/day (T_3). Initial parenteral glucose in the 1:1:1 SPN bridge was limited to 12.5 g/day (250 mL D5% = 50 kcal), while 50.0 g/day of SMOFlipid 20% (500 kcal) was provided. This was intended to limit insulin-mediated intracellular electrolyte shifts in a euglycemic patient (GDS 85 mg/dL). Post-baseline electrolytes were not reported, so a safe metabolic profile cannot be confirmed. Serial monitoring of serum phosphate (PO_4^{3-}), potassium (K^+) and magnesium (Mg^{2+}) is recommended. The third domain was renal and hepatic capacity. Baseline renal reserve (urea 24 mg/dL, BUN 11.21 mg/dL, SCr 0.90 mg/dL, Urea/SCr ratio 26.67, CKD-EPI eGFR 68.35 mL/min/1.73 m^2) and hepatic transaminase integrity (AST 20 U/L, ALT 14 U/L, De Ritis ratio 1.43) supported the full 80.0 g/day protein target (12.80 g N/day); post-baseline urea and creatinine were not reported. Quantitative 24-hour colostomy output and fluid-balance tracking safeguard against high-output stomal dehydration.

Table 4. Perioperative Metabolic, Refeeding, and Stomal Homeostasis Assessment and Tolerance.

Analytical / Physiological Domain & Criterion	Empirical Observation & Quantitative Metric in Index Case	Objective Score / Verification Status	Mechanistic & Clinical Interpretation
Tolerance and Adverse Events	Zero nausea/vomiting, zero ileus, zero phlebitis, zero hypertriglyceridemia, and zero clinical refeeding signs during 1:1:1 SPN, oligo-milk ONS, and IV drugs	No adverse event recorded	Clinically tolerated hybrid parenteral-to-oral transition

Analytical / Physiological Domain & Criterion	Empirical Observation & Quantitative Metric in Index Case	Objective Score / Verification Status	Mechanistic & Clinical Interpretation
GLIM Etiologic Domain & Geriatric Sarcopenia Risk Profile	BMI 24.84 kg/m^2 (62.0 kg / 1.58^2) and Albumin 4.0 g/dL coexist with 30-day obstructive anorexia/fatigue and leukocytosis (WBC 14.97 × 10^3/μL; 1.50× ULN)	GLIM Etiologic Criteria Fulfilled (Inflammation + Reduced Intake)	Demonstrates the geriatric masked malnutrition paradox where normal BMI and albumin conceal active catabolism and sarcopenic risk
Refeeding Syndrome Prophylaxis & Glycemic Homeostasis	Baseline euglycemia (GDS 85 mg/dL; 0.61× ULN), low T_1 parenteral glucose load (12.5 g D5% = 50 kcal), and lipid-predominant SPN (50.0 g SMOFlipid = 500 kcal)	Controlled Insulinemic Transition (No Clinical Refeeding Toxicity Recorded)	Gradual caloric titration (1,100 → 1,450 → 1,800 kcal/day) is intended to limit abrupt hyperinsulinemic intracellular shifts of PO_4^{3-}, K^+, and Mg^{2+}
Hepatorenal Clearance & Diverting Colostomy Fluid Homeostasis	Baseline Urea 24 mg/dL (BUN 11.21 mg/dL), SCr 0.90 mg/dL (eGFR 68.35 mL/min/1.73 m^2), AST 20 U/L, ALT 14 U/L, and IVFD Ringer's Lactate 2,000 mL/24 h	Intact Hepatorenal & Stomal Homeostasis (KDIGO Stage G2)	Preserved renal filtration and hepatocellular function safely metabolize 12.80 g N/day (80.0 g protein) and four-oil lipids while maintaining euvolemia

Abbreviations: ALT, alanine aminotransferase; AST, aspartate aminotransferase; BMI, body mass index; BUN, blood urea nitrogen; eGFR, estimated glomerular filtration rate; ESPEN, European Society for Clinical Nutrition and Metabolism; GDS, random blood glucose; GLIM, Global Leadership Initiative on Malnutrition; IV, intravenous; IVFD, intravenous fluid drip; KDIGO, Kidney Disease: Improving Global Outcomes; MNT, medical nutrition therapy; NPC:N, non-protein calorie to nitrogen ratio; ONS, oral nutritional supplement; PEPT1, proton-coupled oligopeptide transporter 1; POD, postoperative day; PPI, proton pump inhibitor; SCr, serum creatinine; SPN, supplemental parenteral nutrition; ULN, upper limit of normal; WBC, white blood cell count.

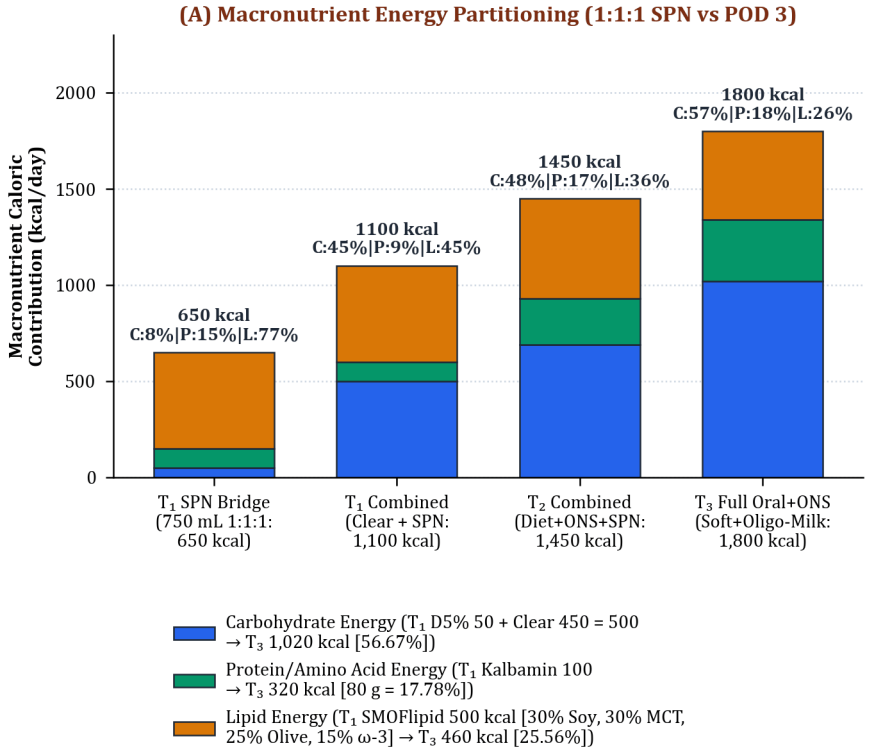


Figure 4. Macronutrient Energy Partitioning of the 1:1:1 Supplemental Parenteral Regimen (D5% : Kalbamin 10% : SMOFlipid 20% Four-Oil Emulsion) Versus POD 3 Full Oral Soft Diet + Oligo-Milk ONS.

To place the index patient's perioperative nutritional kinetics in the context of contemporary global oncology and gastrointestinal surgery evidence, the findings were benchmarked against nine landmark international guidelines, randomized controlled trials, systematic reviews and cohort studies published between 2021 and 2026.[53,54] Six dimensions were compared. They were the caloric target prescription (29.03 kcal/kg/day vs ESPEN 25.0–30.0 kcal/kg/day), the protein target prescription (1.29 g/kg/day vs ESPEN > 1.00–1.50 g/kg/day), early POD 1 luminal priming combined with supplemental parenteral bridging (1:1:1 D5%:Kalbamin:SMOFlipid), and rapid POD 3 progression to a low-fat soft solid diet fortified with 400 kcal/day (28.0 g protein/day) of PEPT1-absorbed oligomeric ONS. The remaining two were the avoidance of unindicated gluten or lactose exclusion and the evaluation of masked geriatric sarcopenia and refeeding risk. On all of them the prescription was consistent with current guidelines. A single case cannot establish a benchmark; it illustrates one feasible pathway, as detailed in Table 5.

Table 5. Global Literature Benchmarking of Perioperative Medical Nutrition Therapy, Supplemental Parenteral Bridging, and Early Oral/Oligomeric Supplementation in Colorectal Cancer Surgery (2021–2026) Versus Index Case.

Author, Year & Study Design	Patient Cohort & Oncological Stage	Nutritional Intervention & Escalation Protocol	Energy & Protein Targets / Achieved Metrics	Key Clinical Outcomes & Alignment With Index Case
Muscaritoli et al. (2021) ESPEN Cancer Guideline	Adult oncology patients across solid tumors including colorectal carcinoma	Early screening (NRS-2002/GLIM), individualized oral counseling, ONS,	25–30 kcal/kg/day (1,550–1,860 kcal for 62 kg); Protein > 1.0 to 1.5 g/kg/day (62–93 g/day)	Index prescription (1,800 kcal = 29.03 kcal/kg/day; 80 g protein = 1.29 g/kg/day) aligns at 96.77% of upper

Author, Year & Study Design	Patient Cohort & Oncological Stage	Nutritional Intervention & Escalation Protocol	Energy & Protein Targets / Achieved Metrics	Key Clinical Outcomes & Alignment With Index Case
		enteral, or supplemental PN when oral < 50–60% of requirement		energy and 129.03% of minimum protein target
Weimann et al. (2021 & 2025) ESPEN Surgical Guidelines	Major gastrointestinal & colorectal cancer surgery cohorts (including colostomy/stoma)	Immediate oral feeding within hours post-surgery if hemodynamically stable; ONS for inadequate intake; early SPN/EN if oral < 50% for > 7 days	25–30 kcal/kg/day and 1.2–1.5 g/kg/day protein; strict refeeding electrolyte (PO_4^{3-}, K^+, Mg^{2+}) monitoring	Index patient initiated clear fluids + 1:1:1 SPN on POD 1 and achieved full oral soft diet + ONS (2 × 200 kcal) by POD 3 without ileus
Lewandowska et al. (2022) Narrative review	Patients with colorectal cancer	Nutritional monitoring and treatment during anticancer therapy; light, low-fat foods; exclusion of lactose- and gluten-containing foods in certain cases; oral nutrition supplements, tailored to individual needs	Not stated in the abstract	Supports an individualized, low-fat diet and the use of ONS in colorectal cancer; mentions lactose and gluten exclusion only in certain cases, in line with the index report's position on unindicated exclusion
Wang et al. (2022) & Pandey et al. (2025) Meta-analysis & RCT on early feeding	Elective colorectal resection (Wang: 10 studies, 1,199 patients); gastrointestinal surgery (Pandey; abstract not available)	Oral feeding within 24 h versus feeding started after flatus or resolved ileus (Wang); early enteral nutrition (Pandey)	Not applicable	Early feeding shortened hospital stay (MD −1.76 days) and reduced complications (OR 0.49), but nasogastric tube reinsertion was more frequent (OR 1.69). Supports early oral feeding after colorectal surgery; stepwise escalation from clear fluids was not studied
Xu et al. (2022) & Sankararaman et al. (2025) SPN & peptide-formula studies	Esophageal cancer surgery (Xu: 72 patients); children with gastrointestinal dysfunction on enteral nutrition in post-acute care (Sankararaman)	Supplemental PN + EN on postoperative days 4–8 versus total EN (Xu); 100% whey peptide-based formula (Sankararaman)	Not stated in the abstracts	Xu: higher prealbumin and lower CRP on day 7 with supplemental PN. Sankararaman: gastrointestinal tolerance and costs. Indirect support for SPN and peptide formulas in other populations; neither matches the index regimen
Qin et al. (2024), Chang et al. (2025) & Lin et al. (2026) Systematic review, RCT & qualitative study	Patients after colorectal cancer surgery (Qin: 11 RCTs, 1,070 patients); hepatocellular or colorectal cancer at risk of malnutrition (Chang); people with colorectal cancer in the postoperative period (Lin: 14 interviews)	ONS after colorectal surgery (Qin); telehealth nutritional care with or without high-calorie/high-protein ONS for 3 months (Chang); preferences for ONS (Lin)	Chang: one daily can providing 425 kcal and 19.1 g protein	ONS is the guideline-recommended primary nutritional support after colorectal surgery, and compliance is a barrier (Lin). These sources concern ONS use in other settings and do not report outcomes of the index regimen (2 × 200 kcal/day, 28 g protein)
Chan et al. (2024) & Shadmanov et al. (2026) cT4b locally advanced rectal cancer	Patients with T4b or locally advanced rectal cancer (Chan: single-center retrospective cohort; Shadmanov: 580 patients over 23 years)	Multivisceral resection (minimally invasive in Chan); beyond-TME resection compared with TME (Shadmanov)	Not applicable (surgical series; no nutrition protocol)	Surgical and oncologic outcomes of multivisceral resection (Shadmanov: CRM positivity 5.3% vs 3.6%; complications 28.9% vs 16.6%). They provide stage context for the index tumor, not guidance on nutritional management
Kesby et al. (2025), Xie et al. (2025) & Jin et al. (2026) Sarcopenia, HALP & refeeding-prediction studies	Colorectal cancer surgical cohorts (Kesby: 545 patients; Xie: 1,441; Jin: 446)	No intervention: CT skeletal muscle index before and after surgery (Kesby); HALP score (Xie); machine-learning prediction of refeeding syndrome (Jin)	Not applicable	Prognostic and prediction studies: sarcopenia kinetics and survival (Kesby), HALP score with survival and sarcopenia (Xie), prediction of refeeding syndrome after colorectal cancer surgery (Jin). They support monitoring but do not mandate electrolyte checks
Index Case (Ginting & Lestari, 2026) Case Report	71-year-old female with cT4bN1bMx rectal adenocarcinoma (2.7 cm mass invading uterine fundus & small bowel; nodes 0.9 × 1.0 cm) post-colostomy	T_1: Clear fluids (450 kcal) + 1:1:1 D5:Kalbamin:SMOFlipid SPN (650 kcal, 25 g AA) → T_2: Semi-liquid + ONS → T_3: Soft diet + 2 × 200 kcal oligo-milk	Target: 1,800 kcal/day (29.03 kcal/kg/day) & 80.0 g protein/day (1.29 g/kg/day; NPC:N = 115.63:1); 100% achieved on POD 3	Oral energy Δ% = +300.00%, total energy Δ% = +63.64%, total protein Δ% = +220.00% (T_1→T_3); no adverse events recorded

Abbreviations: Δ%, percentage delta change; AA, amino acids; BMI, body mass index; EN, enteral nutrition; ERAS, Enhanced Recovery After Surgery; ESPEN, European Society for Clinical Nutrition and Metabolism; GLIM, Global Leadership Initiative on Malnutrition; HALP, hemoglobin-albumin-lymphocyte-platelet score; HGB, hemoglobin; NPC:N, non-protein calorie to nitrogen ratio; NRS-2002, Nutritional Risk Screening 2002; ONS, oral nutritional supplement; PEPT1, proton-coupled oligopeptide transporter 1; PN, parenteral nutrition; POD, postoperative day; RCT, randomized controlled trial; SPN, supplemental parenteral nutrition; WBC, white blood cell count.

4. Discussion

4.1. Multi-Tier Pathophysiological Cascade and Deconstruction of the Masked Malnutrition Paradox in Geriatric cT4bN1bMx Rectal Cancer

This case report offers an integrated clinicopathological, biochemical and kinetic evaluation of stepwise multimodal medical nutrition therapy in a 71-year-old female with locally advanced cT4bN1bMx rectal adenocarcinoma who underwent urgent diverting colostomy. In this patient, perioperative nutrition was an active component of care. The case illustrates structured macronutrient escalation across five interconnected pathophysiological tiers. The escalation ran from Postoperative Day 1 (T_1) trophic clear fluids bridged with 1:1:1 supplemental parenteral nutrition (D5% : Kalbamin 10% : SMOFlipid 20%) to Postoperative Day 3 (T_3) soft solid diet fortified with oligomeric oral nutritional supplements (2 × 200 kcal/day). Tier I is malignant pelvic visceral invasion (2.7 cm rectal tumor invading the uterine fundus and adherent to anterior small bowel loops, with 0.9 × 1.0 cm paracolic/presacral nodes), obstructive anorexia and systemic inflammation (WBC 14.97 × 10^3/μL). Tier II is surgical colostomy decompression stress and pro-absorptive pharmacotherapy (Ringer's Lactate 2,000 mL/24 h, ceftriaxone, metronidazole, omeprazole and ondansetron). Tier III is early trophic luminal priming paired with ω-3/BCAA-enriched 1:1:1 parenteral bridging. Tier IV is apical PEPT1 oligopeptide absorption and full oral anabolic convergence (1,800 kcal/day, 80.0 g/day protein, NPC:N ratio 115.63:1). Tier V is tolerance monitoring, refeeding-

electrolyte homeostasis and multidisciplinary post-colostomy clinical governance, as illustrated in Figure 5.

A central clinical insight of this study is the deconstruction of the anthropometric and biochemical 'masked malnutrition paradox' in geriatric colorectal oncology. At first glance, our 71-year-old patient had an actual body weight of 62.0 kg, height of 158.0 cm, BMI of 24.84 kg/m^2, hemoglobin of 13.3 g/dL and serum albumin of 4.0 g/dL at admission (T_0). All of these lie within conventional adult reference intervals (BMI 18.50–24.99 kg/m^2; albumin 3.5–5.0 g/dL). Still, relying on static BMI or isolated serum albumin to exclude malnutrition in an elderly patient with cT4bN1bMx rectal cancer can be misleading. There are three reasons. First, age-related body composition remodeling in septuagenarians involves visceral adipose tissue expansion and myosteatosis (inter- and intramyocellular lipid infiltration). These preserve or inflate total body weight and BMI while masking severe depletion of appendicular skeletal muscle mass, a phenotype termed normal-BMI sarcopenia or sarcopenic obesity. In this patient, muscle mass, grip strength, and body composition were not measured, so sarcopenia is a possibility, not a finding. Second, the patient had 30 days of obstructive dyschezia, hematochezia, anorexia and clinical weakness before admission. That is a clear etiologic criterion for acute negative energy balance under the Global Leadership Initiative on Malnutrition (GLIM) framework. Third, serum albumin has a long intravascular half-life of approximately 19 to 21 days. It is also heavily modulated by extracellular fluid shifts, vascular permeability and hepatic acute-phase reprioritization. In our patient, an albumin of 4.0 g/dL alongside marked leukocytosis (WBC 14.97 × 10^3/μL; 1.50× ULN) is compatible with an active systemic inflammatory state (Albumin-to-WBC index = 0.27 g·μL/dL·10^3), possibly with mild pre-resuscitation hemoconcentration (hematocrit was not reported). It does not guarantee somatic protein adequacy.

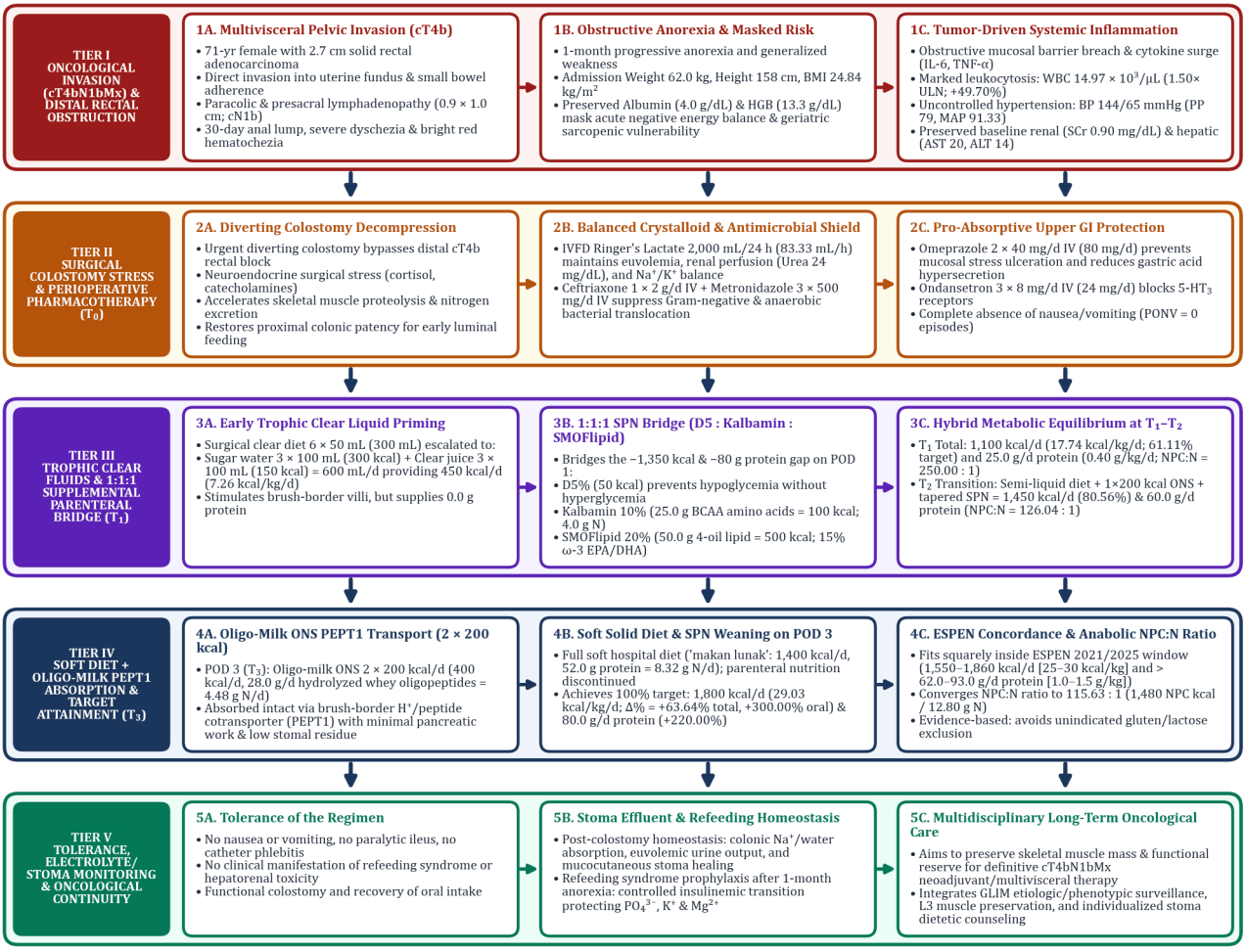


Figure 5. Five-Tier, Fifteen-Node Pathophysiological, Immunometabolic, Enterocyte PEPT1 Absorptive, and Perioperative Medical Nutrition Therapy Cascade in Locally Advanced Rectal Adenocarcinoma (cT4bN1bMx) Post-Diverting Colostomy.

4.2. ESPEN Guideline Concordance, Biochemical Inadequacy of Clear Liquids Alone, and Rationale of the 1:1:1 D5% : Kalbamin : SMOFlipid Bridge

Comparing our patient's prescribed medical nutrition therapy with the 2021/2025 ESPEN Cancer and Surgical Guidelines illustrates individualized weight-based dosing in perioperative oncology. For a 62.0 kg patient, ESPEN recommends an initial energy provision of 25.0 to 30.0 kcal/kg/day (1,550.0 to 1,860.0 kcal/day) and a protein provision of > 1.00 to 1.50 g/kg/day (> 62.0 to 93.0 g/day). These counteract tumor-induced hypermetabolism and surgical catabolism. Our prescribed energy target of 1,800 kcal/day equals exactly 29.03 kcal/kg/day (96.77% of the 30.0 kcal/kg/day upper ESPEN threshold). The prescribed protein target of 80.0 g/day equals 1.29 g/kg/day (129.03% of the 1.00 g/kg/day minimum requirement and 86.02% of the 1.50 g/kg/day ceiling). The prescription was compatible with the patient's baseline hepatorenal reserve. Her admission blood urea of 24 mg/dL (BUN 11.21 mg/dL), serum creatinine of 0.90 mg/dL and CKD-EPI 2021 eGFR of 68.35 mL/min/1.73 m^2 confirmed sufficient glomerular filtration capacity to clear the urea nitrogen load from 80.0 g/day of protein (12.80 g N/day) without uremic azotemia. Her baseline random blood glucose of 85 mg/dL and normal transaminases (AST 20 U/L, ALT 14 U/L; De Ritis ratio 1.43) confirmed intact hepatic glycogenolytic and lipolytic clearance.

The prescribed intakes illustrate why Postoperative Day 1 (T_1) clear liquids alone are metabolically insufficient and why a 1:1:1 supplemental parenteral nutrition (SPN) bridge was used. In traditional surgical workflows, post-colostomy patients are often kept for 2 to 4 days on clear fluids such as sugar water (3 × 100 mL = 300 kcal/day) and clear fruit juice (3 × 100 mL = 150 kcal/day).[55] This 600 mL/day regimen primes vagal cephalic-enteric reflexes, stimulates mucosal brush-border disaccharidases and tests distal bowel patency. It provides only 450 kcal/day (7.26 kcal/kg/day; 25.00% of energy needs) and exactly 0.0 g/day of protein or essential lipids. The NPC:N ratio becomes infinite (∞). The patient would then be expected to catabolize endogenous skeletal muscle protein, estimated at approximately 60 to 75 g/day, to supply gluconeogenic and acute-phase amino acids. [56] The clinical nutrition team co-administered the 1:1:1 SPN bridge (250 mL D5% : 250 mL Kalbamin 10% : 250 mL SMOFlipid 20%) at T_1. This gave an immediate parenteral increment of 650 kcal/day and 25.0 g/day of crystalline L-amino acids (4.00 g N/day). Total POD 1 intake rose to 1,100 kcal/day (17.74 kcal/kg/day; 61.11% of target). The T_1 NPC:N ratio was capped at 250.00:1. The four-oil architecture of SMOFlipid 20% added 50.0 g/day of balanced lipids. These included 15.0 g of rapidly oxidized medium-chain triglycerides and 7.5 g of ω-3 fish oil (EPA and DHA). The fish oil competitively inhibits arachidonic acid metabolism into pro-inflammatory prostaglandin E_2 (PGE_2) and leukotriene B_4 (LTB_4). It also generates specialized pro-resolving mediators (resolvins E1/D1, protectins and maresins) that may attenuate systemic surgical leukocytosis and help preserve hepatic function; post-baseline leukocyte counts and liver enzymes were not reported.

4.3. Enterocyte Peptide Transport (PEPT1), Early Oral Progression, and Unindicated Dietary Restrictions

The rapid transition from hybrid parenteral-oral nutrition at T_1–T_2 to 100.00% oral target attainment (1,800 kcal/day and 80.0 g/day protein) on Postoperative Day 3 (T_3) illustrates the physiological advantage of pairing a low-residue soft solid diet ('makan lunak': 1,400 kcal/day, 52.0 g/day protein) with semi-elemental oligomeric oral nutritional supplements ('susu oligo': 2 × 200 kcal/day = 400 kcal/day, 28.0 g/day protein). After abdominal surgery and colostomy creation, transient splanchnic vasoconstriction, bowel wall edema and mild luminal dysbiosis can impair the pancreatic proteolytic cascade. They can also reduce brush-border free amino acid carrier capacity. Intact polymeric whole-protein formulas need complete intraluminal hydrolysis into free amino acids. The enzymatically hydrolyzed whey oligopeptides (di- and tripeptides) in oligo-milk do not. They cross the apical enterocyte membrane intact through the high-capacity, low-affinity H^+-coupled oligopeptide cotransporter PEPT1 (SLC15A1). Rapid cytoplasmic peptidase cleavage and basolateral efflux into the portal circulation follow. This PEPT1-mediated pathway accelerates nitrogen absorption, reduces intraluminal osmotic pressure and minimizes fecal residue reaching the newly matured colostomy stoma. The prescribed NPC:N ratio converged from 250.00:1 at T_1 and 126.04:1 at T_2 to 115.63:1 at T_3; absorption was not measured.

Dietary restriction myths in oncology nutrition also deserve critical evaluation. General literature reviews on anticancer nutrition sometimes mention light, low-fat diets. They may also mention excluding lactose and gluten in selected patients. One point should be emphasized. Routine gluten or lactose exclusion is not supported by clinical evidence in colorectal cancer patients who lack documented celiac disease, non-celiac gluten sensitivity or post-enteritis lactase deficiency. Blanket elimination of gluten-containing grains or tolerable dairy products in a 71-year-old post-colostomy patient restricts dietary variety, reduces palatability and worsens caloric and micronutrient deficits. Post-colostomy dietary counseling should instead focus on low-saturated-fat, easily digestible soft foods, structured meal fractionation and thorough mastication. Gas-producing or insoluble high-fiber foods should be moderated during the acute 4-to-6-week stomal adaptation phase. Targeted fortification with low-lactose oligomeric or polymeric ONS is also advised.

4.4. Refeeding Syndrome Vigilance, Colostomy Effluent Homeostasis, and Multidisciplinary Perioperative Governance

Perioperative surgical oncology must give high priority to refeeding syndrome prophylaxis and to electrolyte homeostasis during rapid macronutrient escalation. Consider a patient who presents after 1 month of cancer-related anorexia and dyschezia. Caloric delivery rises from 0 kcal/day at T_0 to 1,100 kcal/day at T_1, 1,450 kcal/day at T_2 and 1,800 kcal/day at T_3. This stimulates an endogenous insulin surge that drives glucose, phosphate (PO_4^{3-}), potassium (K^+) and magnesium (Mg^{2+}) into skeletal muscle and hepatic cells. Cellular utilization of thiamine (vitamin B_1) for pyruvate dehydrogenase activity increases at the same time. Our patient remained clinically stable. There were no adverse reactions, and the 1:1:1 SPN dextrose load was controlled (only 12.5 g parenteral glucose at T_1 alongside 50.0 g SMOFlipid). Even so, standardized daily biochemical surveillance of serum PO_4^{3-}, K^+, Mg^{2+}, Na^+, urea, creatinine and blood glucose across POD 1 to 5 is essential. It detects subclinical refeeding hypophosphatemia before diaphragmatic weakness or cardiac arrhythmias can emerge.

Post-colostomy nutritional management also requires quantitative daily monitoring of stoma effluent volume (mL/24 hours) and Bristol stool consistency, together with 24-hour urine output and net fluid balance. Left-sided or

sigmoid diverting colostomies typically produce more formed effluent (200–600 mL/day) than loop ileostomies. Perioperative broad-spectrum antimicrobials (ceftriaxone and metronidazole), mucosal inflammation or hyperosmolar liquid boluses can nevertheless trigger high-output stoma episodes (> 1,000–1,500 mL/day). These lead to isotonic dehydration, hypomagnesemia and prerenal acute kidney injury. The danger is greatest in a 71-year-old female with baseline uncontrolled hypertension (144/65 mmHg; PP 79.0 mmHg) and Stage G2 renal function (eGFR 68.35 mL/min/1.73 m^2). To optimize long-term oncological and metabolic outcomes after colostomy decompression, tertiary surgical and clinical nutrition services should implement a structured five-pillar perioperative nutritional protocol. The pillars are: (1) pre-admission 3-to-6-month weight-loss percentage and formal NRS-2002/GLIM diagnostic scoring at admission; (2) opportunistic CT L3 Skeletal Muscle Index (SMI) quantification and bedside handgrip dynamometry to diagnose normal-BMI sarcopenia; (3) daily verification of actual consumed oral, ONS and parenteral macronutrients against prescribed targets; (4) serial POD 1–5 refeeding electrolyte (PO_4^{3-}, K^+, Mg^{2+}) and 24-hour stoma output monitoring; and (5) structured multidisciplinary post-discharge follow-up that links the clinical nutritionist, digestive surgeon and enterostomal therapy nurse through neoadjuvant/adjuvant oncology care.

This report has limitations. It describes one patient without a comparator, so it cannot show that the regimen caused the observed course. The intakes are prescribed amounts, and actual consumption was not documented. Post-baseline laboratory values, nitrogen balance, and body composition were not measured or reported, and the observation ended on postoperative day 3. The findings may not apply to other patients.

5. Conclusion

A 71-year-old female with locally advanced cT4bN1bMx rectal adenocarcinoma (2.7 cm mass invading the uterine fundus and anterior small bowel, with 0.9 × 1.0 cm paracolic and presacral lymphadenopathy) underwent urgent diverting colostomy. Her individualized medical nutrition therapy was prescribed at 1,800 kcal/day (29.03 kcal/kg/day) and 80.0 g/day of protein (1.29 g/kg/day; 12.80 g N/day). Both targets fell within the 2021/2025 ESPEN reference windows. These were 1,550–1,860 kcal/day (25–30 kcal/kg/day) and > 62.0–93.0 g/day of protein (> 1.0–1.5 g/kg/day). Trophic clear liquids on Postoperative Day 1 (T_1; sugar water 3 × 100 mL + clear juice 3 × 100 mL = 450 kcal/day, 0.0 g protein) were started together with a 1:1:1 supplemental parenteral nutrition bridge (D5% : Kalbamin 10% : SMOFlipid 20%, providing 650 kcal/day and 25.0 g/day amino acids). This avoided protein-free feeding on the first postoperative day. Stepwise progression then ran smoothly through T_2 (1,450 kcal/day, 60.0 g/day protein) to 100.00% oral target attainment on Postoperative Day 3 (T_3: 1,800 kcal/day and 80.0 g/day protein via soft solid diet plus 2 × 200 kcal/day oligomeric peptide ONS).

Over this 72-hour postoperative trajectory, oral caloric delivery rose by Δ% = +300.00% (total energy Δ% = +63.64%) and total protein delivery rose by Δ% = +220.00%. The Non-Protein Calorie-to-Nitrogen (NPC:N) ratio converged by −53.75%, from 250.00:1 at T_1 to 115.63:1 at T_3. No adverse events were recorded during this course. A normal admission BMI (24.84 kg/m^2) and serum albumin (4.0 g/dL) do not exclude masked geriatric malnutrition or sarcopenia. This holds when systemic inflammation (WBC 14.97 × 10^3/μL) and 1-month anorexia are present. Perioperative clinical nutrition protocols should therefore integrate formal GLIM/sarcopenia screening, quantitative tracking of actual versus prescribed intake, serial refeeding electrolyte (PO_4^{3-}, K^+, Mg^{2+}) monitoring and post-discharge stoma-nutrition surveillance.

Declarations

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Conflicts of interest

The authors declare no conflicts of interest.

AI use

None.

Author contributions

N.G.: Conceptualization, Methodology, Investigation, Validation (longitudinal calculations), Formal analysis, Writing – original draft. N.M.D.A.L.: Investigation (data collection, nutritional monitoring), Data curation, Writing – review & editing. Both authors approved the final version.

Data availability

All longitudinal clinical, anthropometric, laboratory, radiological, and macronutrient datasets generated and analyzed in this report are included in the article (Tables 1–5 and Figures 1–5).

Ethics approval and consent to participate

This case report was reviewed and approved by the CMHC Research Center, Ethics Committee, Indonesia (Protocol Approval No.: 2026/0527) and was conducted in compliance with the Declaration of Helsinki and ICMJE guidelines. Written informed consent was obtained from the patient and her legal family representative for clinical nutrition care and study participation.

Consent for publication

Written informed consent was obtained from the patient and her next of kin for the anonymized publication of all clinical, anthropometric, biochemical, radiological, and nutritional data.

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