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RESEARCH ARTICLE

Refeeding Syndrome in Patients with Upper Gastrointestinal Cancer: A Retrospective Analysis of Nutritional and Biochemical Outcomes

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Abstract

Background and Objective: Refeeding syndrome (RFS) is a potentially life-threatening metabolic complication that can develop following the reintroduction of nutrition in malnourished patients. It is characterized by shifts in fluid and electrolyte balance, particularly involving phosphorus, potassium and magnesium. Patients with upper gastrointestinal (GI) cancers may be particularly vulnerable to RFS because of inadequate nutritional intake, gastrointestinal obstruction, cancer-related cachexia and treatment-associated complications. This study was designed to evaluate changes in anthropometric and biochemical parameters associated with nutritional repletion in patients with upper GI cancer undergoing postoperative nutritional support between January 2022 and January 2025.

Materials and Methods: This retrospective observational study was conducted at Shaukat Khanum Memorial Cancer Hospital and Research Center, Peshawar and included 97 adults with upper GI cancer who underwent surgery and received postoperative enteral or parenteral nutritional support. Weight, BMI and serum concentrations of sodium, potassium, magnesium and phosphorus were assessed before and after nutritional repletion. Paired *t*-tests were used to evaluate pre- and post-repletion changes, while Pearson correlation analysis was performed to assess relationships between pre- and post-repletion values.

Results: Following nutritional repletion, significant decreases were observed in weight (-2.77 kg, $p<0.001$), BMI (-1.21 kg/m^2, $p<0.001$), serum potassium (-0.19 mmol/L, $p<0.05$) and phosphorus (-0.51 mmol/L, $p<0.001$). Serum sodium and magnesium levels remained stable. Strong positive correlations were observed between pre- and post-repletion measurements for weight ($r = 0.95$, $p<0.001$) and BMI ($r = 0.96$, $p<0.001$), while a moderate positive correlation was observed for phosphorus ($r = 0.55$, $p<0.001$).

Conclusion: Patients with upper GI cancer demonstrated significant anthropometric and biochemical changes following nutritional repletion, particularly reductions in body weight, BMI, serum potassium and phosphorus concentrations. These findings highlight the importance of careful assessment of refeeding risk, gradual advancement of nutritional support and close monitoring of electrolyte levels in this vulnerable population.

INTRODUCTION

Refeeding syndrome (RFS) is a potentially serious metabolic complication that may develop following the reintroduction of nutrition after prolonged undernutrition or starvation. The characteristic metabolic response involves intracellular shifts of phosphorus, potassium and magnesium, driven primarily by increased insulin secretion. Severe electrolyte disturbances may result in cardiac, respiratory, neurological, or other organ dysfunction[1-3].

Patients with cancer are particularly vulnerable to RFS because of reduced oral intake, tumor-related obstruction, treatment-associated toxicities and cancer-related malnutrition and cachexia[4,5]. Although, nutritional rehabilitation is clinically important in these patients, nutritional support should be introduced cautiously in individuals at risk of RFS[2].

RFS is increasingly recognized as a spectrum of metabolic abnormalities rather than as an isolated laboratory finding. The American Society for Parenteral and Enteral Nutrition (ASPEN) recommends monitoring changes in serum phosphorus, potassium and magnesium following the initiation of nutrition and considering the magnitude and persistence of electrolyte reductions in conjunction with clinical manifestations[3].

In oncology patients, RFS may remain underrecognized because its clinical manifestations can overlap with complications associated with advanced malignancy and postoperative care[4]. A prospective observational study of patients with head and neck cancer reported refeeding phenomena in 52% of participants and clinically defined RFS in 20%, highlighting the susceptibility of patients with cancer during nutritional rehabilitation[6].

Patients with upper gastrointestinal (GI) cancers may be particularly susceptible to nutritional deficiencies and metabolic disturbances because of impaired oral intake, gastrointestinal obstruction, disease-related malnutrition and the effects of surgical and oncological treatment. However, data describing changes in anthropometric and biochemical parameters following postoperative nutritional repletion in this population remain limited. Therefore, the present study was undertaken to evaluate pre- and post-refeeding changes in anthropometric and biochemical parameters among patients with upper GI cancer receiving postoperative nutritional support, with particular emphasis on changes in serum phosphorus, potassium, magnesium and sodium concentrations and to evaluate the correlations between pre- and post-refeeding values.

MATERIALS AND METHODS

Study design and setting: A retrospective observational study was conducted at Shaukat Khanum Memorial Cancer Hospital and Research Center, Peshawar, from January 2022 to January 2025. Data were extracted from the hospital information system (HIS).

Study population: The study included 97 adults who underwent surgery for upper gastrointestinal (GI) cancer and received either enteral or parenteral postoperative nutritional support.

Inclusion criteria:

- Upper GI malignancy.
- Adults aged 18-65 years.
- BMI between 14 and 35 kg/m^2. Body weight and height were recorded and used to calculate BMI as follows:

$$\text{BMI (kg/m}^2\text{)} = \frac{\text{Weight (kg)}}{[\text{Height (m)}]^2}$$

According to the World Health Organization (WHO)[7] classification, BMI was used to categorize nutritional status as follows: underweight, BMI <18.5 kg/m^2; normal weight, BMI 18.5-24.9 kg/m^2; overweight, BMI 25.0-29.9 kg/m^2 and obesity, BMI $\geq$30 kg/m^2.

- Postoperative nutritional support, either enteral or parenteral

Exclusion criteria:

- Age <18 or >65 years
- Pre-existing chronic disorders, such as renal or hepatic disease
- Incomplete medical records

Data collection: Baseline and post-refeeding data included demographic characteristics, body weight, height, BMI and serum concentrations of sodium, potassium, magnesium and phosphorus were collected. Table 1 summarizes the baseline and post-refeeding values.

Statistical analysis: Statistical analyses were performed using SPSS version 25. Continuous variables are presented as mean $\pm$standard deviation (SD). Paired t-tests were used to assess

Table 1: Baseline vs. post-refeeding metrics (N = 97)

Parameter	Pre-refeeding (Mean±SD)	Post-refeeding (Mean±SD)	Mean change	p-value
Weight (kg)	59.19±12.15	56.42±12.42	−2.77	<0.001
BMI (kg/m^2)	21.73±3.63	20.52±3.35	−1.21	<0.001
Sodium (mmol/L)	137.30±3.07	136.89±3.36	−0.41	NS
Potassium (mmol/L)	4.10±0.56	3.91±0.44	−0.19	<0.05
Magnesium (mg/dL)	1.93±0.95	1.92±0.76	−0.01	NS
Phosphorus (mg/dL)	3.49±1.02	2.98±0.79	−0.51	<0.001

NS: Not significant and SD: Standard deviation pre- and post-refeeding differences, while Pearson correlation coefficients were calculated to evaluate relationships between pre- and post-refeeding values. A $p<0.05$ was considered statistically significant. Because clinical manifestations and percentage changes in electrolyte concentrations were not systematically recorded, the findings were interpreted as biochemical changes associated with nutritional repletion rather than as a definitive estimate of the incidence of RFS according to contemporary diagnostic criteria[3].

RESULTS

A total of 97 patients met the inclusion criteria. The mean age of the cohort was 47.4±8.3 years. Anthropometric and biochemical parameters were evaluated before and after the initiation of nutritional support.

Significant declines were observed in mean body weight (−2.77 kg, $p<0.001$) and BMI (−1.21 kg/m^2, $p<0.001$) following nutritional repletion. Among the biochemical parameters, serum phosphorus decreased by 0.51 mg/dL ($p< 0.001$), while serum potassium decreased by 0.19 mmol/L ($p<0.05$). No statistically significant changes were observed in serum sodium or magnesium concentrations.

Correlation analyses revealed strong positive associations between pre- and post-refeeding values for:

- Weight ($r = 0.95$, $p<0.001$)
- BMI ($r = 0.96$, $p<0.001$)
- Phosphorus ($r = 0.55$, $p<0.001$)

These correlations indicate that, although absolute values decreased following nutritional repletion, patients generally maintained their relative ranking across the pre- and post-refeeding measurements.

DISCUSSION

The present study demonstrated significant reductions in body weight, BMI, serum phosphorus and serum potassium following nutritional repletion in patients with upper GI cancer. The most prominent biochemical finding was the reduction in serum phosphorus, accompanied by a smaller but statistically significant decrease in serum potassium. These findings are biologically consistent with the electrolyte shifts described during refeeding, whereby increased carbohydrate availability and insulin secretion promote the intracellular uptake of phosphorus and potassium[1,2,3]. The findings are broadly consistent with previous research in oncology populations. Rasmussen *et al.*[6] evaluated 54 patients with head and neck cancer undergoing surgery and reported refeeding phenomena, defined by a decline in plasma phosphate, in 52% of patients, while clinically defined RFS was observed in 20%. Similarly, our study demonstrated a significant postoperative decline in serum phosphorus. However, a direct comparison of RFS incidence is not possible because the present retrospective dataset did not systematically capture clinical manifestations or the percentage changes in electrolyte concentrations required to classify RFS according to contemporary diagnostic criteria[3]. Therefore, the present findings should be interpreted as evidence of biochemical changes associated with nutritional repletion rather than as a definitive estimate of RFS incidence.

The magnitude and direction of the observed electrolyte changes are also consistent with the broader literature. Ponzo *et al.*[2] identified hypophosphatemia, hypokalemia and hypomagnesemia as the principal electrolyte abnormalities associated with RFS and emphasized that the condition may remain underrecognized among hospitalized patients. In the present cohort, serum phosphorus and potassium concentrations decreased significantly, whereas serum magnesium remained statistically unchanged. The absence of a significant change in magnesium contrasts with the classic biochemical pattern of RFS but does not exclude refeeding-related metabolic stress, as electrolyte responses may vary according to baseline nutritional and biochemical status, supplementation, timing of laboratory assessment and underlying clinical condition[2,3].

Cancer-related malnutrition is an important contextual factor when interpreting these findings. Ravasco[8] emphasized that inadequate nutritional intake, nutritional wasting and cachexia are common challenges in oncology and require early, individualized nutritional intervention. The observed reductions in body weight and BMI despite nutritional support may therefore reflect the persistent catabolic burden associated with cancer and postoperative illness rather than the effects of nutritional repletion alone. Similarly, ESMO guidance recognizes cancer cachexia as a multifactorial syndrome in which weight loss and alterations in body composition may persist despite nutritional intervention[5]. These considerations are important when interpreting the anthropometric findings and support the need to monitor body weight in conjunction with biochemical and clinical parameters.

The strong positive correlations between pre- and post-refeeding measurements of weight ($r = 0.95$), BMI ($r = 0.96$)

and phosphorus (r = 0.55) indicate that patients generally maintained their relative position across measurements despite the overall decline in these parameters. The particularly strong correlations observed for weight and BMI suggest consistency in individual-level measurements, whereas the moderate correlation for phosphorus indicates greater interindividual variability in electrolyte responses. These findings support the importance of individualized monitoring during nutritional repletion rather than relying solely on a single baseline assessment.

The vulnerability of patients with cancer to refeeding-related complications is further supported by oncology case reports and clinical guidelines. Windpessl *et al.*[4] described four oncology patients who developed RFS and highlighted the potential for severe and in some cases, fatal complications, underscoring the importance of early recognition and management in patients with malignancy. Pourhassan *et al.*[9] reported that 69.9% of older hospitalized patients met the National Institute for Health and Care Excellence (NICE) criteria for being at risk of RFS, with weight loss and low serum phosphate and magnesium concentrations identified as important risk factors. Although, their study population was older and not limited to patients with cancer, these findings support the principle that malnutrition and electrolyte abnormalities should trigger careful assessment of RFS risk before nutritional support is intensified.

Clinical implications: Current NICE guidance recommends initiating nutritional support at a maximum of 10 kcal/kg/day in patients at high risk of refeeding problems, followed by gradual advancement to full nutritional requirements over 4-7 days. In patients at extreme risk, an initial intake of 5 kcal/kg/day may be appropriate[10]. Similarly, ASPEN recommends systematic assessment of RFS risk, close monitoring of serum phosphorus, potassium and magnesium concentrations after initiation of nutritional support and appropriate management of electrolyte and vitamin deficiencies[3]. These recommendations are particularly relevant to postoperative patients with upper GI cancer, who may experience prolonged periods of inadequate nutritional intake and substantial metabolic stress. Recent oncology nutrition guidance also emphasizes individualized nutritional support and multidisciplinary management[11].

Future prospective studies should apply standardized diagnostic criteria for RFS, systematically document nutritional intake and electrolyte replacement and evaluate clinically relevant outcomes, including cardiac arrhythmias, respiratory compromise, length of hospital stay and interruptions in cancer treatment.

CONCLUSION

Patients with upper gastrointestinal cancer undergoing postoperative nutritional support experienced significant declines in body weight and BMI following nutritional repletion, accompanied by reductions in serum phosphorus and potassium concentrations. In contrast, serum sodium and magnesium concentrations remained relatively stable. The observed associations between pre- and post-refeeding measurements suggest that patients generally maintained their relative anthropometric and biochemical profiles despite overall declines in selected parameters. These findings highlight the importance of careful nutritional assessment, gradual advancement of nutritional support and close monitoring of electrolytes, particularly phosphorus and potassium, in patients with upper gastrointestinal cancer who are at risk of metabolic disturbances during nutritional repletion.

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