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Observational Study on Changes in Serum Sodium and Potassium Levels and Trends in Serum Vitamin B12 Levels following Temporary Ileostomy

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Abstract: ***Ileostomy is associated with significant electrolyte and nutritional imbalances due to high stoma output. This observational study aimed to evaluate the patterns of serum sodium, potassium, and vitamin B12 levels in patients undergoing temporary ileostomy. The study was conducted at BRD Medical College, Gorakhpur and included 80 patients who had a temporary ileostomy. Serum sodium and potassium levels were measured on postoperative day (POD) 3 and POD 5. Vitamin B12 levels were assessed at admission and at ileostomy closure or three months post - surgery. Results showed no significant changes in serum sodium and potassium levels between admission and POD 5 (p = 0.462). Vitamin B12 levels, initially averaging 226.5 pg/mL, decreased significantly to 157.3 pg/mL three months post - surgery (p = 0.0001). The study also found that patients with high - output stomas (≥1000 mL/day), particularly distal ones, were associated with greater electrolyte loss, although no direct relationship was identified between stoma location and B12 deficiency. These findings emphasize the importance of regular follow - up and timely intervention to manage fluid, electrolyte, and nutritional deficiencies in ileostomy patients. Early management improves outcomes and reduces complications, especially for those with high - output stomas. This study aligns with previous research emphasizing the need for vigilance in managing post - ileostomy patients to reduce morbidity and enhance recovery.***

Keywords: Temporary ileostomy, Serum sodium levels, Serum potassium levels, Vitamin B12, High - output stoma

1. Introduction

An ileostomy is a surgical incision made through the abdominal wall into the ileum. Ileostomies have a high complication rate, with stomal complications occurring in 21% - 70% of cases (Murken et al., 2019). Ileostomies can be classified into two main types: temporary and permanent. Patients with diseases like Crohn's disease that result in toxic megacolon or those with malignant growths in the distal colon are usually the ones who get permanent ileostomies. On the other hand, in order to facilitate the healing of acute disease, a temporary ileostomy involves disconnecting the distal bowel from the remainder of the intestine and making a stoma. An incision is made in the abdominal wall and the ileum, a section of the small intestine, is removed to establish a defuncting ileostomy. The absorption of vital nutrients, such as vitamin B12, may be adversely affected by this procedure (Ambe et al., 2018). Depletion of salt and water in patients after ileostomy surgery has long been acknowledged as a consequence of the early post - operative phase (Banerjee, 2014). The regulation of water content, tissue activity acid - base equilibrium, cellular survival, and other physiological processes are all impacted by inorganic electrolytes. These electrolytes, which include calcium, sodium, potassium, and chloride, are vital components of the body. Changes in electrolyte composition and fluid volume occur before, during, and after surgery. (Piper et al., 2012). Despite the apparent health, ileostomy patients' data reveal a steady, mild extracellular fluid volume depletion, with a reduction in sodium and water levels ranging from 7% to 11%. In ileostomy patients, symptomatic volume depletion is seen often, it may occur when there is an abrupt rise in ileostomy drainage, when eating is interrupted, or when there is excessive perspiration (Weise et al., 2008). Because of the large flow during ileostomy construction, acid - base and electrolyte balance may be affected. The results of this study will give medical professionals important knowledge about the possible hazards of vitamin B12 insufficiency and aberrant electrolyte levels in individuals with temporary defunctioning ileostomies.

Therefore, the study aims to evaluate changes in serum sodium and potassium levels during the early post - operative period and to observe trends in serum vitamin B12 levels following a temporary ileostomy.

2. Review of Literature

Ileostomies are commonly formed as diverting measures to defunction the rest of the bowel in order to protect a distal anastomosis, relieve bowel obstruction the management of inflammatory bowel diseases, gastrointestinal malignancies, bowel perforations, and trauma (Tzovaras et al., 2005). The loop ileostomy with partial ileum resection exhibits a significant volume of effluent, whereas the colostomy exhibits the least amount. Low volume stomas are those with an output effluent volume of 500 ml or less, and large output stomas are those with an effluent volume of ≥1 litre. Individuals who have a high output stoma are susceptible to dehydration and salt loss, particularly if there is a large ileal resection involved (Hill et al., 1979). The study by Fowler DI et al. found that urinary salt excretion reduces in healthy ileostomy patients. This suggests that 300 meq of sodium replacement treatment should be used for fluid loss, while potassium supplements shouldn't be taken unless enteritis develops (Fowler et al., 1959).

Gallagher et al. investigated electrolyte and fluid imbalances in individuals with established ileostomies. They discovered that salt loss was higher than in regular feces and that the volume of ileostomy material varied from 380 to 1, 500 ml/day. The ileostomy group experienced a much larger loss

of urine sodium. Potassium levels in ileostomy material ranged from 2 to 12 mEq/day, which is typical stools. Additionally, they observed that twelve patients with long - standing ileostomies were deficient in both salt and water, indicating that these needs require greater care (Gallagher et al., 1962).

Vitamin B12 absorption was investigated by Jagenburg et al. in patients undergoing continent ileostomy. In 21 cases, they discovered normal absorption, in 4 cases, borderline readings, and in 1 case, poor values. When vitamin B12 - IF complex was injected into the reservoir, the mucosal membrane absorbed it. The building of a continent ileostomy reservoir did not raise the risk of vitamin B12 malabsorption, according to the study's findings (Jagenburg et al., 1975).

The vitamin B12 levels of 235 individuals who had continent ileostomies were investigated by the (Nilsson et al.1984) study. The findings indicated that routine prevention and screening are not necessary because the majority of patients do not acquire a B12 deficiency. Nevertheless, 7% of patients experienced subnormal readings, suggesting that all patients undergoing continent ileostomies should have their vitamin B12 levels routinely checked. There was a median of 7.5 years between the development of an ileostomy and subnormal results.

The two most prevalent types of stomas were determined by (Hills et al., 1975) study to be low volume (less than 500 ml) and large volume (greater than 1 lit). Patients with limited output were shown to be less vulnerable to electrolyte imbalance and dehydration.

According to (Shellito et al., 1998), electrolyte abnormalities are more likely after surgery and call for careful observation. Five patients with terminal ileostomy were evaluated by (Wilson AO et al., 1955) who concluded that salt shortage was most likely and that maintaining fluids may be challenging. Additionally, the study discovered that if the ileostomy is active, a significant dose of sodium citrate should be administered right after surgery. These instances did not, however, exhibit a true potassium shortage.

The review of existing studies highlights the critical role of monitoring electrolyte and nutrient levels, such as sodium, potassium, and vitamin B12, in patients with ileostomies. Several studies have consistently shown that high stoma output is associated with significant fluid and electrolyte loss, which can lead to complications like dehydration and electrolyte imbalances, especially in patients with distal stomas. The findings also indicate that while the majority of patients maintain normal vitamin B12 absorption, a subset may experience deficiencies, particularly over long periods. This underlines the importance of personalized post - operative care focusing on fluid management and nutritional supplementation. The current study builds on these foundations by specifically investigating the trends in sodium, potassium, and vitamin B12 levels post - ileostomy, contributing to the growing body of evidence on managing post - operative ileostomy patients more effectively.

3. Materials and Methods

Study Setting and Design

An observational prospective study was carried out for one year in the Department of General Surgery at BRD Medical College, Gorakhpur.

Study Population and Sample Size

The sample size of 80 patients was determined using the following formula:

$$n = \frac{Z^2 \left(1 - \frac{\alpha}{2}\right) . p\,(1 - p)}{d^2}$$

Where,

n = required sample size

z= 1.96 at 0.05 level of significance

p = proportion of ileostomy which has been taken as 80% based on the study by Jayabal et al

d= 10% margin of error

n=1.96x1.96x0.80x0.20/ (0.10) ^{2}

Sampling Method: Consecutive sampling was used until the required sample size of 80 patients is achieved.

Inclusion Criteria

- Age: Patients aged >16 years.
- Gender: All genders are included.
- Surgical Procedure: Patients who have undergone ileostomy, with or without ileal resection.
- Postoperative Care: Patients managed with intravenous fluids for at least 3 days postoperatively.

Exclusion Criteria

- ASA Grade 3 or above.
- Known comorbidities such as renal failure or end - stage liver disease.
- Patients refusing consent participate in the study.

Study Procedures and Data Analysis

Stoma output was measured on Postoperative Days (POD) 3 and 5 as a 24 - hour collection. Serum sodium and potassium levels were assessed at admission, POD 3, and POD 5, using ion - specific electrode technology. Vitamin B12 levels were measured at admission and either at ileostomy closure or three months post - surgery. All results were evaluated against standard reference ranges for sodium, potassium, and vitamin B12. Continuous variables were analysed using the Mann - Whitney U test for nonparametric data and the student's t - test for parametric data. Discrete variables were evaluated using the Chi - square test, with statistical significance set at $p < 0.05$. Data were processed using SPSS version 22.

4. Results

1) Distribution of Study Patients by Age Group

The descriptive statistics for each variable were computed, and the distribution of study patients according to age group is presented in Figure 1. The age distribution varied across the participants, allowing for a comprehensive analysis of postoperative outcomes across different age groups.

2) Indications for Temporary Ileostomy

The most common indication for temporary ileostomy among the 80 study participants was small intestine perforation, accounting for 38 patients (47.5%). An additional 9 patients (11.25%) required ileostomy due to large bowel perforation, and another 9 patients (11.25%) due to small bowel closed loop obstruction. Ten patients (12.5%) underwent the procedure because of sigmoid volvulus. Furthermore, 7 patients (8.75%) had an ileostomy due to obstructed inguinal hernia, 2 patients (2.5%) due to anastomotic leak, and 1 patient (1.25%) each for midgut malrotation, pyoperitoneum, caecal growth, ileal growth, and mesenteric tear. This distribution highlights the diverse conditions necessitating temporary ileostomy.

3) Comparison of stoma output at different time interval

The comparison of stoma output at different time intervals (table 1) showed that on POD 3, the mean stoma output was 635.63 mL (SD = 295.316), with a median of 550.00 mL, a minimum of 200 mL, and a maximum of 1450 mL. By POD 5, the mean stoma output increased to 1157.81 mL (SD = 549.879), with a median of 950.00 mL, a minimum of 450 mL, and a maximum of 3000 mL. The change in stoma output between POD 3 and POD 5 was statistically significant with a p - value of 0.0001.

4) Comparison of Serum Sodium Levels at Different Time Intervals

The comparison of serum sodium levels at different time intervals showed no statistically significant change from admission to postoperative day (POD) 5 depicted in table no 1. At admission, the mean serum sodium level was 141.02 mEq/L (SD = 6.83), with a median of 141.05 mEq/L, a minimum of 125.0 mEq/L, and a maximum of 162.4 mEq/L. On POD 3, the mean serum sodium level slightly decreased to 140.29 mEq/L (SD = 6.00), with a range of 123.8 to 152.1 mEq/L. By POD 5, the mean sodium level further dropped to 138.19 mEq/L (SD = 5.26), with a median of 138.40 mEq/L, a minimum of 126.8 mEq/L, and a maximum of 154.0 mEq/L. Despite these fluctuations, the p - value of 0.462 indicated that the changes were not statistically significant.

5) Comparison of Serum Potassium Levels at Different Time Intervals

The serum potassium levels also showed no significant changes over time at table no 2. At admission, the mean serum potassium level was 4.00 mEq/L (SD = 0.73), with a median of 4.01 mEq/L, a minimum of 1.78 mEq/L, and a maximum of 5.75 mEq/L. On POD 3, the mean potassium level slightly decreased to 3.95 mEq/L (SD = 0.61), with a range of 2.34 to 5.60 mEq/L. By POD 5, the mean potassium level was 3.93 mEq/L (SD = 0.59), with a median of 3.91 mEq/L, a minimum of 2.36 mEq/L, and a maximum of 6.01 mEq/L. The p - value of 0.501 confirmed that these changes were not statistically significant.

6) Comparison of Vitamin B12 Levels at Different Time Intervals

In contrast to the stability of sodium and potassium levels, Vitamin B12 levels showed a statistically significant reduction over in table no 3. At admission, the mean Vitamin B12 level was 226.48 pg/mL (SD = 395.45), with a median of 61.30 pg/mL, a minimum of 5.2 pg/mL, and a maximum of 2560.1 pg/mL. After three months post - surgery, the mean Vitamin B12 level decreased to 157.32 pg/mL (SD = 278.18), with a median of 37.00 pg/mL, a minimum of 4.2 pg/mL, and a maximum of 1740.8 pg/mL. The p - value of 0.0001 indicated a statistically significant reduction in Vitamin B12 levels during this period.

7) Stoma Output and Correlation with Electrolyte Levels

Stoma output was observed to increase between POD 3 and POD 5, particularly in patients with high - output stomas (≥1000 mL/day). These patients experienced greater losses in fluids and electrolytes. However, no direct correlation was found between stoma location and changes in serum sodium, potassium, or Vitamin B12 levels. This suggests that other factors, such as the stoma output volume, may play a more significant role in fluid and electrolyte imbalances than the stoma's anatomical location.

5. Discussion

The present study described fluid and electrolyte management in the context of high stoma output, investigating changes in blood sodium, potassium, and vitamin B12 levels within the early postoperative period following the construction of temporary ileostomies. Its findings are comparable to the findings of previous studies; significant variations in potassium and sodium serum levels were found in the current study, which is critical to maintaining homeostasis in ileostomy patients. These findings are consistent with the observations of Hill et al. (1979), who found that the stoma distance from the ileocecal junction is one of the factors that determines stoma output in turn, electrolyte levels. Those patients who had their stomas created further from the ileocecal valve tended to have higher rates of stoma output, which meant they were losing more electrolytes and therefore needed continuous and frequent fluid replacement therapy. In line with the findings of Ganguly et al. (2018), who indicated that stoma outputs over 1000 mL/day are related with elevated risks of electrolyte imbalances, the mean stoma output in our study increased considerably between postoperative day (POD) 3 and POD 5. According to their findings, on the fifth postoperative day, patients undergoing high - output ileostomies (≥1000 mL/day) had significantly lower serum salt levels. The mean serum sodium levels decreased from admission to POD 5, which is consistent with those findings in this study and suggests that close monitoring is necessary to avoid severe hyponatremia. While potassium levels were mostly kept within the normal range, there were some slight variations that matched the patterns noted by Songra et al. (2018). According to their research, potassium levels need to be closely watched, especially when there is a high stoma output. The results here support this since potassium levels varied slightly but not significantly, and stoma output was found to be a driver of fluid and electrolyte loss.

Overall, the patterns found in this investigation align with previous research, further supporting the need for vigilance in managing ileostomy - related complications, particularly in terms of electrolyte disturbances and vitamin B12 malabsorption.

6. Implications

This study emphasizes necessity for vigilant postoperative management of fluid and electrolyte management in patients with high - output stomas. Understanding the trend of serum sodium and potassium levels, the clinician can make appropriate adaptations in fluid management to avoid complications such as hyponatremia or hypokalaemia. Furthermore, the highly significant reduction of vitamin B12 level underscores the possibility of a long - term nutritional deficiency and therefore suggests an early checkup and supplementation after ileostomy.

7. Conclusion

This observational study gives the valuable insights into the changes in the serum sodium, potassium, and vitamin B12 following temporary ileostomy. No significant modification in serum sodium and potassium levels in the immediate period following the operation, with increased stoma output. Significant decline in vitamin B12 levels within three months following ileostomy. Significant increase in the stoma output between POD 3 to POD 5, with more distal stomas having higher outputs were concluded. The investigation found that there was no direct relationship between the site of the stoma and the levels of electrolytes or vitamin B12.

8. Future Scope

Future research should focus on personalized fluid and electrolyte management, given the individual variability in stoma output and in nutritional absorption. Long - term studies exploring the broader nutritional impacts of ileostomy, including the role of other vitamins and minerals, could provide a more comprehensive management strategy. Additionally, advancements in surgical techniques or post - surgical care may help mitigate the complications observed in ileostomy patients.

Table 1: Comparison of stoma output at different time interval

	POD 3	POD5
Mean	635.63	1157.81
Median	550.00	950.00
Std. Deviation	295.316	549.879
Minimum	200	450
Maximum	1450	3000
p - value	0.0001	

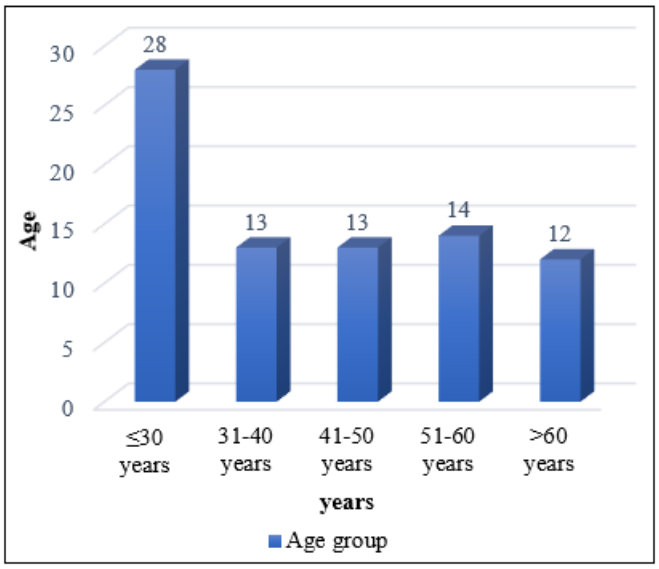

Figure 1: Distribution of study patients according to age group

Table 2: Comparison of serum sodium level at different time interval

	At admission	POD 3	POD5
Mean	141.024	140.285	138.191
Median	141.050	141.050	138.400
Std. Deviation	6.8356	6.0001	5.2614
Minimum	125.0	123.8	126.8
Maximum	162.4	152.1	154.0
p - value	0.462		

Table 3: Comparison of serum potassium level at different time interval

	At admission	POD 3	POD5
Mean	4.0006	3.9518	3.9264
Median	4.0100	4.0000	3.9050
Std. Deviation	.73192	.60577	.58647
Minimum	1.78	2.34	2.36
Maximum	5.75	5.60	6.01
p - value	0.501		

Table 4: Comparison of Vit - B12 level at different time interval

	At admission	After 3 months
Mean	226.481	157.315
Median	61.300	37.000
Std. Deviation	395.4491	278.1807
Minimum	5.2	4.2
Maximum	2560.1	1740.8
IQR	18.9 - 307.6	12.4 - 219.2
p - value	0.0001	

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