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EFFECT OF INFUSION THERAPY ON POSTOPERATIVE INTESTINAL FAILURE AFTER MAJOR ABDOMINAL SURGERIES

Medicine

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ABSTRACT

Background: Postoperative management of abdominal surgeries is crucial to prevent intestinal failure syndrome (IFS) and promote recovery of gastrointestinal tract function. Adequate perioperative infusion therapy is essential for managing IFS risk. In this study, we assess the impact of perioperative infusion therapies on the restoration of bowel function in patients undergoing emergency abdominal surgeries. **Methods:** This prospective observational study analyzed 104 emergency abdominal procedures in Ratnagiri City, India. The study evaluated GIT status and bowel function using laboratory tests and infusion therapy. Statistical analysis was conducted using SPSS Statistics. **Results:** The study involved 104 patients, with 58 in Group 1 and 46 in Group 2. Patients on postoperative day 1 had an average IFS score of 2.92 ± 0.18. This score decreased progressively over the following days, reaching 1.32 ± 0.68 by day 7. Intra-abdominal pressure (IAP) decreased significantly from 22.05 ± 1.24 cm H2O on day 1 to 10.89 ± 2.44 cm H2O by day 7. The lumen diameter of the small bowel (r = 0.928), intestinal wall thickness (r = 0.944) and intra-abdominal pressure (r = 0.986, P = 0.01) were all found to have strong correlations with IFS. The analysis uncovered a strong and statistically significant relationship between the amount of fluid given during surgery and the severity of intestinal failure afterwards (correlation coefficient = 1.000, p-value = 0.01). **Conclusion:** Perioperative infusion therapy significantly impacts postoperative intestinal function in abdominal surgery patients, emphasizing the need for customized protocols to minimize complications and maximize patient outcomes.

KEYWORDS

Intestinal Failure Syndrome (IFS), Perioperative Infusion Therapy, Postoperative Management, Emergency Abdominal Surgeries, Gastrointestinal Tract (GIT) Function

INTRODUCTION

Effective management of abdominal surgeries in the early postoperative period is of utmost importance, with a focus on preventing intestinal failure syndrome (IFS) and promoting the recovery of gastrointestinal tract (GIT) function. In emergency abdominal surgeries, the intestinal wall can be compromised due to acute damage to the abdominal cavity. This can result in postoperative paralysis, which is a common defensive response of injured bowels [1].

Intestinal Failure Syndrome (IFS) is an intricate condition characterized by a substantial decrease in the movement of the bowels and, in certain instances, a diminished capacity of the small intestine to process and assimilate nutrition. Multiple crucial variables contribute to the development of IFS, such as insufficient regulation of fluid and electrolyte levels, which can result in a hazardous imbalance, and decreased oxygen supply to the gut wall, also known as circulatory hypoxia. In addition, IFS is frequently accompanied by disruptions in the equilibrium of the normal microbial flora, leading to dysbiosis, a state in which hazardous microorganisms multiply in the surrounding region. The illness is characterized by abnormalities in antioxidant defenses, which weaken the protective barrier of the mucosa and tissue immunity. This, in turn, facilitates the movement of bacteria from the gastrointestinal tract into the bloodstream, a process known as bacterial translocation [2,3].

In addition, IFS is distinguished by disturbances in the acid-base equilibrium caused by electrolyte loss, depletion of bicarbonate, anaerobic glycolysis, and heightened generation of organic and inorganic acids. Poor fluid management after surgery and recovery can increase imbalances and negatively affect ischemic bowel segments. This can occur due to incorrect infusion levels, which can exacerbate visceral edema or lead to splanchnic ischemia and reduced intestinal perfusion [4]. Adequate perioperative infusion therapy is essential for effectively managing and reducing the risk of postoperative IFS. While the development of balanced ionic solutions and synthetic colloids has expanded the possibilities for infusion therapy, there are still obstacles to overcome to optimize these treatments [5]. In this prospective study, we assess the impact of various perioperative infusion therapies on the restoration of bowel function in patients undergoing emergency abdominal surgeries.

MATERIALS AND METHODS

Study Design and Participants

This prospective observational study was carried out from 2018 to 2024 at clinical facilities in Ratnagiri City, India, following approval from the institutional review board (IRB Approval Number: XXX). The study included 104 patients who underwent emergency abdominal procedures. The mean age of the study population was 54.7±7.5 (35-78 years). Participants were categorized based on the American Society of Anesthesiologists (ASA) physical status classification system, ranging from ASA I to III. Surgical procedures performed to treat disorders such as obstructive tumors, appendicular abscesses, biliary duct injuries, and gastrointestinal tract (GIT) burst ulcers were included. The mean surgical time was 134±32 minutes, with a range of 65 to 220 minutes. The maximum amount of blood lost during surgery was 600 ml. The exclusion criteria encompassed coagulopathies, severe renal or hepatic dysfunction, and the requirement for re-laparotomies resulting from anastomotic dehiscence.

Infusion Therapy Protocol Participants were categorized into two groups according to the type of infusion therapy they received: Group 1, a total of 58 patients were included. These patients were administered balanced ionic solutions as part of their infusion therapy, with an average infusion volume of 2501 ml.

Group 2 consisted of 46 individuals. Patients in this group were administered a mixture of balanced ionic solutions and synthetic colloids, specifically 500 ml of 6% hydroxyethyl starch 130/0.4. The infusion volume administered to this group averaged 2216 ml.

Assessment Methods

- **GIT Status:** An extensive and ever-evolving evaluation of the gastrointestinal tract was conducted, encompassing physical examination, auscultation, intra-abdominal pressure measurement, and ultrasound visualization.
- **Bowel Function Monitoring:** The study closely observed the dynamics of intestinal absorptive function through a combination of laboratory tests and an evaluation of the volume and quality of infusion therapy.

Statistical Analysis: The data processing was carried out using SPSS Statistics. Pearson and Spearman correlation coefficients were calculated to determine the relationships and dependencies between various features and outcomes.

RESULTS

Demographics and Patient Characteristics

The study population consisted of 104 patients who underwent emergency abdominal surgeries, with 58 patients assigned to Group 1

and 46 to Group 2. In Group 1, there were 32 male patients (55.17%) and 26 female patients (44.83%). In Group 2, there were 24 male patients (52.17%) and 22 female patients (47.83%). With 3 occurrences of post-myocardial infarction and 4 cases of type II diabetes mellitus-related IHD, Group 1 patients had somewhat greater incidence of ischemic heart disease (IHD) than Group 2, which had 2 and 4 cases respectively.(Table 1)

Intestinal Failure Severity and Early Postoperative Outcomes

Early postoperative observations revealed a significant prevalence of severe intestinal failure in both groups. Patients on postoperative day 1 had an average IFS score of 2.92 ± 0.18. This score decreased progressively over the following days, reaching 1.32 ± 0.68 by day 7 (Table 2). Parallel trends were observed in small bowel diameter and wall thickness, with both parameters showing gradual reductions over the same period. Notably, intra-abdominal pressure (IAP) decreased significantly from 22.05 ± 1.24 cm H2O on day 1 to 10.89 ± 2.44 cm H2O by day 7 (Table 2). In the first three days following surgery, most patients in both groups exhibited an intestinal failure level of 3, indicating severe impairment of bowel function. By the fourth day, signs of bowel function recovery were noted in both groups.

Correlation Analysis

Several key prognostic factors for intestinal failure severity were identified through correlation analysis. The lumen diameter of the small bowel (r = 0.928), intestinal wall thickness (r = 0.944) and intra-abdominal pressure (r = 0.986, P = 0.01) were all found to have strong correlations with IFS. Out of all the factors considered, intra-abdominal pressure stood out as the most dependable indicator of how postoperative intestinal failure would develop. It played a vital role in guiding perioperative infusion therapy.

Impact of Perioperative Infusion Therapy on Postoperative Outcomes

The perioperative infusion therapy significantly influenced the severity of postoperative intestinal failure and the overall condition of the bowel. Group 2, who received third-generation hydroxyethyl starch (HES) in their infusion solutions, showed a decrease in total intraoperative blood loss and minimized adverse effects on bowel condition. In Group 2, better management of intra-abdominal pressure was observed, indicating that the use of HES could potentially lead to improved outcomes. The analysis uncovered a strong and statistically significant relationship between the amount of fluid given during surgery and the severity of intestinal failure afterwards (correlation coefficient = 1.000, p-value = 0.01). The significant correlation highlights the direct influence of the amount and content of perioperative infusion therapy on the recovery of bowel function after emergency abdominal surgeries.

Blood Osmolarity and Postoperative Intestinal Failure Severity

There was a notable disparity in blood osmolarity between the two groups. Group 1 had an average osmolarity of 276.4 ± 9.8, while Group 2 had an average osmolarity of 290.28 ± 5.26 (P = 0.013). Despite this distinction, there was no significant variation in the severity of IFS between the groups. This implies that factors other than the one mentioned, such as the limited sample size, might have impacted the statistical power of the analysis.

DISCUSSION

The present study offers valuable insights into the effects of perioperative infusion therapy on the severity of postoperative intestinal failure (IFS) in individuals undergoing major emergency abdominal surgeries. The results of our study emphasize the significant importance of implementing proper fluid management strategies to reduce the complications associated with intra-abdominal hypertension (IAH) and abdominal compartment syndrome (ACS), and to facilitate the restoration of normal gastrointestinal tract (GIT) function.

Data collected from the early postoperative outcomes suggests a significant occurrence of severe intestinal failure in both groups, with the average IFS severity gradually decreasing over time. This observed decrease in IFS severity demonstrated a corresponding enhancement in small bowel diameter, wall thickness, and intra-abdominal pressure (IAP). These findings are consistent with prior research that emphasizes the significance of maintaining optimal intra-abdominal conditions to improve postoperative recovery. The reduction in IFS severity and the associated improvements in bowel parameters highlight the critical role of effective perioperative management strategies. Studies have shown that maintaining adequate intra-abdominal pressure can prevent the onset of abdominal compartment syndrome and promote better perfusion of the gastrointestinal tract, leading to enhanced recovery [6,7].

Our correlation analysis revealed strong associations between key prognostic factors, such as the lumen diameter of the small bowel, intestinal wall thickness, and IAP, with the severity of IFS. Notably, IAP emerged as the most reliable predictor of postoperative intestinal failure development, emphasizing its pivotal role in guiding perioperative infusion therapy. This finding corroborates the existing literature, which identifies IAP as a critical factor in the management of postoperative intestinal complications [8].

Furthermore, the observed trends in our study align with evidence suggesting that careful fluid management and the use of advanced infusion solutions, such as hydroxyethyl starch, can mitigate the adverse effects of surgery on bowel function [9,10]. Therefore, our findings reinforce the importance of targeted infusion therapy in the perioperative care of patients undergoing major abdominal surgeries. The type and volume of perioperative infusion therapy significantly influenced postoperative outcomes. Group 2, which received a combination of balanced ionic solutions and synthetic colloids, specifically 6% hydroxyethyl starch (HES), demonstrated better management of IAP and improved bowel condition. This group experienced lower intraoperative blood loss and reduced adverse effects on bowel function compared to Group 1, which received only balanced ionic solutions. These results suggest that the inclusion of HES in infusion therapy can enhance fluid resuscitation and reduce the risk of postoperative complications, consistent with prior research advocating for the benefits of synthetic colloids in perioperative care [11].

The relationship between the volume of fluid administered during surgery and the severity of postoperative intestinal failure was both strong and statistically significant. This correlation underscores the direct impact of infusion therapy on the recovery of bowel function, highlighting the necessity of tailored fluid management strategies to optimize patient outcomes. This finding aligns with previous studies that emphasize the importance of individualized fluid therapy in reducing postoperative morbidity and improving gastrointestinal recovery [12].

Moreover, the analysis of blood osmolarity between the two groups revealed a notable difference, with Group 2 exhibiting higher osmolarity levels. However, this did not translate into a significant variation in the severity of IFS between the groups. This observation suggests that while osmolarity is an important consideration in fluid management, other factors, such as the type of colloid used and the overall volume of infusion, play a more decisive role in influencing postoperative outcomes. The research emphasizes the significance of optimizing perioperative infusion strategies in order to reduce the occurrence of postoperative intestinal failure and improve the recovery of bowel function. The findings of this study indicate that the implementation of personalized infusion therapy, which is specifically customized to meet the individual needs of each patient, may result in enhanced postoperative outcomes and a more rapid restoration of bowel function[13,14].

Research on fluid management during emergency bowel surgery is significantly less comprehensive compared to elective surgery. Recruiting patients to studies in these circumstances [15] can be challenging, which is understandable. However, it is disappointing considering the significantly higher morbidity and mortality associated with these situations. The inflammatory or haemorrhagic processes exhibit a heightened level of prominence, potentially resulting in significant fluid deficits and an augmented demand for tissue oxygen. One of the fundamental observations in the field of Goal-Directed Therapy (GDT) is that when critically ill surgical patients are unable to increase oxygen delivery, their outcomes tend to be worse [16]. This highlights the importance of prioritizing strategies aimed at optimizing oxygen delivery in these patients.In conclusion, the results of this study provide evidence to support the utilization of balanced ionic solutions in conjunction with synthetic colloids, specifically hydroxyethyl starch, in order to enhance fluid resuscitation, minimize blood loss during surgery, and enhance gastrointestinal recovery. Future investigations should prioritize the

continued development and optimization of fluid management protocols, as well as delve into the examination of the extended consequences of various infusion therapies in a wide range of patient cohorts.

Limitations

This study, although offering valuable insights into the impact of perioperative infusion therapy on postoperative intestinal function, is subject to several limitations. The limitations of this study include a relatively small sample size and a single-center, observational design. These factors may restrict the ability to apply the findings to larger populations and diverse clinical settings. Moreover, it is important to note that the study did not take into consideration potential confounding factors, such as variations in surgical techniques, patient comorbidities, and postoperative care protocols. These factors have the potential to significantly impact the outcomes observed in the study. The limited duration of the follow-up period poses a constraint on the capacity to evaluate the long-term impacts of the infusion therapies on bowel function and overall recovery. Additional investigation utilizing larger, multicenter randomized controlled trials is necessary in order to validate these findings and establish more substantial evidence for optimizing infusion therapy protocols in the postoperative management of major abdominal surgeries.

CONCLUSION

In conclusion, the findings of this study provide evidence that the choice of perioperative infusion therapy has a substantial effect on the postoperative intestinal function of individuals undergoing major abdominal surgeries. It has been observed that the utilization of balanced ionic solutions in conjunction with synthetic colloids, like hydroxyethyl starch, has the potential to mitigate the intensity of Intestinal Failure Syndrome (IFS) and facilitate improved restoration of bowel function. The significance of these findings cannot be overstated, as they highlight the critical need for customized infusion protocols in order to maximize patient outcomes, minimize complications, and improve overall recovery. Although the initial findings are encouraging, additional investigation utilizing larger sample sizes and employing more rigorous study designs is imperative in order to validate these advantages and enhance the infusion therapy guidelines for implementation in clinical settings. The aforementioned insights offer a valuable conceptual framework for the purpose of optimizing surgical care and improving patient outcome.

Table 1: Concurrent Comorbidities of the Patients Studied.

Indices, *n*		
	Group 1 (*n*=58)	**Group 2** (*n*=46)
Men	32 (55.17)	24 (52.17)
Women	26 (44.83)	22 (47.82)
IHD, Post MI	3	2
IHD, CHF	2	1
IHD, type II diabetes mellitus	4	4
IHD, Post CVA	2	1

Table 2: Severity of Intestinal Failure During the Early Postoperative Period in Patients

Day	**1**	**2**	**3**	**4**	**5**	**6**	**7**
IFS	2.92±0.18	2.64±0.52	2.28±0.79	2.10±0.82	1.74±0.58	1.36±0.74	1.32±0.68
Small bowel diameter, cm	5.38±0.91	4.72±0.59	4.47±0.82	4.57±0.62	4.49±0.62	3.69±0.74	3.02±0.52
Small bowel wall thickness, mm	4.82±0.72	3.63±0.47	3.32±0.59	3.71±0.32	3.31±0.42	3.32 ±0.69	3.14±0.79
IAP, cm H_2O	22.05 ±1.24	19.74±3.10	18.24±3.02	16.88±2.22	15.54 ±1.89	13.01 ±2.66	10.89±2.44

Note. IFS – Intestinal Failure Severity. – reliability of difference compared to days 5–7 at P<0.05

Table 3: Effect of Perioperative Infusion Therapy on Postoperative Bowel Condition

	Group 1		**Group 2**	
IIT, ml/kg/min	0.564±0.22		0.522±0.15	
Day	**1**	**3**	**1**	**3**
IFS	2.9±0.78	2.7±0.44	2.5±0.32	2.1±0.58
Small bowel wall thickness, mm	4.74±0.72	4.88±0.62	3.92±0.72	3.92±0.71
IAP, cm H2O	24.2±2.61	17.1±1.94	18.1±2.88	15.4±2.83

Note: IIT – intra-operative infusion therapy. P > 0.05 – no significant difference between groups.

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