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EFFICACY OF SOMATOSTATIN ON GASTRO-INTESTINAL FUNCTION IN CHILDREN WITH ACUTE ABDOMEN

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Abstract

Introduction: The effectiveness of somatostatin in the management of acute abdominal discomfort in children is the focus of this study. Evaluating its efficacy in alleviating symptoms, enhancing gastrointestinal function, and maybe shortening the length of hospitalization are the main goals. The study's overarching goal is to fill gaps in our knowledge of somatostatin's function in treating acute abdominal pain in children by shedding light on its therapeutic effects.

Aim and objectives: To evaluate the effectiveness of somatostatin in pediatric acute abdominal cases and its effects on gastrointestinal function, with the aim of determining prospective therapeutic advantages.

Method: The study has included 80 children receiving acute abdominal surgery during the period of one year. Two groups, Observation and Control, were formed. The Observation group received Somatostatin, while the Control group received hemostasis therapy and post-surgical antibiotics. Both groups exhibited similar demographics and acute abdominal conditions. The authors did follow-up study and compared the postoperative recovery conditions, gastrointestinal hormone levels, stress indicators, post operative complications between the groups statistically. The study, authorized by our hospital, adhered to informed consent. Inclusion criteria comprised patients presenting with acute abdomen, undergoing surgery, and completing the treatment protocol. Exclusions included serious organic disorders, massive intra-abdominal hemorrhage, hematological diseases, and underlying or chronic conditions.

Result: The study found that postoperative recovery conditions for children in the Control and Observation groups, showcasing significant group differences in various parameters. The Observation group demonstrated quicker recovery, with shorter times for first anal exhaust (26±6 hours) and bowel sound recovery (21±5 hours) compared to the Control group (38±5 and 30±6 hours, respectively). Additionally, the Observation group exhibited shorter first bowel movement time, reduced 24-hour gastrointestinal decompression quantity, smaller abdominal circumference, and a shorter duration of stay, all statistically significant ($p < 0.002$), indicating positive surgical outcomes. The study also compares post-surgery complications, revealing lower incidence in the Observation group (8%) compared to the Control group (26%) ($p = 0.013$), with no significant difference in specific complications except for incisional hernias.

Conclusion: In conclusion, administration of somatostatin during pediatric acute abdominal surgery improves prognosis, decreases complications, and alleviates postoperative stress.

Keywords: Somatostatin, intussusceptions, volvulus, diverticulums, necrotizing enterocolitis.

INTRODUCTION:

Acute abdomen represents an urgent medical condition typified by the sudden and intense onset of abdominal pain, demanding immediate attention and care. Its emergence stems from diverse origins, encompassing infections, inflammations, vascular blockages, or obstructive issues within the abdominal cavity. Indicative symptoms involve severe discomfort, often accompanied by nausea, vomiting, and an overall distressed appearance in affected individuals [1,2]. The pain may present locally or spread across the abdomen, with clinical examinations revealing telltale signs such as absent bowel sounds, tenderness upon pressure release, and protective muscle contractions indicating peritonitis. A myriad of origins underscores this condition, including appendicitis, perforated peptic ulcers, acute pancreatitis, ruptured sigmoid diverticulum, ovarian torsion, volvulus, ruptured aortic aneurysms, or traumatic injuries to the spleen, liver, or ischemic bowel [2].

Acute abdomen, marked by sudden and severe abdominal pain, constitutes a significant portion of pediatric emergency visits, accounting for approximately 8% of pediatric emergency department attendees. The condition encompasses a wide spectrum of causes, spanning ailments necessitating surgical intervention to those managed with medication or observation [2]. In children, the leading culprits for acute abdomen differ by age, with intussusception and appendicitis emerging as the primary concerns in younger infants and older children, respectively. Additional triggers encompass malrotation, volvulus, typhoid, ischemic enteritis, and lower lobe pneumonia. Diagnosing acute abdomen in children poses a challenge owing to their limited ability to articulate symptoms [1]. Hence, imaging techniques such as ultrasonography play a pivotal role in distinguishing between cases that require medical treatment and those warranting surgical intervention. While ultrasonography stands as the initial choice for imaging studies, computed tomography (CT) is selectively employed for specific indications or inconclusive ultrasonography findings [2-4].

Acute abdomen in pediatric cases is a frequent occurrence encountered in emergency departments, showcasing variability in prevalence across different inquiries. In one instance, among 3980 pediatric patients presenting with acute abdominal pain, 400 cases were diagnosed as acute abdomen. This diagnosis accounted for 5.1% of unscheduled visits within another pediatric population. Another investigation noted that acute abdominal pain was present in 5.4% of children referred to the emergency department. These statistics highlight the recurrent nature of acute abdomen among pediatric cases and underscore the need for prompt assessment and treatment [5-7].

Proper gastrointestinal function holds pivotal importance in pediatric healthcare, ensuring efficient digestion, nutrient absorption, and waste elimination. Any disruption in this delicate balance can trigger acute abdomen episodes, marked by intense abdominal pain and accompanying symptoms like vomiting, diarrhea, or constipation. Functional Abdominal Pain Disorders (FAPDs), prevalent in pediatric gastroenterology, encompass about half of all clinic visits in this field, signifying their substantial impact. Diagnostic tools like upper gastrointestinal endoscopy and colonoscopy serve as pivotal methods in identifying the root cause of symptoms, revered as gold standards in diagnosing various pediatric gastrointestinal disorders. Elevated liver transaminase levels stand as indicators of potential intra-abdominal injury, particularly evident in cases of blunt abdominal trauma in children, potentially disrupting normal gastrointestinal function. Additionally, infections stemming from Dientamoeba fragilis can instigate gastrointestinal distress, manifesting as acute and recurring diarrhea and abdominal pain. Nurturing and upholding normal gastrointestinal function remain imperative in preventing acute abdomen occurrences in pediatric patients, underscoring the critical role of maintaining digestive health in pediatric care [8-11].

Somatostatin, a pivotal hormone in the body's regulatory system, exerts a profound influence by selectively inhibiting the release of various hormones. Its primary interaction occurs with somatostatin receptor 2 (sstr2), a key player in curbing the secretion of growth hormone from the pituitary gland and glucagon from the pancreas.

Moreover, somatostatin also engages somatostatin receptor 5 (sstr5), correlating notably with the suppression of insulin release. This intricate interplay positions somatostatin as a critical controller in maintaining the delicate hormonal equilibrium, wielding significant influence over the secretion patterns of growth hormone, insulin, and glucagon within the body [12].

Somatostatin, a widespread presence in the gastrointestinal tract, holds a pivotal role in modulating gut functionality by effectively restraining the release and activity of numerous gut hormones. Its multifaceted impact encompasses vital functions such as regulating water and electrolyte movement, notably curbing stool output during episodes of diarrhea. Notably, this hormone exerts inhibitory control over various gastrointestinal hormones, hindering the exocrine actions of both the stomach and pancreas while diminishing the motility of the gastrointestinal tract. Particularly in critically ill infants following gastrointestinal surgery, somatostatin emerges as a promoter of postoperative recovery by aiding gastrointestinal function and reducing the likelihood of complications. Moreover, its therapeutic potential extends to diverse conditions, including gastroenteropancreatic tumors, gastrointestinal fistulae, variceal bleeding, and diarrhea [13-16].

Somatostatin and its long-acting derivative octreotide present promising therapeutic avenues in managing pancreatitis and its associated complications, notably pancreatic pseudocysts, among pediatric patients. Their application demonstrates efficacy in fostering pseudocyst regression, potentially circumventing the necessity for surgical intervention. Moreover, octreotide finds utility in treating a spectrum of pediatric gastrointestinal disorders, spanning from massive gastrointestinal bleeding to pancreatic pseudocysts and ascites. Its administration showcases effectiveness by mitigating symptoms and fostering resolution across these diverse conditions [17,18].

The study aims to evaluate the efficacy of somatostatin in managing acute abdominal pain in pediatric patients, specifically investigating its impact on symptom relief, gastrointestinal function, and potential reduction of hospitalization duration.

Method

Research Design

This is a prospective study which was conducted with 80 paediatric patients with acute abdomen who had surgery in our hospital during the period one year. The study made 2 groups, namely, Observation group and Control group. The Observation group was given with Somatostatin while the Control group was given hemostasis therapy and post surgical antibiotics. The authors did follow-up study and compared the postoperative recovery conditions, gastrointestinal hormone levels, stress indicators, post operative complications between the groups statistically. Stress indicators like Endothelin-1 (pg/mL), ACTH (pg/mL) and Cortisol (ng/mL) were studied and pre-operative levels and Day 1 and Day 5 post-operative levels were statistically analyzed between the two groups. Again, motilin and gastrin (gastrointestinal hormone) level were analyzed in each group and its significance findings were done. Post-operative recovery conditions were also analyzed including bowel sound recovery, first bowel movement, length of stay, 24 hour gastrointestinal decompression amount and Poor abdominal circumference. Several complications were noted and the number of patients were noted against each complication. The two groups had similar age, gender, weight, and acute abdominal main illness states ($P>0.05$). This study was approved by the Ethical Committee of our hospital and data collection was done only after procuring the approval.

Inclusion and exclusion criteria

Inclusion

- Patients presented with acute abdomen in our hospital
- Patient who underwent surgery due to acute abdomen in our hospital
- Patient who did not opt out of the whole procedure and stayed till the end of the treatment protocol.
- Patient with acute abdomen who had Peritoneal irritation, worsening symptoms, and elevated white blood cell count with conservative therapy.

Exclusion

- Patients with Serious organic disorders other than the digestive system.
- Patients with Massive intra-abdominal hemorrhage or abdominal trauma.
- Patients with hematological diseases such leukemia, hemophilia, and congenital heart disease.
- Patients with underlying disorders or chronic conditions were excluded.

Statistical analysis

The statistical analysis of the data was carried out using SPSS 27. The measurements with a normal distribution was presented as mean±standard deviation (x¯±s). Comparisons between groups with respect to before and after treatment were made using two-sample t-tests and paired-sample t-tests. The test compared numerous pre- and post-treatment time periods using repeated measures analysis of variance. Groups were compared using the $\chi 2$ test, modified $\chi 2$ test, or Fisher's exact probability technique when count data were reported as percentages (%). A difference of P<0.05 is statistically significant.

Result

In the observation group ranged in age from 3 to 10 years, with an average age of 6.9±3.2 years. The average weight was 23±9 kg, and the predominant condition of acute abdomen was acute. The upper gastrointestinal perforations and acute intussusceptions with intestinal necrosis, intestinal volvulus, Meckel's diverticulums, necrotizing enterocolitis, and Hirschsprung disease were reported. In addition, perforation and ingested foreign body case were reported. There were males and females in the control group, aged 3-9 years weighing 13-30 kg and suffering from acute gangrene. Perforated appendicitis in cases, upper gastrointestinal perforation acute intussusception with intestinal necrosis, volvulus , Meckel's diverticulum, necrotizing enterocolitis, Hirschsprung's disease with perforation, and accidental swallowing of foreign body/perforation. To assess stress indicators between two groups of children (Control and Observation), Table 1 presents mean values (x¯) and standard deviations (± s) before, on the first day, and five days following surgery. Data show considerable postoperative stress changes. Endothelin-1 levels in the control group rose from 86±7 preoperative to 131±11 (day 1) and subsequently dropped to 64±5 (day 5). ACTH levels rose from 55±8 to 74±14 on day 1 and subsequently dropped to 42±5 on day 5. Cortisol levels rose from 256±31 to 653±73 on day 1 and dropped to 200±26 on day 5. The observation group showed similar results, showing that surgery affected stress markers in both groups.

Table 1: Comparison of stress indicators between the two groups of children before surgery, on the 1st day after surgery, and on the)5th day after surgery (x¯ ± s)

GROUP	Endothelin-1 (pg/mL)			ACTH (pg/mL)			Cortisol (ng/mL)		
	Preoperative	Day 1 post surgery	Day 5 post surgery	Preoperative	Day 1 post surgery	Day 5 post surgery	Preoperative	Day 1 post surgery	Day 5 post surgery
Control group (n=40)	86±7	131±11	64±5	55±8	74±14	42±5	256±31	653±73	200±26
Observation group (n=40)	85±8	102±11	41±6	54±8	63±12	31±4	256±30	324±45	164±24

ACTH, Adrenocorticotropic Hormone

Table 2 compares gastrointestinal hormone levels in children (Control and Observation) before and after surgery, using mean values (x¯) and standard deviations (± s, ng/mL). Control group motilin and gastrin levels substantially rose from preoperative to postoperative day 5 (84±8 to 105±11 and 249.4±22.3 to 273.5±20.4, respectively) with t values of -14.67 and -6.794, suggesting significant differences ($p < 0.001$). In the observation group, motilin and gastrin levels increased significantly (84±5 to 126±13 and 249.3±22.1 to 297.6±24.5, respectively) with t values of 0.01 and -12.767, both highly significant ($p < 0.001$). Postoperative gastrointestinal hormone levels changed significantly in both groups.

Table 2: Comparison of gastrointestinal hormone levels between the two groups of children before surgery and on the 5th day after surgery ($\bar{x}$ ± s ,ng/mL)

GROUP	N	Motilin				Gastrin			
		Preoperative	Day 5 after surgery	t-value	P value	Preoperative	Day 5 after surgery	t value	P value
Control group (n=40)	40	84±8	105±11	-14.67	<0.001	249.4±22.3	273.5±20.4	-6.794	<0.001
Observation group (n=40)	40	84±5	126±12	-12.59	<0.001	249.3±22.1	297.6±24.5	-12.767	<0.001
t value		0.114	-8.918			0.01	-5.19		
P value		0.908	<0.001			0.732	<0.001		

Table 3 displays postoperative recovery conditions for children in the Control and Observation groups, including mean values ($\bar{x}$) and standard deviations (± s). Data demonstrate substantial group differences in numerous parameters. The observation group recovered quicker than the control group, with a shorter time to first anal exhaust (26±6 hours) and bowel sound recovery (21±5 hours) compared to 38±5 and 30±6 hours, respectively. The observation group had considerably shorter first bowel movement time, 24-hour gastrointestinal decompression quantity, bad abdominal circumference, and duration of stay. All metrics show statistical significance ($p < 0.002$), indicating positive surgical outcomes in the observation group.

Table 3: Comparison of postoperative recovery conditions between the two groups of children ($\bar{x}$ ± s)

Group	Time of first anal exhaust (h)	Bowel sound recovery time (h) First bowel move	First bowel movement time (h)	24 h gastrointestinal decompression amount (mL)	Poor abdominal circumference (cm)	length of stay (d)
Control group (n=40)	38±5	30±6	4.1±1.2	76±18	3.09±0.63	11.6±3.2
Observation group (n=40)	26±6	21±5	2.5±1.1	57±11	2.08±0.20	6.2±2.8
t value	12.357	4.665	4.665	4.768	11.248	7.23
P-value	0.002	0.002	0.002	0.002	0.002	0.002

Table 4 compares post-surgery complications in Control and Observation children with frequencies and percentages. Both groups had no abdominal residual abscesses. No significant difference ($p = 1.002$) was seen between 3 (6%) control and 2 (4%) observation group instances of inflammatory bowel obstruction. The control group (14%) had more incision infections than the observation group (6%), although the difference was not significant ($p = 0.268$). Incisional hernias and adhesion intestinal blockages were noticed, but none occurred in observations. Complications were 26% in the control group and 8% in the observation group ($p = 0.013$).

Table 4: Comparison of complications between the two groups of children after surgery [n (%)]

Group	Abdominal residual abscess	Inflammatory bowel obstruction	Incision infection	Incisional hernia	Adhesive intestinal obstruction	Overall incidence
Control group (n=40)	0(0)	3(6)	7(14)	2(4)	4(8)	13(26
Observation group (n=40)	0(0)	2(4)	3(6)	0(0)	0(0)	4(8)
χ2 value	-	2.365	1.22	-*	1.376	7.332
P-value	-	1.002	0.268	1.002	0.242	0.013

Discussion

Somatostatin, a peptide renowned for its role in suppressing both pancreatic exocrine and endocrine secretions, encounters limitations due to its brief duration in the body, mandating continuous intravenous infusion for therapeutic use [17,18]. However, octreotide, a synthetic counterpart derived from somatostatin, presents an extended action span and offers the convenience of subcutaneous administration. This analogue not only curbs gastrointestinal and pancreatic secretions but also diminishes splanchnic blood flow. Moreover, octreotide displays a spectrum of effects, from altering gastric emptying—potentially speeding up or delaying the process—to protracting transit time, predominantly at moderate to higher doses. Interestingly, at lower doses, it exhibits the contrary by stimulating motility while impeding gall bladder emptying [19].

A study by Qi et al. (2022) examining 102 children undergoing surgery due to acute abdomen, a study at Xuzhou Children's Hospital from August 2019 to June 2021 delved into the impact of somatostatin on postoperative gastrointestinal function and stress levels. The cohort, evenly split into an observation and control group, witnessed the observation group receiving somatostatin in addition to routine therapy, while the control group received standard postoperative care. Pre-surgery and postoperative (at days 1 and 5) blood samples from both groups were analyzed for endothelin-1 (ET-1), adrenocorticotropic hormone (ACTH), cortisol, gastrin, and motilin levels. Compared to the control group, the observation group displayed notably reduced ET-1, ACTH, and cortisol levels at days 1 and 5 post-surgery, coupled with increased motilin and gastrin levels at day 5. This group also exhibited quicker recovery markers, such as time to first passage of flatus, bowel sounds, and defecation post-surgery, alongside a shorter hospital stay. Additionally, the observation group manifested a significantly lower complication rate compared to the control group (6% vs. 24%). In essence, the study underscores somatostatin's potential to diminish postoperative stress response, enhance gastrointestinal function, and curtail complication ratesS in pediatric acute abdomen cases [18-20].

Somatostatin, a natural peptide, holds multifaceted potential in managing diverse gastrointestinal ailments by leveraging its varied biological actions. It boasts capabilities in assuaging abdominal discomfort, curtailing hemorrhage, minimizing bowel secretions, and potentially stabilizing hemodynamics in particular conditions. Primarily, its capacity to inhibit pancreatic secretions plays a pivotal role in reducing bowel secretions and, consequently, assuaging abdominal pain [16,18]. Additionally, somatostatin's influence on splanchnic hemodynamics aids in controlling hemorrhage and stabilizing blood flow. By elevating lower esophageal sphincter pressure, it mitigates the influx of blood into the esophageal varices, contributing to hemodynamic stability. Furthermore, its regulatory impact on various hormonal secretions, such as growth hormone and prolactin, has far-reaching implications for the body's physiological balance [18,19]. Its profound impact on splanchnic hemodynamics offers potential in managing hemorrhage and stabilizing circulatory dynamics in specific conditions. Notably, it exhibits remarkable efficacy in assuaging abdominal pain, particularly in patients grappling with severe chronic pancreatitis that has proven refractory to conventional therapies [20]. Additionally, its inhibitory prowess over both endocrine and exocrine secretions of the pancreas serves as a crucial mechanism for regulating bowel secretions. This inhibition of acid-peptic and pancreatic secretions proves advantageous, especially in scenarios involving upper gastrointestinal bleeding and surgical pancreas conditions. Though the precise modes of somatostatin's action remain elusive, hypotheses suggest its potential suppression of insulin-like growth factor 1 (IGF-1) activity, inhibition of cytokine release from T-lymphocytes, and interaction with specific cell surface receptors as potential underlying mechanisms [21-23].

Somatostatin and its analogs, particularly octreotide, exhibit promising benefits in managing conditions associated with acute abdomen in pediatric patients. For instance, somatostatin's role in postoperative ascites management following hepatectomy for hepatocellular carcinoma involves reducing portal pressure, potentially averting complications leading to acute abdomen scenarios. Moreover, octreotide's demonstrated efficacy in diminishing nausea and vomiting in bowel-obstructed patients holds promise in alleviating symptoms pertinent to acute abdomen cases. These attributes underscore the potential utility of somatostatin and its analogs in ameliorating acute abdomen-related complications and symptoms among pediatric patients [24,25].

Octreotide, an analog of somatostatin, has been applied in pediatric patients to address various conditions like gastrointestinal bleeding and pancreatitis. The therapeutic effects and clinical progression of these patients receiving octreotide through continuous intravenous infusion or intermittent bolus dosing were thoroughly assessed. Its extended-release variant, Octreotide LAR, is generally well-tolerated, yet some primary adverse effects include diarrhea and the formation of gallstones. While disturbances in glucose regulation were observed as a regular occurrence, their predictability remained uncertain. Patients also reported general side effects like headaches, abdominal discomfort, or fatigue. These insights into octreotide's usage highlight its potential in managing acute abdomen in pediatric patients, albeit considering associated adverse effects [26,27].

Studies exploring the efficacy of somatostatin and octreotide in pediatric acute abdomen cases such as chylothorax treatment highlight promising outcomes but also underscore certain limitations. In the reviewed cases, both somatostatin and octreotide demonstrated positive treatment effects in managing chylothorax [19,20]. However, the observed minor side effects, such as cutaneous flush, nausea, loose stools, transient hypothyroidism, elevated liver function tests, and even serious complications like strangulation-ileus, necrotizing enterocolitis, or temporary hyperglycemia, warrant cautious consideration [22-25]. These findings suggest the necessity for careful patient selection and monitoring, especially in individuals at higher risk of vascular compromise. Importantly, the absence of a widely accepted treatment protocol for somatostatin use in pediatric patients emphasizes the urgent need for systematic clinical research. Developing a comprehensive understanding of its efficacy, optimal dosing, and safety profile is imperative for establishing a secure and effective treatment strategy for acute abdomen conditions in pediatric settings [25,27, 28].

Future investigations into somatostatin's application in pediatric acute abdomen could concentrate on optimizing dosages and administration schedules to enhance therapeutic benefits while mitigating adverse effects. Exploring the long-term safety profile of somatostatin in managing acute abdomen in children is crucial. Additionally, studying its efficacy across various acute abdomen conditions could unveil potential variations in effectiveness. Comparative analyses with alternative treatments would provide comprehensive insights. Delving into the mechanisms underlying somatostatin's ability to mitigate postoperative stress and enhance gastrointestinal function is essential. Moreover, assessing its role in reducing post-surgery complications in pediatric acute abdomen cases could further validate its clinical utility and safety. These research avenues collectively aim to enhance our understanding and refine the utilization of somatostatin in pediatric acute abdomen management [20].

Conclusion

The study has concluded that somatostatin has the ability to effectively decrease the stress response after surgery, enhance gastrointestinal function, lower the occurrence of problems, and enhance the prognosis of children who have acute abdominal surgery. The study on the efficacy of somatostatin in pediatric acute abdominal cases provides valuable insights, yet certain research gaps necessitate further exploration. The investigation primarily focuses on clinical outcomes and the effectiveness of somatostatin without delving into the underlying mechanisms of its action. Future research avenues could include in-depth mechanistic studies to elucidate the molecular pathways through which somatostatin influences gastrointestinal function. Additionally, the study spans a relatively short duration, highlighting the need for long-term follow-up data to assess the sustained effects of somatostatin and the potential recurrence of symptoms. Exploring the impact of somatostatin on specific acute abdominal conditions and patient profiles could enhance the understanding of its varied efficacy. Future prospects include diverse patient population inclusion, comparative effectiveness studies with other therapeutic interventions, and a thorough exploration of potential adverse effects to ensure a comprehensive risk-benefit assessment. Addressing these gaps and considering future prospects will contribute to a more nuanced comprehension of somatostatin's role, ultimately improving treatment strategies and patient outcomes in pediatric acute abdominal cases.

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