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Effect of Perioperative Allogeneic Blood Transfusion in Causing Surgical Site Infection in Elective Gastrointestinal Surgeries: A Comparative Study among the Pediatric Population in A Tertiary Care Hospital of Bangladesh

Dr. Mithun Kumar Sarker[1*], Dr. Abdul Hanif Tablu[2], Dr. Kaniz Hasina Sheuli[3], Dr. Jaglul Gaffer Khan[4], Dr. Partha Sarathy Majumder[5], Dr. Md. Hasanuzzaman[6], Dr. Ashfaque Nabi[7], Dr. Md. Asif Iqbal[8], Dr. Md. Masud Rana[9]

[1]MS (Pediatric Surgery), Medical Officer, Sadar Upazilla Health Office, Mymensingh, Bangladesh
[2]Professor and Head, Department of Neonatal Surgery, Dhaka Medical College Hospital, Dhaka, Bangladesh
[3]Professor and Head, Department of Pediatric Surgical Oncology, Dhaka Medical College Hospital, Dhaka, Bangladesh
[4]Associate Professor, Department of Neonatal Surgery, Dhaka Medical College Hospital, Dhaka, Bangladesh
[5]Associate Professor, Department of Pediatric Surgical Oncology, Dhaka Medical College Hospital, Bangladesh
[6]Assistant Professor, Department of Pediatric Surgery, Dhaka Medical College Hospital, Dhaka, Bangladesh
[7]Assistant Professor, Department of Neonatal Surgery, Dhaka Medical College Hospital, Dhaka, Bangladesh
[8]Resident Surgeon, Department of Pediatric Surgery, Institute of Child and Mother Health (ICMH), Matuail, Dhaka, Bangladesh
[9]MS (Pediatric Surgery), Upazila Health and Family Planning Officer, Patharghata, Barguna, Bangladesh

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***Corresponding author:** Dr. Mithun Kumar Sarker
MS (Pediatric Surgery), Medical Officer, Sadar Upazilla Health Office, Mymensingh, Bangladesh
Email: dr.mithunsarker87@gmail.com

Abstract | **Original Research Article**

Background: Allogeneic blood transfusion (ABT) has been reported as a major risk factor for surgical site infection (SSI) in patients undergoing elective gastrointestinal surgery. ***Objective:*** To find out whether perioperative allogeneic blood transfusion is a significant risk factor for surgical site infection in children undergoing elective gastrointestinal surgery. ***Methods:*** This prospective observational study was carried out at the Department of Pediatric Surgery in Dhaka Medical College Hospital, Dhaka, from January, 2021, to June, 2022, for a period of 18 months. According to CDC standards, patients who underwent elective gastrointestinal surgical procedure or clean-contaminated surgical wound (class II) were chosen as the study population. Total 256 patients were divided into two groups according to the blood transfusion as transfused and non-transfused group. Preoperative and postoperative day 1 CBC were done to observe the lymphocyte count. Blood transfusions were recorded during the perioperative period. After surgery, patients were followed up to check for surgical site infection and anastomotic leakage. Pus or wound swab for C/S was done in all the patients who developed SSI. The duration of the hospital stay after surgery was also noted. ***Results:*** Most of the study subjects in both the groups were ≤5 years($p=0.095$). Males were predominant than females in both groups ($p=0.014$). Infection was found significantly higher among the transfused group (34.6%) than non-transfused group (14.6%) ($p=0.001$). In both the groups common infection was superficial SSI (12.0% in transfused group and 6.5% in non-transfused group). Among the infections, bacterial growth was 39.1% in Group A and 38.9% in Group B ($p>0.786$). Postoperative duration of hospital stay was 10.56 ± 4.05 days and 8.47 ± 2.67 days in Group A and Group B respectively ($p<0.001$). Mean lymphocyte count in Group A and group B was (2353.9±1647.7 vs 3792.5±1455.9; $p<0.001$). ***Conclusion:*** Allogeneic blood transfusion increases the risk of surgical site infection (SSI), wound dehiscence, and anastomotic leakage in children undergoing elective gastrointestinal surgical procedures, leading to longer hospital stays and higher healthcare costs.

Keywords: Allogeneic blood transfusion, SSI, Elective gastrointestinal surgery.

INTRODUCTION

Transfusion of blood and blood products saves lives and allows for sophisticated surgical treatment to be possible when needed [1]. Acute blood loss to replenish circulating blood volume and sustain oxygen delivery, perioperative anemia to ensure oxygen delivery during surgery and symptomatic chronic anemia are the primary goals of perioperative blood transfusion [2]. Although a blood transfusion can restore blood Hb levels back to normal, it can also raise the risk of surgical site infection [3]. Many studies have found an association between transfusion and an increased risk of postoperative surgical site infection. This association has been related to a number of surgical procedures, including colorectal, general abdominal, orthopedics, trauma, and cardiovascular surgery [4]. Perioperative allogeneic blood transfusion is briefly addressed as a possible risk factor in the CDC guidelines for the prevention of surgical site infection [5]. Allogeneic blood transfusion has a negative impact on the immune system because it increases inflammation and immunosuppression. Transfusion of allogeneic blood products exposes recipients to high levels of foreign antigen (alloantigen) in both soluble and cell-associated forms [6]. The presence of these alloantigens in the circulation can result in a range of immunological responses, including alloimmunization and immunoregulatory downregulation. This is known as transfusion-related immunomodulation, or TRIM [7]. Finally, transfused RBC raises serum iron levels, which promotes bacterial growth and increases the patient's infection rate [3]. Several studies, however, have shown a postoperative increase in peripheral blood IL-4 and IL-10 concentrations in patients who receive transfusions. IL-10 is thought to have an immunosuppressive effect on lymphocytes and to reduce lymphocyte production. The CDC classified wound as Clean (no viscus opened) or Class I, Clean- contaminated (viscus opened, limited spillage) or Class II, Contaminated (open viscus with spillage or inflammatory illness) or Class III, and Dirty (Pus or perforation or incision into an abscess) or Class IV. In terms of wound contamination, surgical site infection (SSI) rates (with antibiotic prophylaxis) in these classes are as follows: clean (Class I) = 1% to 2%, clean contaminated (Class II) = 3%, contaminated (Class III) = 6%, and dirty (Class IV) = 7%. [8]. Blood transfusion raises the risk of SSI by 2-3 times when compared to patients who did not get blood transfusion during the perioperative phase. Patients who receive allogeneic blood transfusions may have Anastomotic leakage [3]. In our country we often practice perioperative blood transfusion frequently. Since there isn't a similar study in our country, this study was made to look at the surgical site infection and wound-related complication rate of elective gastrointestinal surgery or class II wounds in both the transfused and non-transfused groups and find out if there is an association between perioperative allogeneic blood transfusion and surgical site infection.

OBJECTIVES

General Objective

General objective of this study was to find out whether perioperative allogeneic blood transfusion is a significant risk factor for surgical site infection in children undergoing elective gastrointestinal surgery.

Specific Objective

- To observe the rate of surgical site infection in both transfused and non- transfused group
- To observe the rate of wound dehiscence in both transfused and non-transfused group
- To observe the rate of anastomotic leakage in both transfused and non- transfused group
- To observe the postoperative duration of hospital, stay in both transfused and non-transfused group
- To observe the preoperative and postoperative day 1 lymphocyte count in both transfused and non-transfused group

METHODOLOGY

This was a prospective observational analytical study. The patients were selected purposively. A total of 256 patients were included in this study- group A and group B, 133 patients were taken in group A who received perioperative allogeneic blood transfusion and 123 Patient in group B who did not receive perioperative allogeneic blood transfusion. The study was conducted in the Department of Pediatric Surgery, Dhaka Medical College Hospital. Dhaka Bangladesh. At January, 2021 to June, 2022 for a period of 18 months.

Inclusion Criteria

- Pediatric population age between one month to 12 years
- Those who are undergoing elective gastrointestinal surgery or clean- contaminated surgery (class II) according to CDC criteria

Exclusion criteria

- All immunocompromised patients
- Patient suffering from malignancy
- Patient receiving steroid or cytotoxic drug
- Malnutrition (Measured by growth chart, BMI and MUAC according to age and sex)
- Emergency procedure
- Accidental gross spillage or contamination of operative field.

Data Collection Technique

A performed data collection sheet was used to collect the data. Relevant socio- demographic information was gathered and documented, along with preoperative and postoperative day 1 lymphocyte counts; wound dehiscence; anastomotic leakage; culture and sensitivity of wound swab or pus; and surgical site infection (SSI).

Statistical Analysis

Data were collected, compiled and tabulated according to key variables and functional assessment scoring. The analysis of different variable was done according to standard statistical analysis. Qualitative data was expressed as frequency with percentage and quantitative data was expressed as mean with standard deviation. Quantitative data was analyzed by student t-test and qualitative data by Chi-square test. For all analysis level of significance was set at 0.05 and p-value

<0.05 was considered as significant. Statistical Package for Social Science (SPSS) 23 was used for data analysis.

Ethical Consideration

The research protocol was approved by the DMCH Ethical Review Committee (ERC) prior to the start of this investigation. Informed written consent was obtained from each patient's parents or legal guardians after they had been informed of the study's aims and objectives, protocol, techniques, risks, and benefits in a language that could be easily understood. All data and records were guaranteed to be kept in strict confidence, and the process helped both patients and doctors manage cases in a logical way.

Study Procedure

The study was conducted at the Department of Pediatric Surgery, Dhaka Medical College Hospital, Dhaka from January, 2021 to June, 2022. Ethical clearance was obtained from the Ethical Review Committee (ERC) of Dhaka Medical College. All the patients scheduled for elective gastrointestinal surgery or clean-contaminated surgery (class II) according to CDC criteria in the Department of Pediatric Surgery, DMCH, were considered as the study population. The subjects were selected on the basis of selection criteria. After selection of the subjects, the nature, purpose, and benefits of the study were explained to parents of each patient in detail. They were encouraged to voluntarily participate. Informed written consent was obtained from the participants. They were allowed to withdraw their names from the study whenever they wanted. Before surgery, all the patients were assessed by a detailed history, clinical examination, and investigation. All patients were investigated for routine hematological and other related imaging investigations to confirm the diagnosis. Preoperative Complete blood counts were done to observe lymphocyte counts in all the patients undergoing surgery according to selection criteria. Intraoperative blood transfusions were recorded during the perioperative phase, and complete blood counts were performed on both groups, and first postoperative day lymphocyte counts were recorded. Following surgery, patients were monitored to see if surgical site infection or anastomotic leakage had developed. Pus or wound swab for C/S was done in all the patients who developed SSI. A postoperative hospital stay was also recorded. Patients were divided into two groups according to perioperative transfusion.

RESULTS

This prospective observational comparative study was carried out to find out whether perioperative allogeneic blood transfusion is a significant risk factor for surgical site infection in children undergoing elective gastrointestinal surgery. The results are as follows:

Table I: Demographic profile of the study subjects (N=256)

Demographic profile	Group A (n=133)	Group B (n=123)	p-value
Age (years)			
≤5 Yrs.	107(80.5)	88(71.5)	0.095
>5 Yrs.	26(19.5)	35(28.5)	
Mean ± SD	3.77 ± 2.75	3.95 ± 2.93	
Gender			
Male	85(63.9)	96(78.0)	0.014
Female	48(36.1)	27(22.0)	

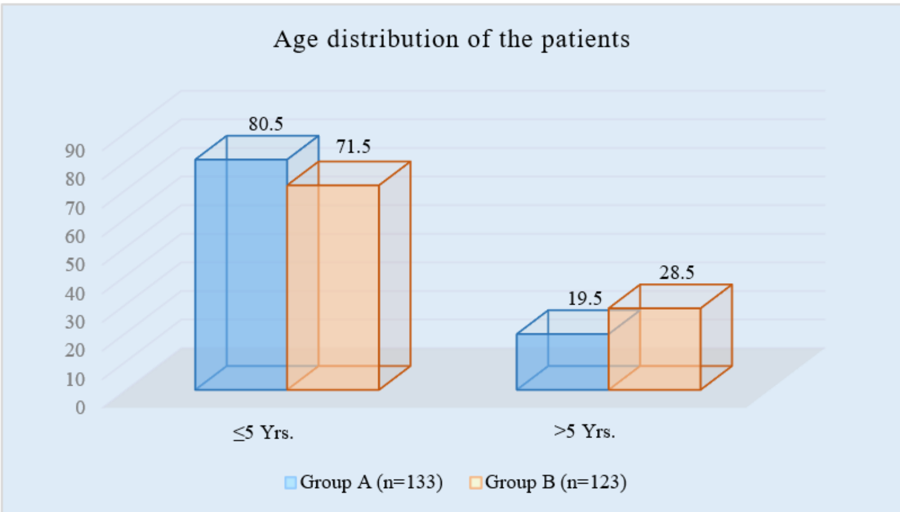

Figure 1: Column chart showed age wise patients in two group (N=256)

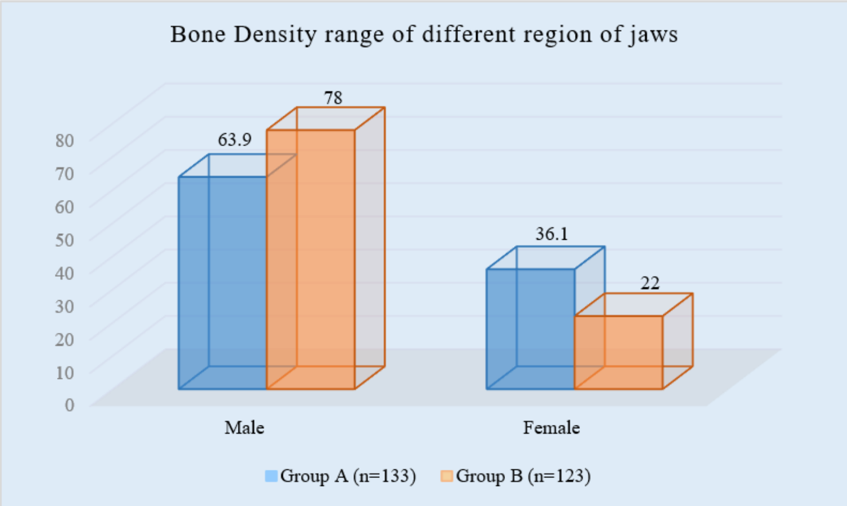

Figure 2: Column chart showed gender wise patients in two group (N=256)

Table II: Procedure done for the study subjects (N=256)

Procedure	Group A (n=133)	Group B (n=123)	p-value
			0.888
Abdominoperineal pull-through	43(32.3)	39(31.7)	
Intestinal stoma closure	59(44.4)	51(41.5)	
PSARP	24(18.0)	24(19.5)	
Ladd's procedure	7(5.3)	9(7.3)	

Table III: Post-operative infection of the study subjects (N=256)

Post-operative infection	Group A (n=133)	Group B (n=123)	p-value
No infection	87(65.4)	105(85.4)	0.001
Infection	46(34.6)	18(14.6)	
Superficial SSI	16(12.0)	8(6.5)	
Deep SSI	7(5.3)	3(2.4)	
Organ/Space	6(4.5)	1(0.8)	
Superficial wound dehiscence	5(3.8)	2(1.6)	
Complete wound dehiscence	6(4.5)	3(2.4)	
Anastomotic leakage	6(4.5)	1(0.8)	

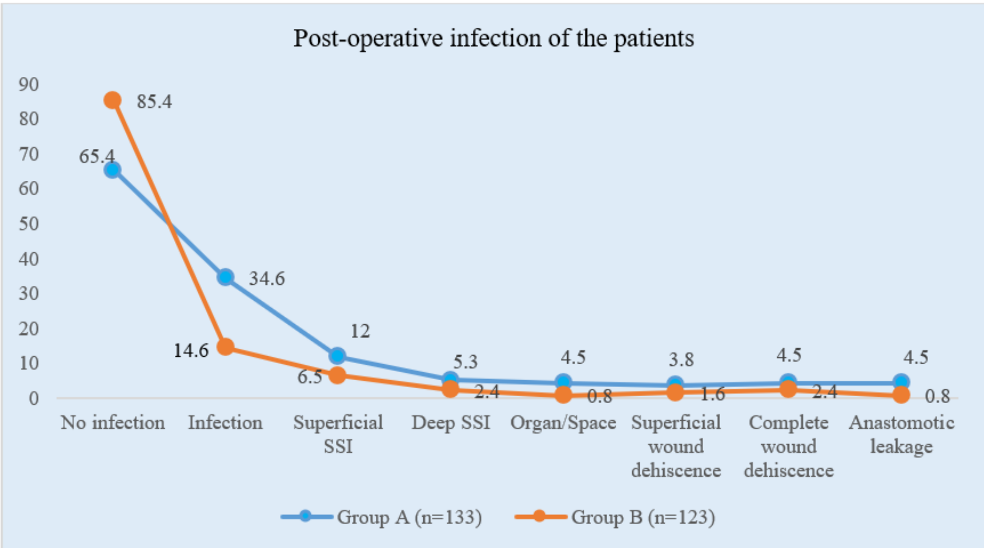

Figure 3: Line chart showed post-operative infection among patients in two group (N=256)

Table IV: Bacterial growth in infection of the study subjects (N=256)

Post-operative infection	Group A (n=46)	Group B (n=18)	p-value
No growth	28(60.9)	11(61.1)	0.786
Growth	18(39.1)	7(38.9)	
E. Coli	9(50.0)	2(28.6)	
Pseudomonas	5(27.8)	4(57.1)	
Klebsiella	4(22.2)	0(0.0)	
Staphylococcus	0(0.0)	1(14.3)	

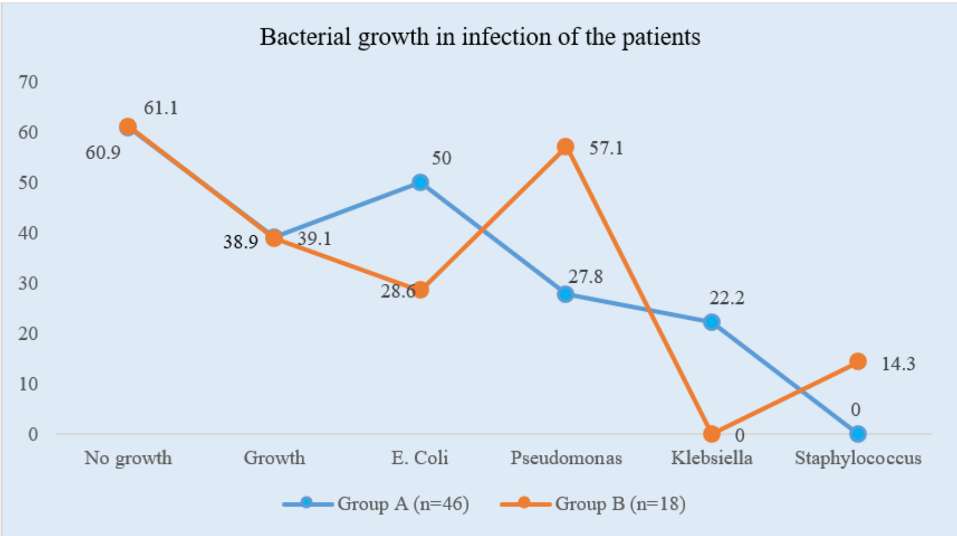

Figure 4: Line chart showed bacterial growth in infection among patients in two group (N=256)

Table V: Post-operative duration of hospital stay (N=256)

	Group A (n=133)	Group B (n=123)	p-value
Postoperative duration of hospital stay	10.56 ± 4.05	8.47 ± 2.67	<0.001

Table VI: Pre and post-operative lymphocyte count (N=256)

Lymphocyte count	Group A (n=133)	Group B (n=123)	p-value (unpaired t test)
Pre-operative	4565.9±1420.4	4353.5±1504.1	0.104
Postoperative	2353.9±1647.7	3792.5±1455.9	<0.001
p-value (paired t test)	<0.001	<0.001	

DISCUSSION

In this study, most of the study subjects in both groups were ≤5 years. 80.5% of the children in blood transfused group and 71.5% in the non-transfused group were ≤5 years. Younger children were required more transfusion than older children. Mean age of the study subjects were 3.77 ± 2.75 years and 3.95 ± 2.93 years respectively. No significant difference existed between the two groups. Males dominated over females in both groups. Significantly more females required transfusions than males. Similar results were reported in the study conducted by Fawley *et al.*, (2018) [9]. Infection was observed to be considerably greater in the transfused group than in the non-transfused group (p = 0.001): 34.6% in the transfused group versus 14.6% in the non-transfused group. In transfused group, most common infection was superficial SSI (12.0%) followed by deep SSI (5.3%), organ/space (4.5%), anastomotic leakage (4.5%), complete wound dehiscence (4.5%) and superficial wound dehiscence (3.8%). In non-transfused group, most prominent infection was superficial SSI (6.5%) followed by deep SSI (2.4%), complete wound dehiscence (2.4%), superficial wound dehiscence (1.6%), anastomotic leakage (0.8%) and organ/space (0.8%). The most prevalent infection in the studies conducted by Fawley *et al.*, (2015) [10] and Fawley *et al.*, (2018) [9] was a superficial SSI, and the total number of infections was significantly greater in the transfused group than in the non-transfused group. Intraoperative transfusion was an independent predictive factor for SSI after APR [11]. Patients who received blood transfusions (BT) had an increased risk of developing post-operative infectious sequelae, such as superficial surgical site infections (SSI), deep SSI, and organ/space SSI [12]. Organ/space SSIs were the most common in patients who received perioperative blood transfusions described by Higgins *et al.*, (2019) [13]. Growth rates for the infections were 39.1% for Group A and 38.9% for Group B. In terms of bacterial infection, there was no discernible difference between the two groups. E. Coli, Pseudomonas, Klebsiella, and S. Aureus were the most prevalent bacteria in both the transfused and non-transfused groups. A higher risk of postoperative bacterial infection is linked to transfusions as described by Hill *et al.*, (2003) [14]. The postoperative duration of hospital stay was significantly longer in the transfused group than in the non-transfused group in this study. The average length of hospital stay in Groups A and B was 10.56 ± 4.05 days and 8.47 ± 2.67 days, respectively. Children who had surgery and needed blood transfusions were more likely to get infections, which meant they had to stay in the hospital longer and cost the hospital more money. This study also focused on perioperative alterations of lymphocyte subsets to clarify the mechanism between perioperative allogeneic blood transfusion and postoperative SSI development. Non-transfused group had a significantly higher first postoperative day lymphocyte count than the patients who had received an intraoperative blood transfusion. Mean lymphocyte count in group A and group B (2353.9±1647.7 vs 3792.5±1455.9; $p<0.001$) respectively possibly due to the effect of TRIM as described by Aguilar-Nascimentoa *et al.*, (2020) [15]. A similar finding was observed in the study of Kaneko *et al.*, (2015) [11] after APR and TPE, where the first–postoperative day lymphocyte count of patients undergoing APR, TPE, and transabdominal rectal resection was significantly higher in non–transfused patients compared with transfused ones.

LIMITATION

This was a single center study. Furthermore, this study was designed to observe the overall SSI rate in elective gastrointestinal surgical procedures or clean contaminated surgical wound according to CDC criteria in both the transfused and non-transfused groups, while the incidence of SSI differs depending on the type of surgery performed.

RECOMMENDATIONS

Large sample size from multiple institutions should be done because it is known that the rate of SSI varies a lot between institutions, which may be due to different causes.

CONCLUSION

Perioperative allogeneic blood transfusion increases the risk of surgical site infection (SSI), wound dehiscence, and anastomotic leakage in children undergoing elective gastrointestinal surgical procedures, leading to longer hospital stays and higher healthcare costs. Blood transfusions should be reserved for extreme cases, and mild anemia should be tolerated instead.

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