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Research Article

To compare the Outcome between Single Layer Extramucosal Continuous and Single Layer Extramucosal Interrupted Anastomosis in Small Intestine in Children

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Abstract

Background: *An intestinal anastomosis is frequently required to restore continuity of the gastrointestinal tract during abdominal surgery. Meticulous and effective anastomotic technique is necessary to optimize surgical outcome and minimize anastomotic complications.*

Objective: *To compare the outcome between single layer extramucosal continuous and single layer extramucosal interrupted anastomosis in small intestine in children.*

Methods: *This study was a prospective comparative interventional study conducted among 64 children aged between one day to five years, who underwent resection and anastomosis for small bowel obstruction and ileostomy closures at Bangladesh Institute of Child Health & Dhaka Shishu (children) hospital from March 2017 to September 2019. Children were purposively selected and randomly allocated in Group A (single layer extramucosal continuous anastomosis group) and Group B (single layer extramucosal interrupted anastomosis group). After operation, children were followed up for three months. Data were collected in a pre-designed, semi-structured questionnaire. Associations of continuous data were assessed using student's t-test while categorical data were assessed using Chi-square test and Fisher's exact test. For both test, p value <0.05 was considered significant.*

Results: *Age, sex, weight, primary diagnosis and area of anastomosis showed no significant statistical differences between two groups. In Group A, 35.5% children were within one month of age while in Group B, 24.2% children were within one month of age. A male predominance was observed. Resection and anastomosis was done in 18 (58.1%) and 16 (48.9%) children in Group A and Group B respectively as emergency procedure. The mean time of anastomosis was significantly less (9.16 ± 1.34 min) in Group A than Group B (15.24 ± 1.66 min) (p value <0.001). The cost of suture material was significantly less in Group A (383.55 ± 4.86 BDT) compared to Group B (764.85 ± 8.70 BDT) (p value <0.001). There was no statistical difference in developing anastomotic leakage, postoperative intestinal obstruction, wound infection, wound dehiscence, mortality between two groups as the p value >0.05.*

Conclusion: *Single layer extramucosal continuous anastomosis is less time consuming and also cost effective than single layer extramucosal interrupted anastomosis in small intestine in children.*

Introduction

An intestinal anastomosis is frequently required to restore continuity of the gastrointestinal tract during abdominal surgery. Meticulous and effective anastomotic technique is necessary to optimize surgical outcome and minimize anastomotic complications (Ross, et al., 2016). Integrity of the anastomosis depends upon several factors such as tension at the suture line (Steele, 1993), an adequate blood supply at the two ends of the intestine, a meticulously cleaned gut, attention to technique and choice of proper suture material (Mickley, et al., 1991; in Burch, et al., 2000). Under ideal conditions, healing at the anastomotic site occurs rapidly in the presence of adequate tissues perfusion and un-interrupted supply of collagens at the anastomosis site (Kulachek, et al., 1997; cited in Rajput, M.J, et al., 2009). The anastomotic technique depends upon the site of anastomosis, bowel caliber, and underlying disease process, but one of the important factors in making decision to perform a particular anastomosis is individual surgical experience and personal preference (Yeo, 2007, cited in Dandi, et al., 2015). Intestinal anastomosis after resection of bowel may be of various types and techniques. These are (a) conventional methods including sutured (single layer or double layer) and stapled and (b) unconventional methods including compression rings (BAR), tissue glue and laser welding (McKinley, et al., 2006).

Single layer technique has been proven superior to double layer method with respect to luminal reduction, tissue strangulation and strength of anastomosis (Matheson, et al., 1975). In single layer technique, employing extramucosal sutures allows for accurate apposition, incorporate the strongest layer (submucosa) of gut, causes minimal damage to submucosal vascular system and least disturbance to the lumen which is the most important determinant (Sarin and Lightwood, 1989; Leslie and Steele, 2003).

This is now an established fact that extramucosal single layer anastomosis can be done by two methods either continuous or interrupted techniques. Which one of these techniques is better than the other in children is yet to be determined. The single layer continuous anastomosis was first described by Hautefeuille as an innovative technique. Single layer continuous extramucosal technique is as safe as interrupted anastomosis but can be performed in shorter time and can be a cost-effective alternative for bowel anastomosis (Hussain, et al., 2015). Moreover, a continuous single layer extramucosal suture line resembles a circular coiled spring, which may be able to expand and contract depending on the intraluminal forces, which also explains why it is rare to have a bowel stenosis (Bailey, et al., 1984). Lastly, as it is an easy technique, it can be safely introduced into a surgical training programme without a painful learning curve (Saboo, et al., 2015; Burch, et al., 2000).

Material and Method

This study was a prospective comparative interventional study conducted among 64 children aged between one day to five years, who underwent resection and anastomosis for small bowel obstruction and ileostomy closures at Bangladesh Institute of Child Health & Dhaka Shishu (children) hospital from March 2017 to September 2019. Children were purposively selected and randomly allocated in Group A (single layer extramucosal continuous anastomosis group) and Group B (single layer extramucosal interrupted anastomosis group). After operation, children were followed up for three months. Data were collected in a pre-designed, semi-structured questionnaire. Associations of continuous data were assessed using student's t-test while categorical data were assessed using Chi-square test and Fisher's exact test. For both test, p value <0.05 was considered significant.

Results

Within this study period, 64 children had completed the follow up schedule. Hence, the result of 64 children (31 children in Group A and 33 children in Group B) were presented in this section.

Variable	Group A (n=31)	Group B (n=33)	value
Age			
Within 1 month	11 (35.5%)	8 (24.2%)	**0.711[a]**
More than 1 month to 6 months	13 (41.9%)	14 (42.4%)	
More than 6 months to 1 year	3 (9.7%)	6 (18.2%)	
More than 1 year	4 (12.9%)	5 (15.2%)	
Gender			
Male	16 (51.6%)	17 (51.5%)	**1.00[b]**
Female	15 (48.4%)	16 (48.5%)	

Table-1. Comparison of age and gender of the children between two groups (n=64)

a= Fisher's exact test, b= chi-square test

Group A: Single layer extramucosal continuous anastomosis

Group B: Single layer extramucosal interrupted anastomosis

Data are expressed as Frequency **(**percentage**)**

Table.1. shows that, there was no significant age difference between the groups as the p-value was >0.05. No significant sex difference was seen between the groups as the p-value was >0.05.

Gender	**Weight (in kg)**	**p value**
	Mean ± SD	
Male (n=33)	6.11 ± 3.33	**0.765***
Female (n=31)	5.82 ± 4.49	

* =Student t test

Table. 2. Comparison of weight according to gender in two groups **(**n=64**)**

Table. 2. shows that the mean weight of male children was 6.11 ± 3.33 kg while the mean weight of female 5.82 ± 4.49 kg. There was no statistical difference between male and female regarding weight.

Type of operation	**Indication of anastomosis**	**Group A (n=31)**	**Group B (n=33)**
Emergency procedure (n=34)	Jejunoileal atresia		
	Type II	2 **(**6.4%**)**	3 **(**9.1%**)**
	Type III a	2 **(**6.4%**)**	1 **(**3.0%**)**
	Type III b	2 **(**6.4%**)**	1 **(**3.0%**)**
	Intussusception	3 **(**9.7%**)**	6 **(**18.2%**)**
	Midgut volvulus	5 **(**16.1%**)**	3 **(**9.1%**)**
	Mesenteric cyst	2 **(**6.4%**)**	0 **(**0.0%**)**

	Meckel's diverticulum	2 (6.4%)	2 (6.1%)
Total		**18 (57.8%)**	**16 (48.9%)**
Elective procedure (n=30)	Ileostomy for meconium ileus	12 (38.7%)	13 (39.4%)
	Ileostomy for Intussusception	1 (3.2%)	4 (12.1%)
Total		**13 (41.9%)**	**17 (51.5%)**

Table. 3. Comparison of type and indication of anastomosis between two groups (n=64)

Group A: Single layer extramucosal continuous anastomosis

Group B: Single layer extramucosal interrupted anastomosis

Data are expressed as Frequency (percentage)

Table-4.3. shows that in Group A, 18 (57.8%) children underwent emergency resection & anastomosis and 13 (41.9%) children underwent ileostomy closure as elective procedure. In Group B, 16 (48.9%) children underwent resection & anastomosis as emergency and 17 (51.5%) children underwent ileostomy closure as elective procedure.

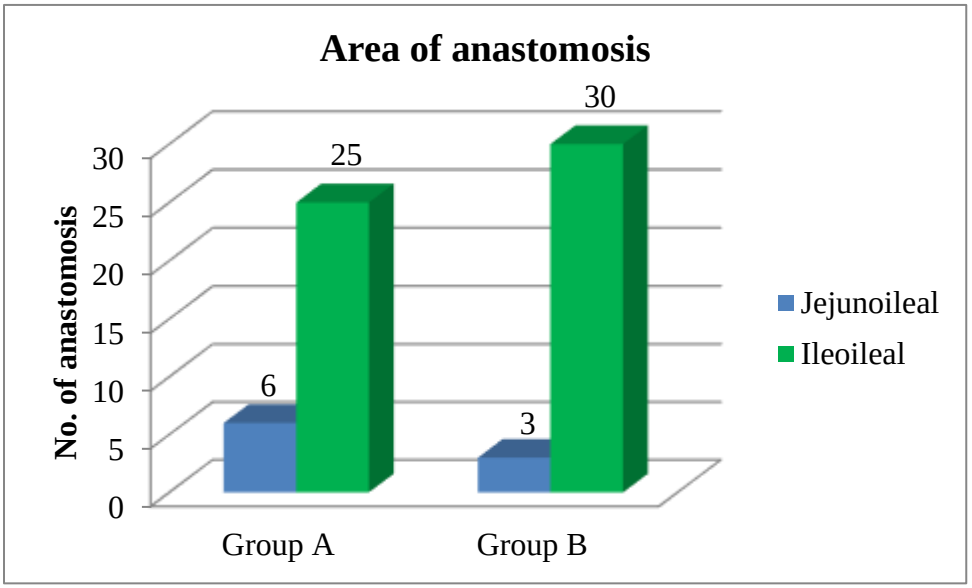

Figure.1. Distribution of area of anastomosis between two groups (n=64)

Group A: Single layer extramucosal continuous anastomosis **(**n=31**)**

Group B: Single layer extramucosal interrupted anastomosis **(**n=33**)**

Figure-.1. shows that in Group A, 6 **(**19.4%**)** had jejunoileal anastomosis and 25 **(**80.6%**)** had ileoileal anastomosis. In Group B, 3 **(**9.1%**)** had jejunoileal anastomosis and 30 **(**90.9%**)** had ileoileal anastomosis. The result showed that there was no statistical difference in area of anastomosis between two groups as the p=0.296 **(**obtained from Fisher's exact test**)**.

	Group A (n=31)	**Group B (n=33)**	**p value**
Time of anastomosis (min) Mean ± SD	9.16 ±1.34	15.24 ±1.66	<0.001*

* = Student's t test

Group A: Single layer extramucosal continuous anastomosis

Group B: Single layer extramucosal interrupted anastomosis

Table.4. Comparison of time of anastomosis between two groups **(**n=64**)**

Table.4. shows that, in Group A, the mean time of anastomosis was 9.16 **(**±1.34**)** minutes. In Group B, the mean time of anastomosis was 15.24 **(**±1.66**)** minutes. There was highly significant statistical difference between time of anastomosis of two groups as the p <0.001 **(**obtained by Student's t test**)**.

Complication	**Group A (n=31)**	**Group B (n=33)**	**value**
Anastomotic leakage			
Present	3 **(**9.7%**)**	2 **(**6.1%**)**	0.667*
Absent	28 **(**90.3%**)**	31 **(**93.9%**)**	
Wound infection			
Present	4 **(**12.9%**)**	5 **(**15.2%**)**	1.000*

Absent	27 (87.1%)	28 (84.8%)	
Wound dehiscence			
Present	1 (3.2%)	0 (0.0%)	1.000*
Absent	30 (96.8%)	33 (100.0%)	

* = Fisher's exact test

Table.5. Comparison of complications of anastomosis between two groups (n=64)

Table.5. shows that there was no statistical difference in developing anastomotic leakage between the groups as the p-value =0.667. No significant wound infection was seen between the groups as the p-value =1.000. No significant wound dehiscence was seen between the groups as the p-value =1.000.

Complication	Procedure	Group A	Group B	Total
Anastomotic leakage (n=4)	Emergency	3 (100%)	2 (100%)	5 (100.0%)
	Elective	0 (0.0%)	0 (0.0%)	0 (0.0%)
Wound infection (n=9)	Emergency	2 (40.0%)	3 (60.0%)	5 (100.0%)
	Elective	2 (50.0%)	2 (50.0%)	4 (100.0%)

Group A: Single layer extramucosal continuous anastomosis

Group B: Single layer extramucosal interrupted anastomosis

Table.6. Comparison of anastomotic leakage & wound infection by emergency and elective procedure between two groups

Table.6. shows that two children of emergency procedure in Group A and B had anastomotic leakage while no patient of elective procedure in Group A and B had anastomotic leakage. Two children of emergency procedure in Group A and B had wound infection while three children of emergency procedure in Group A and two children in B had wound infection.

Mortality	Group A (n=31)	Group B (n=33)	value
Present	1 (3.2%)	1 (3.0%)	.000*
Absent	30 (96.8%)	32 (97.0%)	
Total	31 (100.0%)	33 (100.0%)	

*= Fisher's Exact Test

Group A: Single layer extramucosal continuous anastomosis

Group B: Single layer extramucosal interrupted anastomosis

Data are expressed as Frequency (percentage)

Table.7. Comparison of mortality between two groups (n=64)

Table.7. shows that in both groups, only one patient died. The result showed that there was no statistical difference regarding mortality between two groups as the p=1.000 (obtained from Fisher's Exact Test).

Type of suture material	Cost (BDT)	
	Group A (n=31)	Group B (n=33)
4/0 vicryl round body	380	760
5/0 vicryl round body	390	780

Group A: Single layer extramucosal continuous anastomosis

Group B: Single layer extramucosal interrupted anastomosis

Table.8. Cost of suture material requiring anastomosis in two groups (n=64)

Table.8. shows that anastomosis with continuous manner required one 4/0 vicryl round body suture which costs 380 BDT while anastomosis with interrupted manner required two 4/0 vicryl round body suture which costs 760 BDT.

Cost of suture material (BDT)	**Group A** **(n=31)**	**Group B** **(n=33)**	**p value**
Mean±SD	383.55 ±4.86	764.85 ±8.70	<0.001*

* = Student's t test

Group A: Single layer extramucosal continuous anastomosis

Group B: Single layer extramucosal interrupted anastomosis

Table.9. Comparison of cost of suture material between two groups (n=64)

Table.9. shows that the mean cost of suture material in Group A and Group B were 383.55 ±4.86 BDT and 764.85 ±8.70 BDT respectively. The result showed that there was highly significant statistical difference regarding cost of suture material between two groups as the p value <0.001 (obtained from Independent t-test).

Discussion

An intestinal anastomosis becomes necessary when a segment on the gastrointestinal tract is resected for gastrointestinal continuity which needs to be restored (Chen, 2012). Extramucosal technique is the procedure of choice for anastomosis involving small intestine (Leslie and Steele, 2003). The present study had been conducted to compare the outcome between single layer extramucosal continuous and single layer extramucosal interrupted anastomosis in small intestine in children. This was a prospective comparative interventional study conducting among 67 children who underwent resection and anastomosis for small intestine obstruction, atresia (jejunal and ileal) and ileostomy closures at Dhaka Shishu (Children) Hospital during specified period of time. Children were randomly allocated into two groups: Group A (single layer extramucosal continuous anastomosis group) and Group B (single layer extramucosal interrupted anastomosis group). After operation, children were advised for follow up at 2nd, 4th and 6th week and 3rd month after discharge. Within this follow up, 2 children in Group A and 1 child in Group B were dropped out from the study. Finally, 64 children completed the study.

Resection and anastomoses performed in both groups in which primary causes were atresia, midgut volvulus in neonates and intussusception, Meckel's diverticulum, mesenteric cyst was found in between one day to five years. Proportion of children within one month to six months age range were more in the study as elective procedure was done within this period.

In this study, in both groups majority of the children were male. Black, et al. **(**2020**)** showed that males have higher prevalence rates of most congenital anomalies. Intussusception and Meckel's diverticulum are common in male **(**Columbani & Scholz, 2012; Snyder, 2012**)**. As one third of the children of the present study were suffered from these two diseases the proportion of male were more compared to female. A slight male predominance was also reported in other studies **(**Brain and Kiely, 1985; Wani, et al., 2017**)**.

In the present study, resection and anastomosis was done in 18 children in Group A and 16 children in Group B as emergency procedures because of acute presentation of intestinal obstruction i.e. total of 34 **(**53.12%**)** children. Ross, et al. **(**2016**)** reported that 35.4% anastomosis were done as emergency procedure. Rajput, et al. **(**2009**)** reported that 87.5% children were operated in emergency procedure. Dhaka Shishu **(**Children**)** Hospital is the largest tertiary level Hospital in Bangladesh, so that the rate of emergency procedures were more in comparison to other study.

Majority of the area of anastomosis in both groups performed in the ileoileal area as the regional disease involved predominantly at ileal site. Other studies also reported that anastomosis was commonly done on ileoileal area **(**Habash, et al., 2013; Hussain, et al., 2015; Ross, et al., 2016**)**.

In the present study, the mean time of anastomosis was significantly lower in Group A than Group B. The mean time of anastomosis was 9.16 **(**±1.34**)** minutes and 15.24 **(**±1.66**)** minutes in Group A and Group B respectively. In continuous anastomosis there is no need of making multiple knots which saves the time while in interrupted anastomosis there is need to make several knots and for that the suture has to cut several times. Several studies measured the anastomotic time. Burch, et al. **(**1999**)**, Habash, et al. **(**2013**)** and Saboo, et al. **(**2015**)** compared the anastomotic time of single layer continuous anastomosis with double layer interrupted technique and found that single layer continuous anastomosis required less time than interrupted method. Hussain, et al. **(**2015**)** had conducted a prospective study to find out the outcome of a single layer extra mucosal continuous technique as compared to interrupted for the anastomosis of small intestine and also found that the mean time of anastomosis was significantly lower in single layer continuous group than single layer interrupted group. Mittal, et al. **(**2014**)** reported the mean time of anastomosis in single layer interrupted group was 15.30 **(**±3.63**)** minutes which matched the present study.

Anastomotic leakage had always been a cause for concern in patients undergoing surgery with gastrointestinal anastomosis, as it adversely affects the surgical outcome **(**Wani, et al., 2017**)**. In this study, near about 8.0% children had anastomotic leakage in both groups. Similar result was reported by Hussain, et al. **(**2005**)** and Matheson and Irving **(**1975**)**. Habash, et al. **(**2013**)** reported 3.6% leakage rate after single layer extramucosal continuous anastomosis. Rajput, et al. **(**2009**)** reported 2.8% leakage rate after single layer extramucosal interrupted anastomosis. However, Brain, and Kiely **(**1985**)** found no anastomotic leakage after single layer extramucosal interrupted anastomosis. There are several factors which affects leakage such as healthy supply of blood, maintenance of apposition, appropriate alignment and lack of tension **(**McKinley & Krukowski, 2006**)**. These anastomotic leakages might be due to neonatal age group, emergency procedure and disproportion of gut caliver, perioperative poor nutritional condition, lastly unnoticed injury to the bowel wall or its blood supply during surgery.

In the present study, higher incidence of anastomotic leakage in children operated on emergent basis **(**100%**)** than elective cases **(**0.0%**)**. It is might be due to lack of adequate preoperative preparation who usually present with hemodynamic instability. Farghaly, et al. **(**2018**)** also found that emergency small bowel anastomosis have a higher risk of anastomotic leakage. These cases were managed by re-exploration peritoneal wash and ileostomy formation under general anesthesia.

In the present study, 12.9% children in Group A and 15.2% children in Group B developed wound infection. Rate of wound infection vary from study to study. Ayub, et al. **(**2009**)** reported 8.9% wound infection rate after intestinal anastomosis. Sarhan, **(**2013**)** found that 3.6% patients developed wound infection after single layer extramucosal continuous anastomosis. Mittal, et al. **(**2015**)** reported that the wound infection rate was 16.67%. Wani, et al. **(**2017**)** found that 10.0% patients developed wound infection after single layer extramucosal interrupted anastomosis. Hussain, et al. **(**2015**)** reported 10% overall wound infection rate after anastomosis. The rate of wound infection was higher in the present study than those studies might be due to the age of the children. Wound infection was common in neonates. The current study was conducted among children of one day to five years of age while other studies were done among patients of all age group. Children with ileostomy have high output effluent leading to nutritional deficiency, failure to thrive and reduced immunity. Moreover, stoma care is difficult in children so, wound infection was more than those studies. These children were treated with broad spectrum antibiotics according to C/S report and regular dressing.

In this study, only one child had developed wound dehiscence in Group A. This wound dehiscence followed by wound infection along with hypoalbuminemia and anaemia. Immediate re-suturing of the wound with nonabsorbable (proline 3/0) suture under general anesthesia. Nutritional support, fresh frozen plasma and antibiotic (according to C/S) also given. Ayub, et al. (2009) reported 3.3% patients developed wound dehiscence after intestinal anastomosis. Mittal, et al. (2015) reported that the wound dehiscence rate was 6.67%. The present study found no statistical difference in developing wound dehiscence between two groups which was consistent with the study of Hussain, et al. (2015).

Within the study period, two children (one in each group) had died. The overall mortality rate was found near about 3.0%. That was mainly due to anastomotic leakage, peritonitis and later on septicemia. Habash, et al (2013) and Hussain, et al. (2015) reported that 0.0% mortality in extramucosal continuous anastomosis. In extramucosal interrupted anastomosis, Wani, et al. (2017) found 0.0% mortality whether Hussain, et al. (2015) found 3.8% mortality.

The cost of suture material was double in case of interrupted manner as it required double suture materials. Thus it could be said that single layer extramucosal continuous anastomosis is more cost effective than single layer extramucosal interrupted anastomosis. Hussain, et al. (2015) also found that the cost effectiveness in single layer extramucosal continuous anastomosis.

Conclusions

Single layer extramucosal continuous anastomosis is significantly less time consuming, cost effective with no risk of complications in contrast to single layer extramucosal interrupted anastomosis in small intestine in children.

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