Evaluation of Both Single Layer Simple Interrupted Extramucosal Sutures and Single Layer Interrupted Connell Sutures for Intestinal Anastomosis in Children in Elective and Emergency Laparotomy

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ABSTRACT

Background: Intestine anastomosis in pediatric surgery is a relevant matter because of the frequency of the procedure, nonetheless, there is no general agreement about the most appropriate surgical technique, nor are there records comparing the different methods in children. To validate the better technique in children, it is necessary to have clinically comparative experimental studies.

Objective: the aim of this work is to evaluate both single layer simple interrupted extramucosal and single layer interrupted Connell sutures for intestinal anastomosis in children in elective and emergency laparotomy as regard technical, functional and financial aspects.

Patients and Methods: his study was carried out on 40 patients candidate for intestinal anastomosis in elective and emergency laparotomy managed at Pediatric Surgery Department, Al-Azhar University in Cairo throughout the period from January 2017 to May 2019.

Results: As regard the most frequent diagnosis or cause for anastomosis in our study, jejunal atresia was the most common cause of anastomosis with 9 cases (45%) in the extramucosal group and one case (5%) in the Connell group, then the intussusception with 2 patients (10%) in the extramucosal group, and 7 patients (35%) in the Connell group, then ileal atresia, 3 patients (15%) in the extramucosal group, and one patient (5%) in the Connell group. **Conclusion:** We concluded that both techniques for intestinal anastomosis are effective, safe and successful. We prefer single-layer interrupted extramucosal technique in elective and emergency laparotomy due to less operative time, and valuable cost-effectiveness.

Keywords: Single Layer Simple Interrupted Extramucosal Sutures, Single Layer Interrupted Connell Sutures, Intestinal Anastomosis, Children in Elective and Emergency Laparotomy.

INTRODUCTION

About 1% of all patients who undergo surgery, younger than 1 year of age, require a bowel anastomosis for various reasons. The gut anastomosis heals by same mechanism like that of wound healing [(1)].

The submucosa is the strongest layer of gut wall[(2)], therefore ideal anastomotic technique is the one which includes apposition and approximation of submucosa of gut wall [(3)].

As intestinal anastomosis is a commonly performed surgical procedure both in emergency and elective settings in surgical practice; therefore its leak and disruption is a common cause of postoperative mortality and morbidity and economical burden. The basic principles of gut anastomosis were established more than a century ago and have gone through the process of evolution [(4)].

There are different techniques for intestinal anastomosis. Conventional methods, which range from sutured (single layer interrupted or continuous, double layer) to stapling techniques. Unconventional methods include compression rings, tissue glue and laser welding [(5)]. Healing of the anastomosis depends upon several factors, like tension at the suture line, an adequate blood supply at the two ends of the intestine, clean gut at the time of operation and meticulous surgical technique [(6)].

Single layer technique was proven superior to two-layer method with respect to luminal reduction tissue strangulation and strength of anastomosis [(7)].

The single layer continuous anastomosis was first described by Hautefeuille as an innovative technique. It is an established fact that extramucosal single layer anastomosis can be done by two methods either continuous or interrupted techniques [(8)].

AIM OF THE WORK

The aim of this work is to evaluate both single layer simple interrupted extramucosal and single layer interrupted Connell sutures for intestinal anastomosis in children in elective and emergency laparotomy as regard technical, functional and financial aspects.

PATIENTS AND METHODS

Patients:

This study was carried out on 40 patients candidate for intestinal anastomosis in elective and emergency laparotomy managed at Pediatric Surgery Department, Al-Azhar University in Cairo throughout the period from January 2017 to May 2019. Patients were randomly subdivided into 2 groups; Group A

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(single layer simple interrupted extramucosal anastomosis) and Group B (single layer interrupted Connell anastomosis).

Ethical consideration and written informed consent:

An approval of the study was obtained from Al-Azhar University Academic and Ethical Committee. Every patient signed an informed written consent for acceptance of the operation.

Methods

All patients were subjected to:

- **Preoperative procedures:**

(1) Full history taking.

(2) Clinical examination:

A- General examination.

B-Local abdominal examination.

(3) Investigations:

- **Laboratory investigations.**
- **Imaging study.**

(4) Preoperative preparation:

Preoperative fluid resuscitation to optimize hydration status is imperative because patients who present in emergency settings are frequently dehydrated.

Preoperative antibiotic prophylaxis is a must to prevent infective complications in emergent settings, as well as some elective settings when associated with a major surgical procedure.

A nasogastric tube and indwelling urinary catheter should be inserted to decompress the stomach and the urinary bladder, respectively. Decompression of the stomach decreases the risk of aspiration of gastric contents during induction of anesthesia.

(5) Operative Techniques for Selected Anastomoses:

I) Patient positioning and incision

Under general anesthesia, laparotomy mostly through a transverse abdominal incision of adequate length with the patient supine on the operating table after skin preparation.

II) Exposure, mobilization, and dissection

Access is a critical determinant of the ease with which an operative procedure can be carried out. Accordingly, the incision made in such a way as to allow adequate exposure of the operating field. The lateral aspects of the field can be controlled by using a suitable retractor. The small bowel can be extremely difficult to handle and therefore was commonly packed away by placing wet gauze. The next stage involved bringing the bowel to the surface.

III) Preparation

The segment of bowel to be removed was isolated with an adequate resection margin. To this end, all surrounding adhesions were divided. Next, the mesentery was divided. The key consideration in this step was to preserve the blood supply to the two remaining ends of bowel while still achieving adequate excision of the diseased bowel. This was more easily accomplished in the small bowel than in the large bowel, transillumination of the mesentery and careful division of the vascular arcade were vital**.**

IV) Division of Bowel

The bowel segment to be removed isolated between non crushing clamps placed across the intestinal lumen some distance away from the resection margin so as to limit the amount of bowel contents that can escape into the wound. Crushing clamps then were placed on the specimen side of the diseased segment at the point of the resection, and the bowel was divided with a knife just proximal and distal to the clamps. Thus, the lumen of the diseased segment was never opened within the abdominal wound. Even so, the contents of the bowel between the open ends and the non-crushing clamps can leak into the wound. To minimize this problem, the working area was isolated with abdominal packs.

V) Techniques of bowel anastomosis

- **Group A (single layer simple interrupted extramucosal anastomosis)**

22 anastomoses were performed in 20 cases for various causes **(Jejunal atresia, Ileal atresia, Congenital band, Ileal duplication, Ligated ileum with the umbilical stump, Mesenteric Lipoblastoma obstructing the ileum, Intussusception, Cecal duplication)** using an interrupted **Vicryl** sutures with size ranging from 6/0 to 3/0 as appropriate that began at the mesenteric border, incorporating all the layers except the mucosa. Each bite included 2-5 mm of the wall from the edge and about 2-5 mm from each other. The larger bites were used at the mesenteric border to ensure an adequate seal. Only enough pressure was applied to the suture to avoid ischemia of the anastomosis. The edges of the mesentery were closed to prevent any internal herniation. The patency of the anastomosed segment was confirmed by milking or gently palpating the anastomosis between the thumb and the index finger. Water tight test was also performed**.**

Each case was analyzed with respect to duration required to perform intestinal anastomosis. The duration of anastomosis begins with placement of first stitch on the bowel and ended when the last stitch was cut.

- **Group B (single layer interrupted Connell anastomosis)**

22 anastomoses were performed in 20 cases for various causes **(Jejunal atresia, Ileal atresia, Adhesive band, Strangulated oblique inguinal hernia OIH, Mesenteric cyst, Closure of ileostomy,**

Meckel`s diverticulitis, Intussusception). The Connell stitch was achieved using an interrupted **Vicryl** sutures with size ranging from 6/0 to 3/0 as appropriate that began at the mesenteric border, incorporating all the layers by passing the suture from the outside in, then inside out. The suture was tied so that the knot was outside, the needle must be pulled through each edge separately. Trying to include both edges in one pass of the needle can prevent the surgeon from taking a good-thickness bite on both edges. It is necessary to include the submucosa carefully because this is the strongest layer of the bowel wall and gives strength to the anastomosis. Each bite included 2-5 mm of the wall from the edge and about 2-5 mm from each other. The larger bites were used at the mesenteric border to ensure an adequate seal. Only enough pressure was applied to the suture to avoid ischemia of the anastomosis. The edges of the mesentery were closed to prevent any internal herniation. The patency of the anastomosed segment was confirmed by milking or gently palpating the anastomosis between the thumb and the index finger. Water tight test was also performed**.**

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VI) Postoperative care:

- The patients recovered in the recovery room.
- Postoperatively patients were given IV fluids or TPN and feeds commenced when appropriate mostly from 48 to 72 hours postoperatively.
- Observation of the vital sings especially temperature and respiratory rate and the amount of secretion in the drains collected. The drains were usually removed after the patient allowed orally.
- Patients were monitored closely for distention, vomiting, first motion, wound infection, wound dehiscence, persistent peritonitis intra-abdominal abscess, with specific attention given to assessing for clinical signs of anastomotic leak that was defined as fecal discharge in the drain or from the wound or a visible disruption of the suture line during re-exploration.
- The patients were discharged from the hospital when passed and allowed and there was no distention or vomiting or high grade fever.

VII) Postoperative follow up:

- All patients were followed in surgical outpatient clinic for one month as a whole with especial emphasizes on postoperative complications e.g. wound infection, abdominal distention, vomiting and leak.

Statistical analysis:

Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean± standard deviation (SD). Qualitative data were expressed as frequency and percentage.

The following tests were done:

- Independent-samples t-test of significance was used when comparing between two means.
- Chi-square (x^2) test of significance was used in order to compare proportions between two qualitative parameters.
- P-value <0.05 was considered significant.
- P-value <0.001 was considered as highly significant.
- P-value >0.05 was considered insignificant.

RESULTS

Patient's characteristics (Table1 and 2).

Table 1: Age distribution in both groups

	Group										
	A					B					value
	Mean	SD	Median	Minimum	Maximum	Mean	SD	Median	Minimum	Maximum	
Age (days)	215.00	810.95	7.50	2.00	3650.00	1263.90	1433.20	365.00	28.00	4380.00	<0.001

Table 2: Sex distribution in both groups

Parameters		Group				
		A		B		P value
		Count	%	Count	%	
Sex	Male	12	60.0%	11	55.0%	>0.05
	Female	8	40.0%	9	45.0%	

Clinical finding: In this study at time of examination we found that abdominal distention was the main presentation, the 2nd was the vomiting, then the abdominal pain, then the red currant jelly stool, then the

constipation, then the palpable intraabdominal mass, then the inguinoscrotal swelling, and then the fever as shown in (Table 3).

Table 3: Clinical presentation

Clinical presentation		Group				P value
		A		B		
		Count	%	Count	%	
Abdominal distention	Yes	20	100.0%	19	95.0%	>0.05
	No	0	0.0%	1	5.0%	
Vomiting	Yes	19	95.0%	19	95.0%	>0.05
	No	1	5.0%	1	5.0%	
Abdominal pain	Yes	4	20.0%	18	90.0%	< 0.001
	No	16	80.0%	2	10.0%	
Red currant jelly stool	Yes	2	10.0%	5	25.0%	>0.05
	No	18	90.0%	15	75.0%	
Palpable intraabdominal mass	Yes	3	15.0%	3	15.0%	>0.05
	No	17	85.0%	17	85.0%	
Constipation	Yes	2	10.0%	5	25.0%	>0.05
	No	18	90.0%	15	75.0%	
Inguinoscrotal swelling	Yes	0	0.0%	3	15.0%	>0.05
	No	20	100.0%	17	85.0%	
Fever	Yes	0	0.0%	3	15.0%	>0.05
	No	20	100.0%	17	85.0%	

Radiological finding:

In our study, x- ray (PXR) standing for chest and abdomen had done for all patients. We had found that the most common radiological finding was the dilatation of the bowel loops and multiple air fluid levels as sign of intestinal obstruction (table 4).

Table 4: Radiological finding

Radiological finding		Group A		Group B		P value
		Count	%	Count	%	
Dilated bowel loops and multiple air fluid levels in erect abdominal x-ray	Yes	18	90.0%	13	65.0%	>0.05
	No	2	10.0%	7	35.0%	
arget sign in pelviabdominal ultrasonography	Yes	2	10.0%	5	25.0%	>0.05
	No	18	90.0%	15	75.0%	
Pneumoperitoneum in erect abdominal x-ray	Yes	1	5.0%	2	10.0%	>0.05
	No	19	95.0%	18	90.0%	
Intraabdominal mass in pelviabdominal CT	Yes	1	5.0%	2	10.0%	>0.05
	No	19	95.0%	18	90.0%	

Operative finding:

Site of lesion:

The most common site of lesions and pathology indicated for resection and anastomosis was the ileum (table 5).

Table 5: Site of lesion

Parameters		Group				P value
		A		B		
		Count	%	Count	%	
Site of lesion	Jejunum	9	45.0%	2	10.0%	>0.05
	Ileum	8	40.0%	10	50.0%	
	Ileum and Caecum	2	10.0%	3	15.0%	
	Caecum	1	5.0%	3	15.0%	
	Caecum and Ascending colon	0	0.0%	1	5.0%	
	Ileum, Caecum and Ascending colon	0	0.0%	1	5.0%	

Diagnosis:

As regard the diagnosis (Cause of anastomosis), jejunal atresia was the most common cause of anastomoses in our study, then the intussusception, then ileal atresia, then the obstructed inguinal hernia, then Meckel's diverticulum, then adhesive band with ischemic line, then congenital band with ischemic line, ileal duplication, cecal duplication, lipoblastoma, ligated ileum with the umbilical stump, closure of ileostomy post Hirschsprung`s disease, mesenteric cyst, and then colonic diverticulitis with perforated caecum as shown in table 6.

Table 6: Diagnosis (Cause of anastomosis)

Parameters		Group			
		A		B	
		Count	%	Count	%
Operative finding	Jejunal atresia	9	45.0%	1	5.0%
	Ileal atresia	3	15.0%	1	5.0%
	Intussusception	2	10.0%	7	35.0%
	Ileal duplication	1	5.0%	0	0.0%
	Cecal duplication	1	5.0%	0	0.0%
	Mesenteric cyst	0	0.0%	1	5.0%
	Lipoblastoma	1	5.0%	0	0.0%
	Obstructed inguinal hernia	0	0.0%	3	15.0%
	Adhesive band with ischemic line	0	0.0%	2	10.0%
	Congenital band with ischemic line	2	10.0%	0	0.0%
	Meckel's diverticulum	0	0.0%	3	15.0%
	Closure of ileostomy	0	0.0%	1	5.0%
	Ligated ileum with the umbilical stump	1	5.0%	0	0.0%
	Colonic diverticulitis	0	0.0%	1	5.0%

Anatomical location of anastomoses: (Table 7)

Table 7: Anatomical location of anastomosis

Parameters		Type				P value
		A		B		
		Count	%	Count	%	
Anatomical location of anastomosis	Ileoileal	6	30.0%	10	50.0%	>0.05
	Jejunojejunal	8	40.0%	2	10.0%	
	Ileoascending	5	25.0%	5	25.0%	
	Ileotransverse	0	0.0%	2	10.0%	
	Ileosigmoid	0	0.0%	1	5.0%	
	Jejunotransverse	1	5.0%	0	0.0%	

Time of anastomosis

As regard the time of anastomosis in minutes, in group A it was significantly shorter than group B as shown in table 8.

Table 8: Time of anastomosis

Parameters	Group										P value
	A					B					
	Mean	SD	Median	Minimum	Maximum	Mean	SD	Median	Minimum	Maximum	
Time of anastomosis (min)	22.80	2.07	23.00	20.00	26.00	29.60	2.04	29.00	27.00	34.00	< 0.001

Intraoperative wound contamination and drain insertion (Table 9)

Table 9: Intraoperative wound contamination and drain insertion

Parameters		Group				P value
		A		B		
		Count	%	Count	%	
Drain	Yes	1	5.0%	1	5.0%	>0.05
	No	19	95.0%	19	95.0%	
Intraoperative wound contamination	Yes	1	5.0%	2	10.0%	>0.05
	No	19	95.0%	18	90.0%	

Postoperative complications (Table 10)

Table 10: Postoperative complications

Parameters		Group				P value
		A		B		
		Count	%	Count	%	
Postoperative complications	Wound infection	2	10.0%	2	10.0%	>0.05
	Leakage	1	5.0%	1	5.0%	
	No	17	85.0%	17	85.0%	

DISCUSSION

Our study included 40 patients, 20 patients underwent single layer simple interrupted extramucosal intestinal anastomoses with the median age at the time of anastomosis was 7.5 days (range 2 days – 120 months), and 20 patients underwent single layer interrupted Connell sutures for intestinal anastomosis with the median age at the time of anastomosis was 3.5 months (range 28 days – 146 months). In the study done by **Ross et al.,** 550 patients were included, all patients underwent 613 single layer interrupted extramucosal anastomoses. Median age at the time of anastomosis was 6 months (range 1 day – 226 months) [9]. In the study done by **Shandall *et al.*** [10], 68 patients included in the study, all patients underwent 75 single layer interrupted extramucosal anastomoses. Median age at the time of anastomosis was 9 months (range 1 day – 204 months).

In the study done by **Hussain *et al.*** [11]**,** 50 cases requiring small intestine anastomosis were included. 24 patients underwent single layer continuous extramucosal anastomosis, and 26 patients underwent single layer interrupted extramucosal anastomosis. In the study done by **Kirti *et al.*** [12]**,** 145 patients were included, 73 underwent single layer interrupted extramucosal anastomosis, and 72 underwent double layer anastomosis.

Regarding the clinical presentation in our study, distension of abdomen was the most consistent sign in all patients (100%) of the extramucosal group and, 19 patients (95%) in Connell group, followed by the vomiting, 19 patients (95%) in each group, then the abdominal pain, 4 patients (20%) in the extramucosal group, and 18 patients (90%) in the Connell group. In the study done by **Zia *et al.*** [13]**,** 34 patients (48.6%) presented with abdominal pain, followed by distension in 21 patients (30%), constipation in 9 patients (12.9%) and vomiting in 6 patients (8.5%). Distension of abdomen was the most consistent sign in 58% of cases, followed by tenderness in 30% of cases.

Concerning the most frequent diagnosis or cause for anastomosis in our study, jejunal atresia was the most common cause of anastomosis with 9 cases (45%) in the extramucosal group and one case (5%) in the Connell group, then the intussusception with 2 patients (10%) in the extramucosal group, and 7 patients (35%) in the Connell group, and ileal atresia with 3 patients (15%) in the extramucosal group, and one patient (5%) in the Connell group. In the study done by Ross et al. the most frequent diagnosis was closure of stomas in 271 patients (49.3%) [9]. In the study done by **Shandall *et al.*** [10]**,** the most frequent diagnosis was closure of colostomy in 26 patients (38.2%).

In the study done by **Hussain *et al.*** [11]**,** the most frequent diagnosis was ileostomy closure in 16 patients (61.5%), followed by trauma in 10 patients (38.4%) in the interrupted extramucosal group [11]. In the study done by **Kirti *et al.*** [12]**,** the most frequent diagnosis was trauma, with 35 patients (47.9%), followed by enteric perforation with 17 patients (23.2%) in single layer interrupted extramucosal group.

As regard the anatomical location of anastomosis, in our study ileum was the most common site for anastomosis, ileoileal anastomosis was done to 6 patients (30%) in the extramucosal group, and 10 patients (50%) in the Connell group, followed by the jejunum, jejunojejunal anastomosis was done to 8 patients (40%) in the extramucosal group, and 2 patients (10%) in the Connell group. Similar to our study, ileum was the most common site for anastomosis in the study done by Ross et al.**,** ileoileal anastomosis was done to 246 patients (40.1%), but followed by the colocolic anastomosis that was done to 180 patients (11%), as they didn`t excluded the colocolic anastomosis as in our study [9]. Similarly it was seen in the study done by **Hussain *et al.*** [11]**,** as the

ileum was the most common site for anastomosis in 15 patients (57.6%), followed by the jejunum in 11 patients (42.3%) in the interrupted extramucosal group.

Mean time taken for creation of anastomosis in our study was 22.8 minutes in the extramucosal group, and 29.2 minutes in the Connell group. In the study done by **Ross et al.,** time taken for creation of anastomosis wasn`t reported [(9)]. Similar to our study, the mean time taken for creation of anastomosis in the study done by **Hussain *et al.*** [(11)]**,** was 19.2 minutes in the interrupted extramucosal group. In the study done by Kirti et al., the mean time was 9.5 minutes in single layer interrupted extramucosal group [(12)].

Concerning the postoperative complications in our study, intestinal leakage was found in one patient (5%) in each group, so there was no difference in postoperative intestinal leakage between the two groups. In the study done by Ross et al., intestinal leakage was found in 5 patients (0.9%) [(9)]. In the study done by **Zia *et al.*** [(13)]**,** anastomotic leak was found in 3 patients (4.2%) in the single layer group. In the study done by **Hussain *et al.*** [(11)]**,** intestinal leakage was found in 2 patients (7.7%) in the single layer group. Similar to our study, intestinal leakage was found in 4 patients (5.3%) in the single layer group in the study done by **Kirti *et al.*** [(12)].

In our study, long hospital stay in the simple interrupted extramucosal group was due to patients in the neonatal period and not related to the technique. Considering the fact that most of the patients we operated upon were on emergency basis, having some degree of hemodynamic instability, with reduced construction time, the time of anesthesia was also reduced, and hence seemed beneficial to such patients. Also, with the kind of population we serve here in our set-up, the cost factor definitely seems significant.

In our hospital, in a 3-year surgical residency protocol, only a third-year resident performs surgeries like resection and anastomosis. But because of the ease of the single layer interrupted extramucosal technique, even a second-year resident can perform it satisfactorily.

CONCLUSIONS

We concluded that both techniques for intestinal anastomosis are effective, safe and successful. We prefer single-layer interrupted extramucosal technique in elective and emergency laparotomy due to less operative time, and valuable cost-effectiveness.

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