

Ileocaecal Implantation with Ileocaecal Valve Reconstruction versus Right Hemicolectomy in Terminal Ileal Lesions

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Abstract

Objectives: The aim of the study was to evaluate the ileo-caecal anastomosis with simple nipping (valve reconstruction) versus resection of terminal ileum with ileo-transverse anastomosis in terminal ileal lesions.

Patients and methods: 38 patients with incidental terminal ileal lesion included in the study they were divided randomly into 2 groups, group A included 19 cases and submitted to resection of the injured terminal ileum with ileotransverse anastomosis and group B 19 included cases submitted to repair or resection of the injured part then ileocaecal implantation was done with nipping of ileum into caecum in attempt to reconstruct ileocaecal valve.

Results: The mean operative time in group A was 3 h ± 40 mint. but was 2 h ± 30 mint. in group B. Although blood loss was more in group A neither of the 2 groups needed blood transfusion. The first time to pass flatus and resumption of oral feeding in group A were (3 ± 0.75) days and (4 ± 0.5) days respectively but in group B were (2 ± 0.5) days and (2 ± 0.75) days respectively, the hospital stay in group A was 8 ± 0.5 days but in group B was (4 ± 2) days, Nine cases in group A were suffered of diarrhoea but no cases in group B suffered of diarrhea, no cases of leakage in group B but in group A there were 2 cases of leakage.

Conclusion: ileo-caecal anastomosis was feasible, safe and rapid procedure also the nipping of the terminal ileum into caecum imitated the ileocaecal valve in preventing reflux of caecal contents into ileum when compared with ileo-transverse anastomosis in terminal ileal lesions.

Keywords: Ileocaecal valve; Right hemicolectomy; Terminal ileum

Introduction

Resection of the terminal ileum and ileocaecal valve in particular can lead to several well established pathophysiological problems, including malabsorption of bile acids, maldigestion of fat, mixed secretory-osmotic diarrhea, acceleration of bowel transit, hypovitaminosis, and an increased propensity to form gallstones and renal tract stones [1].

The right colon (cecum and ascending colon) plays a major role in water and electrolyte absorption and fermentation of undigested sugars, Bile salts or long-chain fatty acids are malabsorbed in sufficient quantities, their digestion by colonic bacteria generates potent secretagogues. Bile salt malabsorption causing "choleric diarrhea" typically occurs following terminal ileum resection, usually for management of Crohn's disease. When the resection involves segments greater than 100 cm this problem is further complicated by depletion of the bile salt pool, because bile salt production cannot compensate for the increased fecal loss. In these circumstances diarrhea also results from fat malabsorption also vitamin B12 is absorbed exclusively in the terminal ileum so the resection of which may produce malabsorption of B12 [2].

Ileocecal valve plays a very important role in the regulation of intestinal transit. It acts as a barrier to delay passage for small bowel contents and hence increases absorption. It also prevents reflux from the caecum into the ileum [3].

Although digestion and absorption primarily take place in the stomach and small intestine, the colon still plays a major role in these operations. The colon processes various complex carbohydrates and, to a lesser extent, proteins that prove resistant to digestion and absorption in the more proximal intestine [4,5].

Unlike the small intestine, the colon salvages nutrients from these products via fermentation. Fermentation occurs by means of the

saccarolytic and proteolytic members of the over 400 species of bacteria, the majority of which are obligate anaerobes, present within the colon [6]. 10% of ingested carbohydrates enter the cecum as undigested material. The ascending colon demonstrates the greatest absorptive capability, as the chyme resides within this segment the longest, thus maximizing its contact with the mucosa. As a consequence, diarrhea more consistently ensues after a right, as opposed to a left, hemicolectomy. When challenged, the proximal colon, with the additional contribution of the sigmoid colon and rectosigmoid, is able to save a further 5-6 L of intestinal water daily [7].

The colon contributes to three important functions in the body concentration of fecal effluent through water and electrolyte absorption, storage and controlled evacuation of fecal material and digestion and absorption of undigested food. Although the colon is not essential for survival, its functions contribute significantly to the overall well-being of humans. The colon can be functionally divided through the transverse colon into two parts, the right and left colon. The right colon (cecum and ascending colon) plays a major role in water and electrolyte absorption and fermentation of undigested sugars, and the left colon (descending colon, sigmoid colon and rectum) is predominantly involved in storage and evacuation of stool.

The iliocaecal valve was described as a passive valve to prevent

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reflux from the colon into the ileum later the studies revealed thickened muscle layer and high pressure zone at the valve giving idea about sphincteric mechanism which regulate intestinal transit and emptying keeping intestinal contents in the terminal ileum for sufficient time for absorption especially vitamin B12 and bile salts the valve regulated by 2 specific reflexes as ileo-caecal inhibitory reflex as distention of the terminal ileum leads to relaxation of ileocaecal valve allowing passage of contents to caecum, the other reflex is caeco-ileal excitatory reflex as distention of caecum leads to contraction of the sphincter preventing reflux of contents into ileum, also the ileocaecal valve serves as bacteriological barrier between small and large bowel especially in children as the flora of the ileum and the caecum completely different, recent neuroanatomic studies suggest the possibility of reconstruction of functional ileocaecal junction as there is no neuroanatomic sphincter at the ileocaecal valve such as pyloric sphincter and internal anal sphincter but in contrast the ileocaecal valve resembles simple intussusception of the ileum into the caecum so we can do end to end ileocaecal anastomosis with 2 cm intussusception of the ileum into the caecum [8].

The aim of our study was to evaluate the ileo-caecal anastomosis with simple intussusceptions and nipping (valve reconstruction) versus resection of terminal ileum with ileo-transverse anastomosis in terminal ileal lesions.

Patients and Methods

This randomized controlled study has been conducted in the department of general surgery at Benha university hospital during the period from March 2012 to January 2015, after approval of the study by the local ethical committee and obtaining written informed consent from the patients. The study included thirty eight 38 cases with terminal ileal lesions (last 15 cm of ileum) were included in this study. The cases were 12 cases with right iliac fossa stab injury, 12 cases with gun shot injury, 3 cases with terminal ileal injury during gynaecological operations (2 ovarian cystectomy, hysterectomy), 8 cases with ileocaecal intussusceptions with terminal ileal injuries, and 3 cases with perforated typhoid ulcer.

These cases operated upon randomly by doing resection of terminal ileum and right hemicolectomy with ileotransverse anastomosis in 19 cases (group A) and by doing ileocaecal implantation with ileocaecal valve reconstruction by simple nipping in 19 cases (group B) with exclusion of late peritonitis cases and multiple organs injuries cases.

Group A included 19 cases (10 male, 9 female), the ages ranging from 3 months to 50 years with mean age 36.7.

Group B included 19 cases (12 male, 7 female), the ages ranging from 2 months to 55 years with mean age 41.2, demographic data of the patients enrolled in Table 1.

	Group A	Group B	p-value
Number	19	19	
Age(mean)	36.7 ± 7.4 years	41.2 ± 7.13 years	0.06
Gender (♂:♀)	10:9	12:7	0.32
Disease	Stab injury	6	0.76
	gynecologic	1	
	intussusception	4	
	Gun shot	6	
	Typhoid ulcer	2	

Table 1: Demographic data.

Surgical techniques

Under general endotracheal anaesthesia and the patient placed in the supine position, a midline vertical exploratory incision was done through which a systematic abdominal exploration of the solid abdominal organs and the bowel has been carried out. Incidental ileal injuries most of them were confined to the last 15 cm of the ileum and not associated with other intestinal or solid organs injuries. A localized greenish bloody pelvic collection of mild to moderate amount was found and cleaned off the peritoneal cavity.

In 19 patients (Group A) the isolated terminal ileal lesions were dealt with by doing the standard right hemicolectomy including the injured ileal segment and restoration of the continuity by primary ileo-transverse anastomosis. In other 19 patients (Group B) resection of the injured ileal segment with preservation of the right colon and restoring the continuity by doing ileo-caecal implantation with fashioning of a new ileo-caecal valve as follows, a first layer of full thickness through and through continuous sutures using Vicryl 2/0 or 3/0 then a second interrupted seromuscular layer taken at 1 cm distance from the first suture line on caecal wall above the ileum to 3 cm on the ileal wall then a 1cm stitch taken on the caecal wall below the ileum to a 2 cm on the ileal wall creating an unequal nipping of the ileal end into the caecum using PDS 2/0 or 3/0, the upper half longer than the lower half the way that preventing reflux of the caecal contents when the intracaecal pressure increases compresses the upper longer leaflet against the lower leaflet (valve like mechanism). Finally, closure of the abdominal cavity over intraperitoneal drain after ensuring a proper hemostasis.

Operative data were observed including operative time and operative blood loss, need for blood transfusion and any operative complications. Postoperative data as hospital stay, first time to pass flatus and stool, resumption of oral feeding, serum bile salts, vitamin B12 estimation, and any postoperative complications were included.

Statistical Analysis

Statistical analysis was carried out using SPSS software, version 14.0 (SPSS Inc., Chicago, IL, United States). A Pearson Chi-square test was used to compare the complications found in the two groups. Data were expressed as mean ± SD, $P < 0.05$ was considered statistically significant.

Results

A total of 38 patients were included in the study they were divided randomly into 2 groups, group A included (19) patients (10) male, (9) females with mean age (36.7) years and group B included (19) patients (12) male, (7) females with mean age (41.2) years. All patients received general anesthesia and operated upon by doing either excision of terminal ileum, right hemicolectomy in 19 cases (group A) or limited ileal resection, ileocaecal implantation with ileocaecal valve reconstruction in 19 cases (group B).

Operative data as operative duration, amount of blood loss, need of blood transfusion and operative complication if any were determined. Postoperative data as hospital stay, time to pass flatus and stool, time of resumption of oral feeding, vitamin B12 and bile salt evaluation and any post-operative complications were determined.

All operations passed without major complications but in 2 cases of group A there was minor serosal tears in the duodenum which were repaired and without any operative complications in group B, the mean operative time in group A was 3 h ± 40 minutes but was 2 h ± 30 minutes

in group B. Although blood loss was more in group A neither of the 2 groups need blood transfusion, all operative data shown in Table 2.

The first time to pass flatus and resumption of oral feeding in group A were (3 ± 0.75) days and (4 ± 0.5) days respectively but in group B were (2 ± 0.5) days and (2 ± 0.75) days respectively, the hospital stay in group A was 8 ± 0.5 days but in group B was (4 ± 2) days (Tables 3-5). As regard postoperative complications no cases of leakage in group B but in group A there were 2 cases of leakage were managed with temporary ileostomy for 2 months then ileocolic reanastomosis (Figures 1-3).

By doing barium enemas late postoperative to all patients in the two groups, all patients in group A were showed reflux of barium to the ileum but in group B only 2 patients were showed reflux. Nine cases in group A were suffered of diarrhea but no cases in group B suffered of

	Group A	Group B	p-value
Operative time(hrs)	3 ± 0.4	2 ± 0.3	< 0.001**
Blood loss (c.c)	630.1 ± 109.3	450.4 ± 93.6	< 0.001**
Need for blood transfusion	No need	No need	
Operative complications	Duodenal serosal tear in 2 cases	No injury	

Table 2: Operative data.

	Group A	Group B	p-value
First time to pass flatus and stool(day)	3 ± 0.75	2 ± 0.5	< 0.001**
Time of resumption of eating(day)	4 ± 0.5	2 ± 0.75	< 0.001**
Hospital stay(day)	8 ± 0.5	4 ± 2	< 0.001**

Table 3: Postoperative data.

	Group A	Group B	p-value
Vitamin B12 Normal value (200-900) pg/mL	325 ± 123	721 ± 93	< 0.001**
Bile salts Normal value (0-10) mmol/L	6.4 ± 3.2	9.2 ± 2.1	0.003*

Table 4: Postoperative vitamin B12 and bile salts after one week.

	Group A	Group B	p-value
Leakage	2	0	0.14
Reflux (barium enema)	19	2	< 0.001**
Diarrhea	9	0	< 0.001**
Wound infection	10	3	< 0.001**
Wt. loss	10	2	< 0.001**
Stool analysis (fat)	12	1	< 0.001**

Table 5: Post-operative complications.

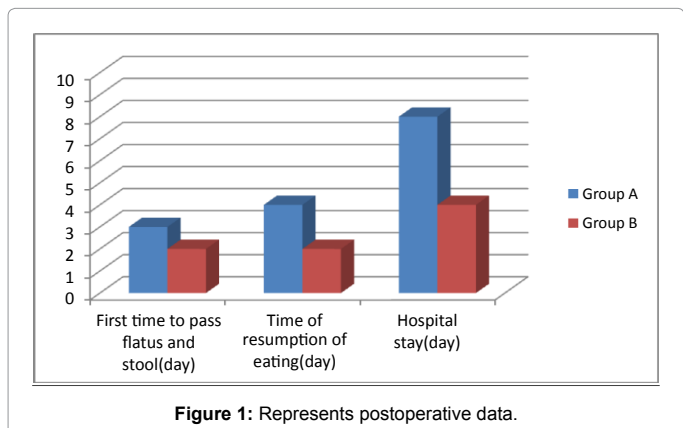


Figure 1: Represents postoperative data.

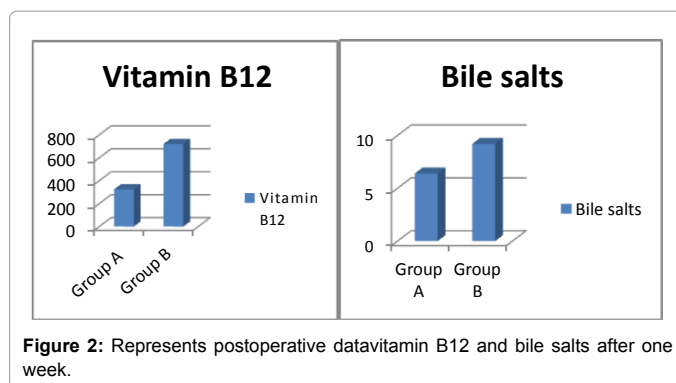


Figure 2: Represents postoperative data vitamin B12 and bile salts after one week.

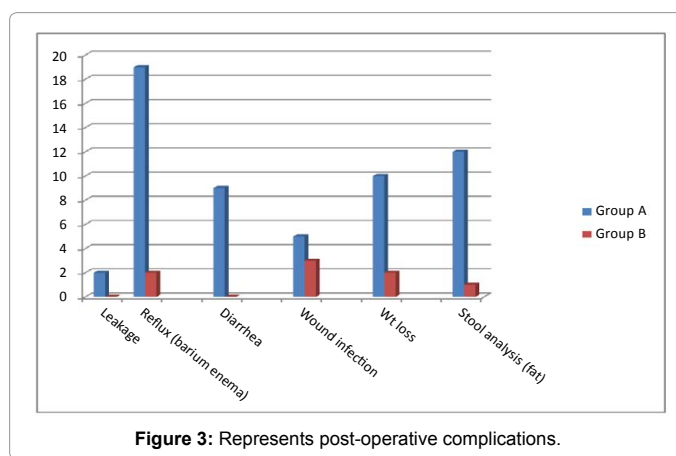


Figure 3: Represents post-operative complications.

diarrhea. Stool analysis was revealed increased fat content in stool of 12 patients in group A but only one patient in group B had fat in stool.

Discussion

Numerous studies have been demonstrated that resection of the ileocaecal valve has several adverse effects [9], this valve has a weak sphincteric action making the flow of the ileal contents to caecum in one direction so prevent reflux of colonic contents with its colonic bacterial load to small bowel leading to inflammation of ileal mucosa [10,11], Also this leads to decreased transit time in the terminal ileum so decreased absorption especially vitamin B12 and bile salts with passage of the later in stool with fat which contribute with decreased transit time to diarrhea [12], from this point of view Dorney et al. [13] found that bowel length required for survival was more than two folds if the ileocaecal valve was resected. In a study of Folaranmi et al. [14] noted that incidence of diarrhea after right hemicolectomy was 7 cases out of 26 cases (27%) with no cases if ileocaecal valve was preserved, and this was agreed with our results which revealed that diarrhea occurred in 9 (47.3%) cases in group A compared with no cases in group B which was statistically significant (p < 0.001).

Benner et al. [15] showed that ileal absorption of bile salts is mediated by an apical sodium dependant bile salts transporter located in the terminal ileum so Aldini R et al. [16] shown that terminal ileal resection or disease associated with bile salts excretion in stool and these data was in accordance with the present study.

Although the study with Wei-Wei Jiang et al. [17] concluded that ileo-ileostomy in the region adjacent to the ileocaecal valve is safe and resulted in fewer complications than ileo-transverse anastomosis in

infants but according to our study it is advisable to avoid anastomosis adjacent to the ileocaecal valve due to the functional distal obstruction by the valve also the terminal ileum has poor vascularization as the arterial supply of the terminal ileum in the region adjacent to the ileocaecal valve comes from a single arch from the ileocolic artery.

In a study with Ganesan et al. [18] Showed that the use of ileocaecal segment for urinary bladder reconstruction resulted in decreased vit. B12 level which was in accordance with our study.

The usage of ileocaecal segment was widely used in urinary bladder reconstruction after resection in an attempt for ileocaecal valve reconstruction a study with Fisch et al. [3] experimentally on 15 dogs demonstrated that the surgically reconstructed valve genuinely mimics the physiological function of the authentic valve and confirmed a marked transit time prolongation without evidence of obstruction, they used the same mechanism in 12 patients by embedding ileum into ascending colon via a submucosal tunnel in analogy to technique used when creating the continence mechanism during the Mainz Pouch procedure using the appendix, the morphological appearance of the newly created valve closely resembles the genuine ileocaecal valve during barium enema as well as endoscopic investigation.

Our results agreed with these data except that we reconstructed the valve by anastomosing ileum with caecum instead ascending colon and nipping this anastomosis into the caecum to direct the contents from ileum to caecum and when caecal contraction occurred this compresses nipping leaflets against each other so prevent reflux of caecal content into ileum, this nipping was in accordance with the latest concept of the ileocaecal valve anatomy in a study with Awapittaya et al. [19] depending on the anatomy and neuroanatomy of the ileocecal junction suggested that the ileocaecal junction is a simple intussusception of the ileum into the caecum. As regard complication, wound infection noted in 10 (52.6%) cases in group A but only 3(15.7%) cases in group B this may be due to increased time of manipulation so increased incidence of soiling and infection.

Weight loss was noted in 10 (52.6%) cases in group A but only 2 (10.5%) cases in group B this may be due to decreased fat absorption, decreased water absorption also due to decreased transit time and decreased fermentation of carbohydrates due to loss of right colon. As regard leakage after anastomosis 2 cases in group A were developed intestinal fistula and were managed by temporary ileostomy then reanastomosis after 2 months but no cases of leakage in group B.

From the obtained results we concluded that ileocaecal anastomosis was feasible, safe and rapid procedure also the nipping of the terminal ileum into caecum imitated the ileocaecal valve in preventing reflux of caecal contents into ileum when compared with ileotransverse anastomosis in terminal ileal lesions.

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