

Comparison of Vicryl, Dexon and Intestinal Stapler for the Closure of Colon in Dogs

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Abstract: Eighteen healthy mongrel dogs of sexes, varying ages (16.50 ± 0.22 months) and weights (19.83 ± 0.16 kg) were used in this study. The experiment was conducted in the Department of Surgery and Obstetrics, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University, Tandojam. A total of 18 dogs (male and female) were randomly divided into three groups placing 6 animals in each i.e., group-A (Vicryl 3/0 suture material), B (Dexon 3/0 suture material) and C (stapler). Physically healthy animals were used in this study in order to achieve the required results. Xylazine (9.91 ± 0.08 mg/dog) and thiopental Sodium (198.33 ± 1.05 mg/dog) was administered intramuscularly in all groups. The anaesthetized animals were placed on the dorsal recumbancy on surgical table in order to perform surgical procedure. The caudal ventral midline incision of 5 cm was made in all dogs to exteriorized the colon. One incision of 5 cm was given on colon and bleeding was controlled by artery forceps. Colon incision was closed with Vicryl (3/0) in group-A, Dixon (3/0) in group-B and intestinal stapling materials in dogs of group-C. The peritoneum in each dog was sutured with chromic catgut by simple interrupted suture technique, the linea alba was sutured with chromic catgut by simple continuous suture technique, sub-cutaneous layer was apposed with sub-cuticular suture technique using 3/0 chromic catgut. Skin was closed with simple interrupted suture pattern using silk 2/0 suture material in dogs. The total duration of anesthesia required was 328.33 ± 1.17 , 330.00 ± 1.39 and 313.83 ± 2.52 minutes for closure of colon closed with Vicryl, Dexon and Stapling material respectively. The mean number of total stitches for colon closure with Vicryl, Dexon and stapling material was 15 ± 0.57 , 17.00 ± 0.36 and 6.66 ± 0.21 respectively. Though the partial development of mucosal folds can be seen on day 10 of post-surgery whereas fully development except lamina epithelia on day 20. It is concluded that Vicryl suture material showed the superiority in terms of better apposition of the sutured tissues and better healing and lesser complications like minimal adhesions between sutured site and other structures applied with double layer appositional suture technique for the closure of colon in dogs. This study also reveals that all suture materials were not completely free from complications but staple technique showed quicker application and lesser number of staples was required as compare to Vicryl and Dexon suture stitches and duration.

Keywords: Comparison, Vicryl, Dexon, Intestinal stapler, colon, Dogs.

INTRODUCTION

Resection and anastomosis are generally required for the treatment of neoplasia, megacolon, intussusception, neoplasia and obstruction. Complications related with intestinal incision and anastomosis are main reason of death in animals during surgery [1]. Intestinal complications arise mostly due to absence of strict asepsis, poor surgical technique, unsuitable suture material and poor suturing methods. While, end-to-end intestinal anastomosis physiologically compatible and simple method for intestinal repair as compared with side-to-side intestinal anastomosis [2]. The suture materials and some other factors such as fistulas, dehiscences and blood loss occur throughout surgery effect the normal healing of intestinal anastomoses [3]. Passage of solid feces

through intestinal lumen as well as complications in the intestinal wall have been cited as reasons for reduced healing [4, 5]. The procedure of a temporary colostomy is necessary in the management of trauma, diverticulitis, iatrogenic perforations, carcinoma and a number of hereditary abnormalities of the colon. Closure of a colostomy can be related with a major complication rate and even death can occur and should not be considered a minor procedure [6].

MATERIAL METHODS

Mongrel dogs of both sex, varying ages (16.50 ± 0.22 months) and body weight (19.83 ± 0.16 kg) were used in this study (Table 1). The experiment was conducted in the Department of Surgery and Obstetrics, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University, Tandojam. The mongrel dogs were trapped from surroundings of Tandojam and brought in the experimental house of Department of Surgery and

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Obstetrics. Dogs were allowed for acclimation to the environment for 15 days before the start of experiment. A total of 18 dogs (male and female) were divided into three groups placing 6 animals in each. Dogs were dewormed with Vermox (Janssen-Cilag, Pakistan). One dog was housed in one cage, and were given free access to eat and drink water. Animal care facilities were maintained. All animals were maintained at room temperature 22°C, humidity 60% and maintained on a 12-hour light-dark cycle. Physically healthy animals were used in this study in order to achieve the required results

Experimental Design

Total 18 dogs were allocated identification numbers from D1 to D18. After surgery animals were kept for recordings, observations and then euthanized by injecting magnesium sulphate (10 ml) on 3rd day, 10th day and 20th day after operation for necropsy findings and recordings.

Following three suture materials were used for closure of colon incisions in each dog as shown in Table 1.

1. Vicryl 3/0. (Johnson and Johnson international)
2. Dexon 3/0. (Davis and Geck Inc. U.S.A)
3. Intestinal stapler. (MEDICORE intestinal stapler, Coral pharmaceuticals Karachi-Pakistan. Stiches size 7.4mm×4.6mm).

Pre-Operative Preparations

Each dog was kept off fed for 12 hours and water was held for 6 hours before the start of the experiment. Dogs were operated one by one and each dog was operated by one surgeon in a day.

Anaesthesia

Xylazine hydrochloride 0.5mg/kg was administered intramuscularly in each animal as pre-medication 30

minutes before general anaesthesia. General anaesthesia was induced with thiopental Sodium (Abbott Laboratories Pakistan Ltd, Landhi, Karachi), 10 mg/kg intravenously and maintained with boosting doses when needed [7].

Surgical Procedure

The experiment was conducted under aseptically condition in the operation room in the Department of Surgery and Obstetrics, Sindh Agriculture University, Tandojam. After induction the anaesthetized animal was placed on the dorsal recumbancy on surgical table in order to perform surgical procedure. The incision site was prepared by clipping the hairs. Hydrogen peroxide was used to remove the germs, dust or any foreign particle from the exterior surface of the skin. Then incision site was disinfected with povidone-iodine (10%). Sterility of the instruments was maintain for the whole study. The caudal ventral midline incision of 5 cm was made in all dogs in such way to gain access to the abdomen for identification of colon. The Sufficient length of the colon was isolated from the abdomen with the help of sterile packs. Contents of the selected site were removed and placed away with the help of intestinal clamps to prevent faecal materials contamination on the operative table. One incision of 5 cm was given on colon and haemorrhage was controlled by the artery forceps. Colon incision was closed either with Vicryl 3/0 (Johnson and Johnson international) and Dexon 3/0 (Davis and Geck Inc. U.S.A) using double layer suturing technique or with intestinal stapler (MEDICORE intestinal stapler, Coral pharmaceuticals Karachi-Pakistan. Stiches were made (size 7.4 mm×4.6mm) using stapler technique.

Laparotomy incision was closed in four layer method. Antibiotic (Procain penicillin 40 lac powder) was sprinkled in the abdomen before closure. The peritoneum in each animal was sutured with chromic catgut (3/0) by simple interrupted suturing technique, the linea alba was sutured with chromic catgut (3/0) by simple continuous sutured technique, sub-cutaneous

Table 1: Experimental Design

Groups	No. of Animals	Procedure	Suture materials	Suturing techniques
A	6	Colostomy	Vicryl	Double layer interrupted suturing technique
B	6	Colostomy	Dexon	Double layer interrupted suturing technique
C	6	Colostomy	Intestinal stapler	Stapler technique
Total	18			

A= Vicryl (Polyglactin 910).
B= Dexon (Polyglycolic acid).
C= Intestinal stapler.

layer was apposed with sub-cuticular suture technique with 3/0 chromic catgut (Johnson and Johnson international). Skin incision was closed with silk (Sherwood, Davis and Geck) 2/0 using simple interrupted suture pattern in dogs.

Post-Operative Care

After laparotomy completion, antiseptic pad and bandage were applied around the wounds and then daily antiseptic dressing was performed till healing completed. Antibiotics penicillin 40 Lac was given postoperatively. Anti-inflammatory analgesic (Diclofenac Sodium) was given every 12 hours for five days post-operatively to reduce inflammation and pain. Soft feed was offered to the operated dogs up to completion of healing.

All animals were brought to Indoor Patient Ward after recovery from anaesthesia and kept in clean and restricted environment. Dogs were given outdoor walk in the morning and evening. Milk was given to dogs for 24 hours after surgery and then only nutritive liquid (milk and bread) was given to all the animals for further two days. Water was made available *ad libitum* then normal diet (bread, meat and milk) was given to dogs during rest of the experimental period.

Observations and Recordings

During experiment heart rate, respiratory rate and body temperature were recorded before and after pre-medication. Body temperature, heart rate and respiratory rate were recorded before premedication and then every 05 minutes till recovery from anaesthesia. All animals were observed twice daily (morning and evening) for physiological functions such as heart rate, respiratory rate, rectal temperature feeding, drinking, urination, defaecation etc. Dogs were kept under observations for 3 days, 10 days and 20 days and progress of healing of the sutured wound was thoroughly studied. The animals were euthanized by administering magnesium sulphate through intravenous route to study the healing of colon wound. The following parameters were recorded.

Parameters

1. Progress of wound healing
2. Union of wound edges
3. Complications during wound healing if any:

- a. Evisceration
- b. Sinus formation
- c. Incisional hernia
- d. Oedema
- e. Inflammation
- f. Breakage of suture
- g. Loss of suture material
- h. Tearing of tissues
- i. Wound infection
- j. Peritonitis

Necropsy Findings

Each incision site was evaluated on necropsy examination. Complications such as peritonitis, excessive swelling, tearing of wound edges, loss of knots/suture material, breakdown of sutures, wound infection, leakage from incision site, adhesion formation between suture site and omentum, visceral organs or peritoneum if any were recorded. Absorption of suture material was also recorded.

Determination of Bursting Pressure

After euthanasia, two segments of colon, 5 cm long, one from control and one from suture line were obtained from each dog for measurement of bursting pressure and intestinal lumen diameter.

The testing device for bursting pressure consists of a closed, water-filled glass bottle. The bottle was closed with rubber stopper having one steel hose. One end of the intestinal segment was ligated and sealed with silk suture. The other end was sealed around the steel hose within the bottle filled with water. A manometer and air source was connected to the top of this hose which allowed continuous monitoring of the pressure until leakage was detected by the appearance of bubbles in the surrounding water. At that point, the bursting pressure was recorded and data collected.

RESULTS AND DISCUSSION

The results showed the mean weight, age, xylazine dose, total induction dose and total anesthesia duration was 19.83 ± 0.16 , 16.500 ± 0.22 months, 9.91 ± 0.08

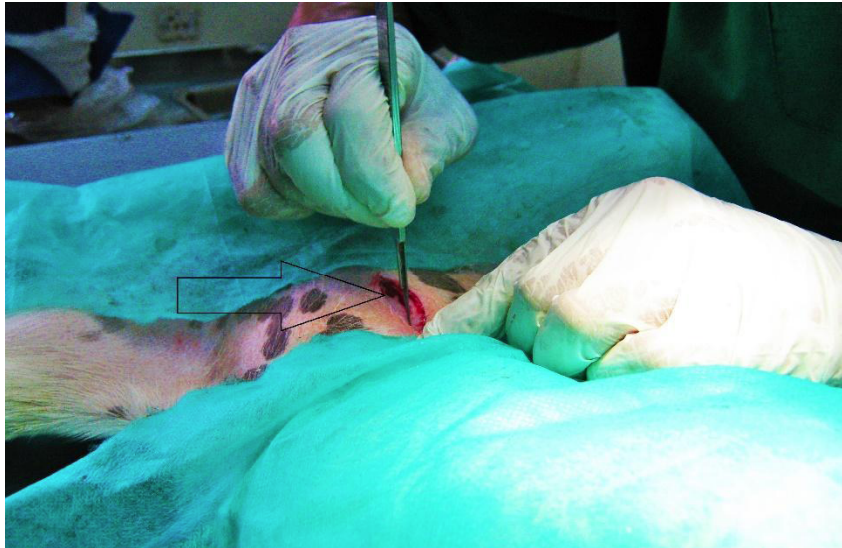


Plate 1: Shows ventral mid-line incision using scalpel in a dog.

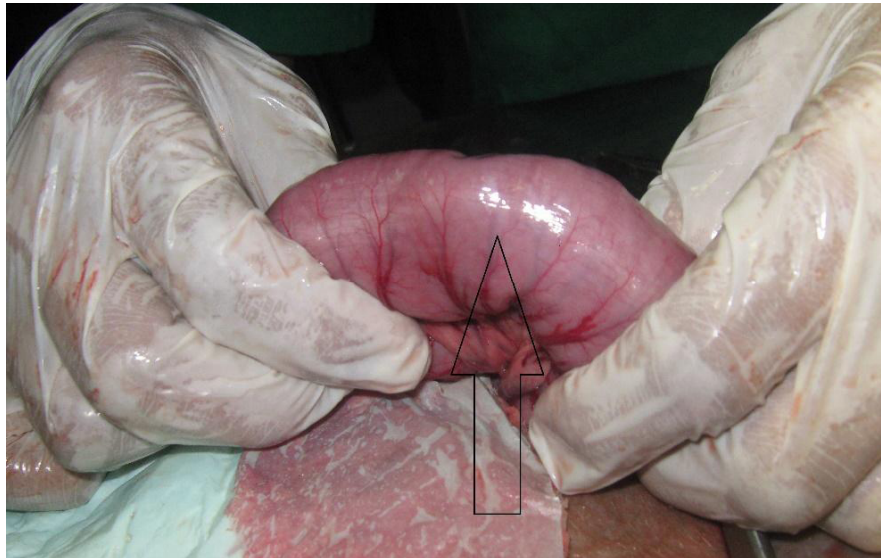


Plate 2: Exteriorization of colon for longitudinal incision in a dog.

mg, 198.33 ± 1.05 mg, 68.33 ± 1.67 minutes and 328.33 ± 1.17 minutes respectively for group A.

The mean weight, age, xylazine dose, total induction dose and total anesthesia duration was 19.50 ± 0.22 kg, 16.500 ± 0.22 months, 9.9167 ± 0.08 mg, 198.33 ± 1.67 mg, 67.500 ± 1.67 minutes and 330.00 ± 1.39 minutes respectively for group B, while the mean weight, age, xylazine dose, total induction dose and total anesthesia duration was 19.833 ± 0.17 , 16.833 ± 0.17 , 9.92 ± 0.08 , 198.33 ± 1.67 mg, 66.67 ± 1.67 and 313.83 ± 2.52 minutes respectively for group C (Table 2).

The mean number of total stitches of vicryl suture material and time taken was 15 ± 0.57 and 12.22 ± 0.55

minutes respectively for the closure of colon in group-A. The mean number of stitches for peritoneum, linea alba, subcutaneous layer and skin were 7.16 ± 0.47 , 7.33 ± 0.21 , 8.66 ± 0.49 , 9.83 ± 0.30 and time for its closure was 6.16 ± 0.47 , 6.33 ± 0.21 , 6.83 ± 0.60 and 8.66 ± 0.21 minutes respectively in group-A. Total duration for laparotomy closure and total duration of surgery was 40.16 ± 1.62 and 50.16 ± 1.62 minutes respectively in group-A (Table 3).

The total number of stitches of Dexon suture material and time taken was 17.00 ± 0.36 and 15.16 ± 0.40 minutes respectively for the closure colon in group-B. The mean number of stitches for peritoneum, linea alba, subcutaneous layer and skin were 8.16 ± 0.30 , 6.83 ± 0.30 , 8.33 ± 0.33 , 9.33 ± 0.21 and time for

Table 2: Anesthetic Protocol and Duration for Closure of Colon with Vicryl, Dexon and Stapling Materials in Dogs

Parameters	Group-A (Vicryl suture material)	Group-B (Dexon suture material)	Group-C (Stapling material)
	Mean± SE	Mean± SE	Mean± SE
Weight (kg)	19.83±0.16	19.50±0.22	19.83±0.17
Age (months)	16.50±0.22	16.50±0.22	16.83±0.17
Xylazine dose (mg)	9.91±0.08	9.916±0.08	9.92±0.08
Induction dose (mg)	198.33±1.05	198.33±1.67	198.33±1.67
Total anesthesia duration (min)	68.33±1.67	67.50±1.67	66.66±1.67
Recovery time (min)	328.33±1.17	330.00±1.39	313.83±2.52

Table 3: Mean Number of Stitches and Total Duration Required for Closure of Colon with Vicryl, Dexon and Stapling Materials in Dogs

Parameters	Group-A (Vicryl suture material)	Group-B (Dexon suture material)	Group-C (Stapling material)
	Mean± SE	Mean± SE	Mean± SE
Abdominal incision length (cms)	5.00 ± 0.00	5.00 ± 0.00	5.08 ± 0.08
Colon incision length (cms)	5.00 ± 0.00	5.00 ± 0.00	5.00 ± 0.00
Total no of stitches for colon closure	15.00 ± 0.58 ^{^^}	17.00 ± 0.37 ^{**}	6.67 ± 0.21 ^{****}
Total duration for colon closure (min)	12.33 ± 0.56 ^{^^}	15.17 ± 0.4 ^{**}	2.67 ± 0.21 ^{****}
Interrupted stitches for peritoneum	7.17 ± 0.48	8.17 ± 0.31	5.33 ± 0.21
Time taken for peritoneum closure (min)	6.17 ± 0.48	7.33 ± 0.21	5.33 ± 0.21
Continuous stitches for linea alba	7.33 ± 0.21	6.83 ± 0.31	5.66 ± 0.33
Time taken for linea alba closure (min)	6.33 ± 0.21	6.00 ± 0.37	5.00 ± 0.26
Sub-cuticular stitches for S/C closure	8.67 ± 0.49	8.33 ± 0.33	5.50 ± 0.22
Time taken for subcutaneous layer closure	6.83 ± 0.60	7.33 ± 0.33	5.17 ± 0.17
No. Of stitches for skin closure	9.83 ± 0.31	9.33 ± 0.21	5.50 ± 0.34
Time taken for skin closure	8.67 ± 0.21	8.33 ± 0.21	5.00 ± 0.26
Total duration for laparotomy closure	40.17 ± 1.62 ^{^^}	44.17 ± 1.01 ^{**}	20.50 ± 0.50 ^{****}
Total duration of surgery	50.17 ± 1.62 ^{^^}	61.17 ± 1.22 ^{**}	25.00 ± 0.50 ^{****}

^{**} = Mean values carrying same superscripts differed significantly (P>0.01), and having different superscripts differed non-significantly with corresponding mean values.

^{^^} = Mean values carrying same superscripts differed significantly (P>0.01), and having different superscripts differed non-significantly with corresponding mean values.

its closure was 7.33 ± 0.21, 6.00 ± 0.36, 7.33 ± 0.33 and 8.33 ± 0.21 minutes respectively in group-B. Total duration for laparotomy closure and total duration of surgery was 44.16 ± 1.01 and 61.16 ± 1.22 minutes respectively in group-B (Table 3).

The mean number of total staples and time taken was 6.66 ± 0.21 and 2.66 ± 0.21 minutes respectively for colon closure in group-C. The mean number of stitches for peritoneum, linea alba, subcutaneous layer and skin were 5.33 ± 0.21, 5.66 ± 0.33, 5.00 ± 0.25, 5.50 ± 0.22 and time for its closure was 5.33 ± 0.21,

5.00 ± 0.25, 5.16 ± 0.16 and 5.00 ± 0.25 minutes respectively in group-C. Total duration for laparotomy closure and total duration of surgery was 20.50 ± 0.50 and 25.00 ± 0.44 minutes respectively in group-C (Table 3).

The results indicated that there was no significant difference in mean number of stitches for colon closure for group A and group B 15.00 ± 0.57, 17.00 ± 0.36 while the mean number of staples of group C were 6.66 ± 0.21 for colon closure which showed significantly lower stitches than stitches required for group A and

Table 4: Mean Percentage of Adhesions with Vicryl, Dexon and Stapling Materials Used for Closure of Colon in Dogs

Groups	No. of dogs	Days after surgery	Adhesion %	Mean \pm SE
Group-A (Vicryl suture material)	1	3	35	29.83 \pm 1.74
	2	3	30	
	3	10	25	
	4	10	25	
	5	20	30	
	6	20	34	
Group-B (Dexon suture material)	7	3	35	30.50 \pm 1.60
	8	3	30	
	9	10	25	
	10	10	28	
	11	20	35	
	12	20	30	
Group-C (Stapler material)	13	3	40	33.00 \pm 1.82
	14	3	35	
	15	10	30	
	16	10	35	
	17	20	30	
	18	20	28	

group B (Table 3). However the [10] reported the mean number of total stitches for abdominal incision closure, interrupted stitches for peritoneum, Continuous stitches for linea alba, Sub-cuticular stitches for subcutaneous layer closure, number of stitches for skin closure and time taken for the closure of each layer were not significantly different from each other in all groups. The total duration for laparotomy and total time of operation was significantly lower in group-C as compared to Group-A and group-B. The present study is similar to corresponding values recorded by [9], who used Vicryl 3/0 for anastomosis of colon in dogs.

The mean percentage of adhesions was 29.83 \pm 1.74, 30.50 \pm 1.60 and 33.00 \pm 1.82 respectively for group A, B and group C (Table 4). The percentage of adhesion of group A, B and group C were significantly different. Similarly study was performed by (Hanson *et al.*, 1988). Comparison of staple and suture techniques for end-to-end anastomosis of the small colon in horses. They observed various parameters in their study the adhesions were not associated with the sutured anastomosis after the 2-week evaluation. The stapled anastomoses, however, had as many adhesions at 2 months (68% of anastomotic circumference) and 6 months (58% of anastomotic circumference) as were found at 2 weeks (52% of

anastomotic circumference). Adhesions were related to the stapled anastomoses in all horses and to the sutured anastomosis in horse 5. Lumen diameters for all anastomoses were smaller than control lumen diameters at 2 weeks, but were larger than control lumen diameters at 2 months and 6 months. For the entire evaluation period, the lumen diameter at the sutured anastomosis was an average of 6 mm greater than that at the stapled anastomoses. The bursting pressure of the isolated segments was determined by a modification of a previously described technique by [2, 11].

The mean lumen diameter (mm) for control and sutured was 49.66 \pm 1.33 and 32.83 \pm 2.08, 48.83 \pm 1.53 and 31.33 \pm 1.76, 50.50 \pm 1.60 and 30.50 \pm 2.14 respectively for group A, B and C (Table 5). The lumen diameter of group A, B and group C were not significantly different.

The mean bursting pressure (mm/Hg) for control and sutured was 235.00 \pm 6.58 and 191.67 \pm 34.00, 232.50 \pm 8.34 and 181.67 \pm 34.07, 253.33 \pm 4.40 and 145.83 \pm 23.03 respectively for group A, B and group C (Table 6). The bursting pressure of group A, B and C were significantly different from each other.

Table 5: Mean Lumen Diameter (mm) with Vicryl, Dexon and Stapling Materials Used for Closure of Colon in Dogs

Groups	No. of dogs	Days after surgery	Control Mean \pm S.E	Sutured Mean \pm S.E
Group-A (Vicryl suture material)	1	3	49.66 \pm 1.33	32.83 \pm 2.08
	2	3		
	3	10		
	4	10		
	5	20		
	6	20		
Group-B (Dexon suture material)	7	3	48.83 \pm 1.53	31.33 \pm 1.76
	8	3		
	9	10		
	10	10		
	11	20		
	12	20		
Group-C (Stapler material)	13	3	50.50 \pm 1.60	30.50 \pm 2.14
	14	3		
	15	10		
	16	10		
	17	20		
	18	20		

Table 6: Mean Bursting Pressure (mm/Hg) with Vicryl, Dexon and Stapling Materials Used for Closure of Colon in Dogs

Groups	No. of dogs	Days after surgery	Control Mean \pm S.E	Sutured Mean \pm S.E
Group-A (Vicryl suture material)	1	3	235.00 \pm 6.58	191.67 \pm 34.00
	2	3		
	3	10		
	4	10		
	5	20		
	6	20		
Group-B (Dexon suture material)	7	3	232.50 \pm 8.34	181.67 \pm 34.07
	8	3		
	9	10		
	10	10		
	11	20		
	12	20		
Group-C (Stapler material)	13	3	253.33 \pm 4.40	145.83 \pm 23.03
	14	3		
	15	10		
	16	10		
	17	20		
	18	20		

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