Laparoscopic assisted colonotomy suture using evertion and inversion techniques in goats

M. J. Eesa[*], F. H. Khalaf[**] and A. F. Ali[*]
[*]College of Veterinary Medicine\ University of Baghdad
[**]College of Veterinary Medicine\ University of Diyala

Abstract

The aim of the study was to investigate colonotomy via hand assisted laparoscopy device and to evaluate the closure by using Connell's and horizontal mattress suture technique. Twelve adult healthy local breed goats were used. They were divided randomly into two equal groups, Connell group and horizontal mattress group. The operations were done under the effect of general anesthesia using xylazine 2% (0.05 mg/kg B.W.) and ketamine 5% (3mg/ kg B.W.) injected intramuscularly together. The enterotomy incision was closed by Connell's pattern in Connell's group and by interrupted horizontal mattress technique in horizontal mattress group using polyglycolic acid suture material (No.0) after exteriorized of part of colon laparoscopically. Each group was divided into two equal subgroups depended on follow up of histopathological examination at a periods of 5 and 15 days post- surgery. The results of clinical examination revealed that the activity and appetite of animals were return early to the normal level, also the physical findings returned to the normal level value with a short time after operation in both groups. The histopathological findings of two groups appeared that there was on an inflammatory phase at a period of 5 days post operation, but the granulation tissue and collagen fiber formation was more prominent in horizontal group compared with Connell's group, while at the 15 days post operation in both groups revealed that a granulation tissue in the incision site which covered by epithelial layer with thick fibrous connective tissue and presence of myofibroblast at the incision site. This indicated that the wound was in a mature phase which was clear in horizontal group than in the Connell's group.

استخدام الجراحة المنظارية المساعدة لخياطة القولون بتقنيتي الحافات المقلوبة للخارج والداخل في المعز

محمد جواد عيسى[*]، فلاح حسن خلف[**] وعبد فاضل علي[*]
[*]كلية الطب البيطري/ جامعة بغداد
[**]كلية الطب البيطري/ جامعة ديالى

الخلاصة

هدفت الدراسة الحالية معرفة التئام شق القولون باستخدام طريقة الجراحة المنظارية المساعدة باستعمال تقنيتي كونيل والمنجد المتوازي المتقطع في المعز حيث استخدمت في التجربة (12) من أناث الماعز البالغة ومن السلالة المحلية. قسمت الحيوانات عشوائياً الى مجموعتين متساويتين (مجموعة كونيل ومجموعة المنجد الموازي). أجريت العمليات الجراحية تحت تأثير التخدير العام بإعطاء الزايلازين 2% (0.05 ملغم \كغم من وزن الجسم والكيتامين 5% (3 ملغم \كغم من وزن الجسم) حقناً بالعضل، تحت تقنية التطهير الجراحي وبطريقة الجراحة المنظارية المساعدة تم استخراج جزء من القولون وعمل شق جراحي وتم أغلاق الشق الجراحي بخياطة تقنية كونيل في المجموعة الأولى وبتقنية المنجد المتوازي المتقطع في المجموعة الثانية وباستعمال الخيط الجراحي الممتص بولي كلايكولك أسيد (حجم 0). قسمت كل مجموعة إلى مجموعتين فرعيتين اعتماداً على اختبار فحص المتابعة النسجية المرضية للفترات 5 و15 يوماً بعد العملية. اظهرت نتائج

الفحص السريري الى ان فعالية والشهية عادة مبكراً إلى المعدلات الطبيعية وكذلك المعايير الفيزياوية أصبحت ضمن المعدلات الطبيعية وبوقت قصير بعد العملية. أوضح الفحص النسيجي المرضي لكلا المجموعتين ان المجموعتين في الطور الالتهابي في اليوم الخامس بعد العملية وتكون النسيج الحبيبي وألياف الغراوين (الكولاجين) كان اكثر وضوحاً في مجموعة المنجد المواز مقارنة بمجموعة كونيل بينما اظهر الفحص المرضي النسجي لكلا المجموعتين لفترة اليوم الخامس عشر بعد العملية الى وجود النسيج الحبيبي في منطقة الشق الجراحي مغطى بطبقة من الظهارة مع وجود نسيج ليفي ضام ووجود خلية الارومة العضلية الليفية في مكان الشق الجراحي والتي تشير الى ان الجرح أصبح في مرحلة النضوج التي كانت اكثر وضوحاً في مجموعة المنجد المواز المتقطع مقارنة بمجموعة كونيل.

Introduction

Laparoscopic surgery describes the performance of surgical procedures with the assistance of a video camera, light source, insufflators and several thin instruments (1). The increased uses of intestinal laparoscopic surgery has resulted in less pain, decreased morbidity and shorter hospitalization after the surgical treatment of many diseases and decreased post-operative ileus, fewer pulmonary complications and reduced costs of care (2). Laparoscopic techniques in the treatment of various bowel diseases have become more and more popular as clinical routine (3). Enterotomy is an incision into the intestine is most often indicated for gastrointestinal perforation, ischemia, malpositioning, infection, and diagnostic or supportive procedures such as biopsy, culture, cytology and feeding tubes (4). The colonic incision may be closed by a single-layer or two - layers techniques. The gastro- enteric single-layer technique was low time and it is safe, simple, easy to perform, quick and reliable (5 and 6). The aim of the study was compared between two techniques, Connell's and interrupted horizontal mattress patterns for closure of longitudinal colonic incision via laparoscopic assisted surgery.

Materials and Methods

Twelve adult healthy local breed does were used, aged range between 2-4 years and 25-40 kg in weight. The animals were divided randomly into two equal groups as the following: The Connell's group and horizontal group. Each group was divided into two equal subgroups (3 animals of each) depended on follow up of histopathological examination at a periods of 5 and 15 days postoperation. In addition to the clinical and physical examination was achieved to determine the condition of the animals. The laparoscopic instruments were used in this study (Fig.1 and 2).

Fig. (1) Laparoscopic system; LCD monitor (A), Insufflator unit (B), Electro-cautery (C), DVD recorder (D), Video-camera system (E), Xenon light sources (F) and suction-irrigation machine (G).

Fig. (2) Laparoscopic instrument; grasper forceps (A), Trocar (B), cannula (C) (10 mm) Verses needle (D) and probe or cannula for suction and irrigation machine (E).

Animals were withheld of food for 48 hrs, and water for 12 hrs. prior to operation. Ventral abdominal region was prepared aseptically from the xiphoid cartilage to the pubis and laterally as far as possible to the flanks. Animals were received systemic antibiotic (penicillin- streptomycin) at 2hrs before surgery at a dose of 22000 I.U/Kg B.W. and 20 mg/Kg B.W. injected intramuscularly (7). The operation was performed under general anesthesia by a mixture of xylazine hydrochloride 2% (xyla 2% Castenray, Holland) at dose of 0.05 mg/Kg B.W. and ketamine hydrochloride 5% (Kanox injection. 50 duopharma- Malysia) at dose of 3 mg/Kg B.W intramuscular (8). The operative animal was in dorsal position with head and chest region slightly down word and rotated to left side. Two sites were labeled for two ports. The first one was at umbilicus for telescope and the second port right to the mid-line for the grasping and pulling the part of colon. 1 cm umbilical skin incision was made, then using artery forceps for adequate dissecting subcutaneous tissue. Abdominal wall should be held full thickness with help of thenar, hypothenar and all the four fingers of surgeon and assistant to facilitate and safety entry of Veress needle (Fig .3). Once its confirmed that Veress needle inside the abdominal cavity, the tubing of insufflations was attached and flow of Co_2 gas was started at a rate of 3.5 L/min. to obtain 8-10 mmHg intra-abdominal suitable pressure for this operation. Veress needle was removed and 10 mm port was inserted at the same incision to introduce of telescope into abdominal cavity, and reattached tubing of insufflation to maintenance of Co_2 insufflation, inspection of abdominal wall and viscera for any vessels or bowel injury or any abnormalities. Under vision inserted second port (10 mm) to helping of introducing of grasper or suction-irrigation if needed (Fig. 4). After colon was identified, hold part of it's by grasper to pull it outside the abdominal cavity (Fig. 5) and exteriorized with port after 1-2 cm enlargement of its port incision. This technique was incorporated with deflating and at the same time of removal of telescope once the part of colon was seen at the surface of abdominal wall (Fig. 6). The contents of segment of exteriorized part was milking into its part inside abdominal cavity in order to reduce the ingesta of the exteriorized part, then 4-5 cm enterotomy incision was made at the anti-mesenteric area, which closed by Connell technique in Connells groups and interrupted horizontal mattress technique in horizontal mattress group using poly glycolic acid (PGA) (No.0) (Fig. 7 and 8) respectively. Normal saline 0.9% was used to flash of exteriorized colon before inserted into abdominal cavity. Skin and muscles of second port was closed routinely. Regain insufflations and telescope was inserted inside the abdomen to inspect the position and enterotomy of colon (Fig.8 and 9). Removal of telescope and port, complete deflation and closed incision routinely.

Animals were injected systemic antibiotic (penicillin-streptomycin) at in a dose which mentioned before for 4 days intramuscularly. Fluid therapy was administrated I.V during 24 hrs. postoperation and gradually returned to normal foods. Skin suture was removed at 10 days postoperation. The animals were examined physically and clinically for temperature, respiratory rate, heart rate, defecation and urination during a period of one week post operation. Experimental animals were checked laparoscopically to investigate any pathological changes at the same time of biopsy at a period of 5 and 15 days post-operative. Biopsies were taking from all animals form the site of enterotomy and kept in a solution of 10% formalin, and then staining with hemotoxilin and eosin for histopathological examination to compare the degree of healing between the two groups.

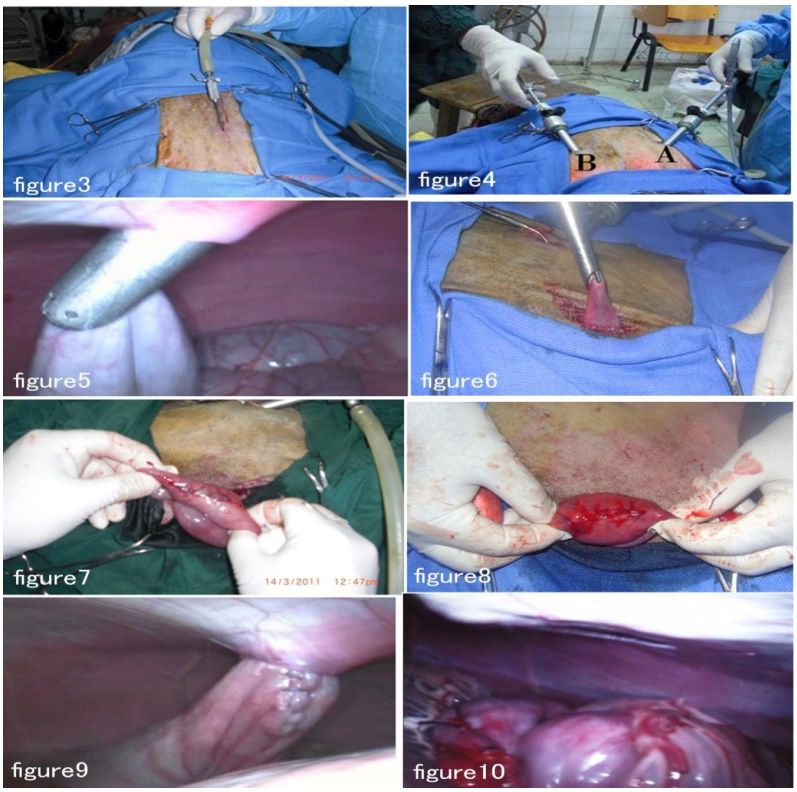

Fig. (3) Inserted of Verses needle in umbilical area.

Fig. (4) Inserted of two ports, Laparoscope (A) and port of Suction- Irrigation or used for grasper forceps (B).

Fig. (5) Grasping a part of the colon and pulling into the near tip of Cannula inside abdominal cavity.

Fig. (6) Exteriorized a part of colon, outside of abdominal wall.

Fig. (7) Connell's suture technique, to close longitudinal incision of colon.

Fig. (8) Interrupted Horizontal matters suture technique, to close longitudinal incision of colon.

Fig. (9) Show colon during insertion to abdominal cavity.

Fig. (10) Show Position of the colon in inside abdominal cavity.

Results and Discussion

The experimental animals of both groups were examined physically and clinically during the period 5^{th} and15^{th} days post operation according to design of the study. The animals appeared normal in activity and the physical parameters were within the normal ranges at the fourth day postoperation. Days 2- 4 post operation there was slight swelling at the site of incision and disappeared after 5 day postoperation, there was no abnormalities at the incision site and the animals activity and appetite were returned to normal range at short period after surgery .This results were similar to the observation mentioned by other researcher (9) whom their study were made on the colonic anastomosis in dogs and (10) on small colon anastomosis in horses. The main pathological lesion in the period of the 5 days post operation in Connell's group characterized by hematoma, and tissues necrosis with inflammatory cells infiltration mainly neutrophils in the incision site with granulation tissue started to form in the base of the incision, also showed hemorrhagic clot blood, fibrin deposition and neutrophils infiltration in the incision site with granulation tissue replaced fibrin deposition (Fig. 11), mononuclear cells infiltration were reported between mucosal glands, fibrin deposition and few neutrophils infiltration were seen in the incision and granulation tissue which consist of congested blood vessels and cellular collagen extend to fibrin deposition in the incision (Fig.12). At the period of 15 days post operation, the main

lesion characterized by congested blood vessels and the inflammatory cells infiltration were decreased in number between mucosal glands with mononuclear cells in the sub - epithelial layer and mucosal glands as well as goblet cells hyperplasia (Fig.13), the suture space contain suture materials, myofibroblast and surrounded by dense fibrous connective tissues (Fig.14). The microscopic examination at a period of 5 days post operation in horizontal mattress group showed neutrophils infiltration in the incision site with necrotic debris and congested blood vessels (Fig.15). Fibrin deposition and granulation tissue which extend to the necrotic area were reported, the fibrin network deposition with neutrophils infiltration were seen in the sub- epithelial layer adjacent to incision site (Fig.16). At the period of 15 days post operation, the microscopic section revealed that the cellular granulation tissues in the incision site cover by epithelial layer consist of cuboidal or columnar cells with goblet cells (Fig.17). The microscopic section showed space contain suture material and surrounded by thick fibrous connective tissue, mononuclear inflammatory cells were seen between mucosal glands and sub-epithelial layer and necrotic debris in mucosal glands. Fibrous connective tissue and myofibroblast closed the suture space were seen in the sub- mucosa together with mononuclear cells infiltration and the giant cells also noticed (Fig.18). The results of histopathological examination at the period of 5 days postoperation for both groups, revealed that, there were hemorrhage and infiltration of inflammatory cells mainly neutrophils, this may be due to increase porosity of blood vessels by action of chemical mediators which released from platelets. This result agreed with other researcher (11 and 12). Granulation tissue formation in horizontal mattress group which consist of blood vessels and proliferation of fibroblast with collagen production and mononuclear cells infiltration, that revealed the proliferation phase was started, this agreed with other (13) whom said that the fibroblasts begin entering the wound site two to five days after wounding as the inflammatory phase is ending and making the onset of proliferative phase. This mean that healing process of intestinal wound of horizontal mattress group was better than that in Connell's group, this result may be due to a good apposition of averting interrupted suture in intestinal wound leads to an increase of blood flow to incision site more than in inverted continuous suture. This leads to enhance the process of wound healing which interferes with collagen formation process, this agreed with other researcher (14 and 15). The histopathological findings of both groups at the period of 15 days postoperation showed granulation tissue in the incision site which covered by epithelial layer consist of cuboidal or columnar cells with goblet cells and surrounded by thick fibrous connective tissue and mononuclear inflammatory cells infiltration between mucosal glands and sub-epithelial layer and myofibroblast closed the suture space. This mean the inflammatory process in ending phase, because the presence of myofibroblast in the wound site revealed to the wound in mature phase, this result agreed with (12). But the stages of maturation phase was more clear in horizontal group than in the Connell's group, these results consisted with other researchers (16) in his study of colonic anastomosis in goats. In conclusions of this study revealed that this technique was easily to achieve with minimal complications.

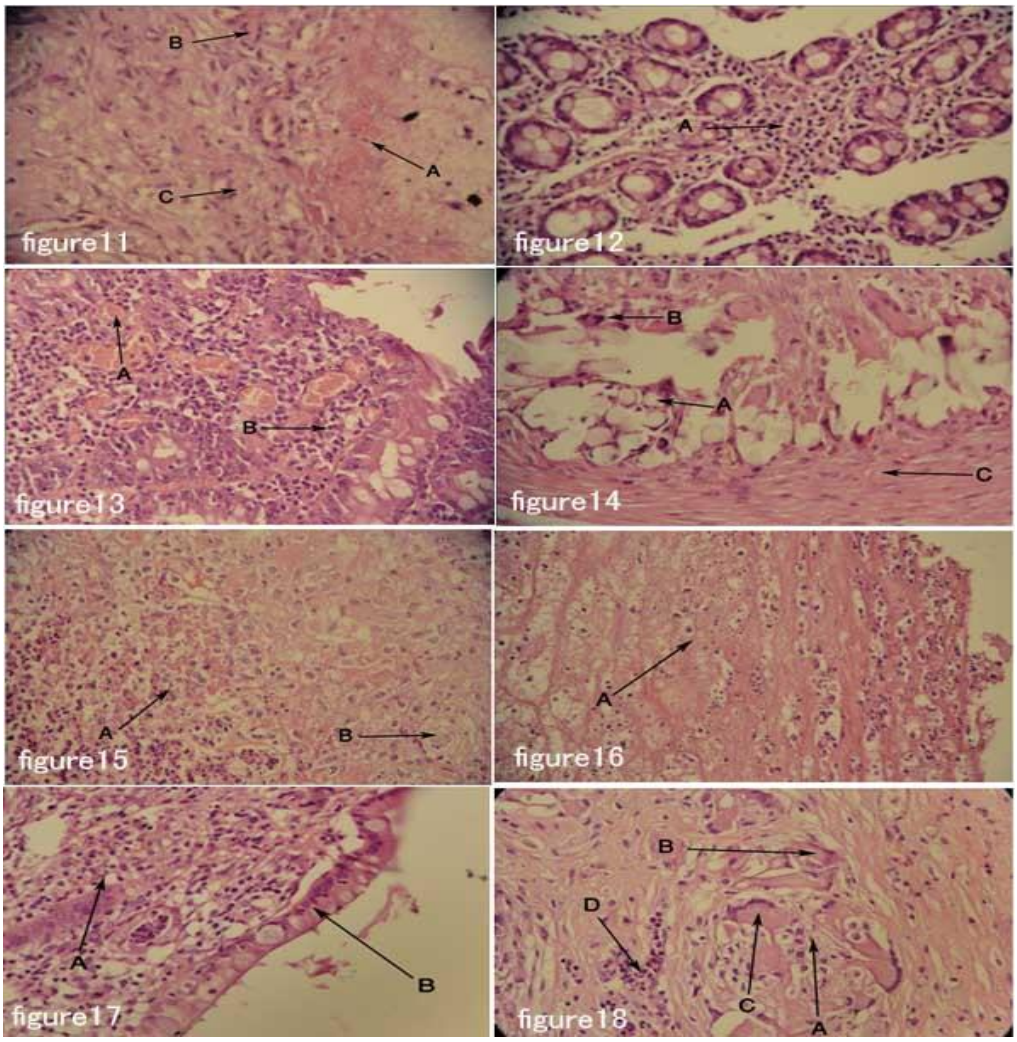

Fig. (11) Clot blood, fibrin deposition (A) and granulation tissue (C) as well as neutrophils infiltration (B) at 5 days postoperative in Connell's suture technique (H & E. X 40).

Fig. (12) Mononuclear cells infiltration (A) between mucosal glands at 5 days postoperative in Connell's suture technique (H & E. X 40).

Fig. (13) Congested blood vessels (A), inflammatory cells particularly mononuclear cells infiltration in the lamina properia and between mucosal glands (B) at 15 days postoperative in Connell's suture technique (H & E. X 40).

Fig. (14) The suture space contain suture material (A), myofibroblast (B) and surrounded by dense fibrous connective tissue (C) at 15 days postoperative in Connell's suture technique (H & E. X 40).

Fig. (15) Neutrophils infiltration, cellular debris (A) and granulation tissue extend to the necrotic area (B) at 5 days postoperative in horizontal mattress group (H & E. X 40).

Fig. (16) Fibrin deposition with neutrophils infiltration in the incision site (A) in the horizontal mattress suture technique at 5 days postoperative (H & E. X 40).

Fig. (17) Epithelial layer composed of columnar epithelial cells and cuboidal cells together with goblet cells (B) over granulation tissue infiltrated by mononuclear cells (A) in the horizontal mattress suture technique at 15 days post-operative (H & E. X 40).

Fig. (18) Closed of suture space by fibrous connective tissue (A), myofibroblast (B) as well as gait cells (C), neutrophils, macrophage (D) in horizontal mattress group (H & E. X 40).

References

1. Monnet, A. S. & David, C. T. (2003). Laparoscopy Clinc. Sm. Anim., 33:1147-1154.
2. Ghosheh, B. & Salameh, J. R. (2007). Laparoscopic approach to acute small bowel obstruction: Review of 1061 cases. Surg. Endosc., 21:1945- 1949.
3. Raphael, R.; Stumpf, M.; Junge, K.; Ardic, D.; Ulmer, F. & Schumpelick, V. (2004). Impact of pressure and gas type on anastomotic wound healing in rat. Langenbecks Archives of Surg., 389 (4): 261- 266.
4. Fossum, T. W. (2007). Surgery of the digestive system. Small animal surgery. 3rd. ed. By Mosby, Inc. PP. 159-489.
5. Demartines, N.; Marc Rothenbuhler, J.; Pierre Chevalley, J. & Harder, F. (2005). The single- layer continuous suture for gastric anastomosis. World J. of Surg., 15 (4): 522- 525.
6. Nieto, J. E.; Dechant, J. E. & Snyder, J. R. (2006). Comparison of one-layer (continuous Lembert) versus two-layer (simple continuous/Cushing) hand-sewn end-to-end anastomosis in equine jejunum. Vet. Surg.,35 (7): 669-673.
7. Haskell, S. R. R. & Anttila, T. A. (2001). Small Ruminant Clinical Diagnosis and Therapy. Editors: Melissa carrtaryn dentinger rachel preston. University of MN, College of Veterinary Medicine. Minnesota. PP. 51-52.
8. Ivany, J. M. & Muir, W. W. (2004). Farm Animal Anethesia. In: Fubini, S. L. and Dusharme, N. G. Farm animal surgery. Saunders Company PP. 97- 112.
9. Kachiwal, A. B. & Kalhoro, A. B. (2003). Histopathological evaluation of two suturing techniques for end-to-end anastomosis of colon in dogs. Pakistan Vet. J., 23 (2): 54-58.
10. Hanson, R. R.; Nixon, A. J.; Calderwood-Mays, M. & Gronwall, R. (1988). Evaluation of three techniques for end- to- end anastomosis of small colon in horses. Am. J. Vet. Res., 49: 1613- 1620.
11. Fowler, D. (1993). Principle of wound healing. In: Harari, J. Surgical Complication and wound healing in the Small Animal Practice Saunders Company. PP. 2-27.
12. Deodhar, A. K. & Rana, R. E. (1997). Surgical physiology of wound healing: review. J. Postgraduate Medicine (JPGM). 43. (2): 52-56.
13. Stadelmann, W. K.; Digenis, A. G. & Tobin, G. R. (1998). Physiology and healing dynamics of chronic cutaneous wound. Am. J. of Surg., 176 (2): 26- 38.
14. Ballantyne, G. H. (1983). Intestinal suturing. Review of the experimental foundations for traditional doctrines. Dis. Colon Rectum., 26 (12): 836-843.
15. Shandall, A.; Lowndes, R. & Young, H. L. (1985).Colonic anastomotic healing and oxygen tension. Br. Surg., 72: 606.
16. Ibrahim, J. Kh. (2010). A comparative study between cross mattress and schmiedens suture techniques on colon end- to- anastomosis in goats. M.Sc. thesis, Vet. Medicine College. Baghdad University. Iraq. (unpublished).