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ARTERIAL VASCULATURE OF THE DESCENDING COLON IN DOG BEFORE AND AFTER EXPERIMENTAL RESECTION

(With 3 Figs.)

By

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المدد الدموي الشرياني للقولون الهابط في الكلب قبل وبعد إستئصال جزء منه

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أجري الجزء التشريحي لهذا البحث على عدد خمس عشراً كلباً بعد حقن الشريان المساريقى الخلفي بمادة البطاط السائل وكذلك بمادة غير نافذة للأشعة . وقد وجد أن الشريان القولوني الأيسر يتوزع داخل القولون الهابط على هيئة نظامين السطحى والغائر . حيث ان التفرعات القولونية للأفرع السطحية تتوزع تحت الطبقة المصابة موازية للطبقة العضلية الطولية ولكن التفرعات القولونية للتفرعات الغائرة تتوزع تحت الطبقة العضلية . أما الجزء الجراحي لهذا البحث فقد أجرى على عشرين كلباً وذلك لتقييم إستئصال ٤ سم ، ٦ سم من القولون الهابط على الدورة الشريانية لهذا الجزء المستئصل . وقد لوحظ بأن مكان الإستئصال يتغذى بتفرعات جانبية وذلك من الشريان القولوني الأيسر والأوسط ودلك عندما كان الإستئصال أمام الشريان المساريقي الخلفي . وقد تم الحكم على درجة الإتصال القولوني والتئامه بالفحص الاشعاعي بإستخدام المواد غير النافذة للاشعة بالإضافة إلى إستخدام الباريوم بالحقن الشرجي .

SUMMARY

The normal arterial vasculature of the descending colon of 15 native breed dogs was anatomically studied after injection with gum milk (Latex) and radioopaque substance. The left colic artery of the caudal mesenteric artery is distributed within the colon in superficial or deep manner. The colic twigs of the superficial branches are distributed under the serosa parallel to the longitudinal muscular layer while that of the deep colic branches are distributed under the muscular layer of the colon.

Experimental resection of 4 cm and 6 cm from the descending colon was carried out on 20 native breed dogs in order to evaluate the influence of segmental colonic resection on the arterial vasculature of that part. After resection, the area of operation which lies cranial to the

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origin of caudal mesenteric artery is supplied by side branches from the left and middle colic arteries. The degree of anastomotic healing was assessed on radiological examination through angiography of the part of colon in addition to the barium enema.

INTRODUCTION

Diseases of the colon and rectum are common resulting from a variety of causes. The cause will be an important factor in the selection of treatment. Neoplasma are not uncommonly encountered in the posterior bowel. Benign lesions, such as adenomas, arising in the colon may require segmental resection of the colon for complete removal (MOJRAB, 1975). The author indicated resection of about 70% of the colon without adverse effects.

Complications following colonic anastomosis are and still a serious problems. The majority of these complications are due to anastomotic failure (FOUSSELOT and SLATTARY 1964; GETZEN, et al. 1966 and HARGREAVES and KEDDIE, 1968) which is mostly accompanied by a high mortality (SCHROCK, et al. 1973). Many factors have been included as causing complications, such as tension over the anastomosis, disturbed blood supply, leakage, local trauma, obstruction and infection (HAMLEY, 1973 and JIBORN, et al. 1978).

The aim of the present work is to evaluate the influence of segmental resection of descending colon by means of studying its arterial vasculature in nomral dogs and follwing surgery.

MATERIAL and METHODS

The anatomical work was carried out on 15 adult healthy dogs of both sex. The investigated animals were anesthetized with combelen and thoroughly bled through the common carotid artery. For studying the arterial vasculature of the descending colon, the abdomen is dissected and the intestine with its blood vessels is obtained in fresh state. Ten specimens were injected through the cranial and caudal mesenteric arteries with gum milk (Latex), while the remaining five dogs were injected with radioopaque subatance, barium sulphate 40%. The nomenclature used is that adopted by N.A.V. (1983).

The surgical study was carried out on 20 clinically healthy native breed dogs varying in weight from 8-19 kg and in age from 2 to 5 years. They were under clinical observation before and after operation. The animals were divided into two equal groups depending upon the length of the resected part from descending colon. In the first group 4 cm from the descending colon was resected, while in the second group 6 cm from the colon was removed. All animals of both groups were subjected to laparotomy through a mid line incision under the effect of intravenous general anaesthesia using thiopental sodium (Nesdonal, Specia), ten minutes after intramuscular tranquelization with propyl

promazine combelen (Bayer)* in a dose of 0.05 ml/kg body weight. The small blood vessels of the resected segment were ligated. Care was taken not to injure the caudal mesenteric vessels. A measured segment fro the descending colon was resected and end-to-end anastomosis with inverted lembert suture was performed using 3/0 eyeless catgut.

Barium enema was performed preoperatively and at 15, 30 and 45 days to outline the lumen of the bowel. Five dogs from each group were sacrificed 45 days Post-operatively. The rest were left alive. The colon was dissected free along the mesenteric border. 10-15 cm in length with the line of anastomosis in the middle was exteriorized. These specimens were used to study the arterial vasculature of anastomotic segment using gum milk (Latex) and barium sulphate.

RESULTS

The main arterial blood supply to the descending colon comes from the caudal mesenteric artery. It originates in dogs from the abdominal aorta nearly at the level of th 5th lumbar vertevra.

The caudal mesenteric artery (Figs. 1, 2/3) passes within the descending mesocolon till about 1 cm from the attached border of th descending colon where it divides into the equal sized left colic and cranial rectal arteries.

The left colic artery (Fig. 1/4) courses within the descending mescolon in a cranial direction to join the middle colic artery (Fig. 1/2) which supplies the transverse colon and the initial portion of the descending colon.

The colic branches of the left colic artery arise from the colic aspect of the artery at short regular intervals. Each colic branch divides into nearly two equal branches for both sides of the colic tube. As they reach the colic wall, the colic branches either distribute in superficial or deep manner. The superficial colic branches pass in irregular course and detach fine twigs at right angles. These twigs course under the serosa parallel to the longitudinal muscular bundles of the outer longitudinal muscular layer of the colic wall and terminate within it. The deep colic branches disappear under the muscular layer to distribute in the deep layer of the colic wall. At the antimesenteric border of th descending colon the most colic twigs of the superficial and deep colic branches of both sides join, forming a sort of arterial loops around the colic tube.

The role of the middle colic artery (Fig. 1/2) in vascularization of the initial part of the descending colon is restricted on few colic branches arising from its ventral aspect. These colic branches are relatively longer and weaker than that of the left colic artery. On reaching the colic wall the colic branches of the middle colic artery

* Bayer Leverkusen, West Germany.

are distributed in similar pattern as those of the left colic artery. In two cases the colic branches of the middle colic artery divide in a dichotomic manner, the resulting branches join each other forming a longitudinal anastomotic vessel which courses near and parallel to the attaned border of th colic tube. A short similar vessel joins also three or four colic branches of the left colic artery.

The cranial rectal artery (Fig. 1/5) supplies the caudal part of the descending colon and the initial part of the rectum. It communicates with the middle rectal artery.

Fifteen dogs had survived after surgery in good general condition. No complications developed in any of the animals except two dogs from the first groups, and three from the second one, died between 12-72 hours Post-operatively. Post-mortum examination of the dead animals revealed that the death was due to leakage from the anastomosis resulting in severe diffuse peritonitis.

All radiographic studies following barium enema in the 15 dogs sample after one month, was sealed off across the anastomosis (Fig. 3 A & B) in both groups. The colon proximal to the site of anatomosis was dilated with respect to the distal part. Stenosis of the lumen of colon was noticed in some of the animals specially those subjected for resection of 6 cm from their colon.

Radiographs of the arterial vasculature of the descending colon following resectio revealed that the area of operation is supplied by side branches from both the left and the middle colic arteries toward the site of anastomosis. The anastomotic site is completely avascular and had no any type of over crossing or communication between the left and the middle colic arteries (Fig. 2/C).

DISCUSSION

The origin, course and branches of the caudal mesenteric artery studied in th examined specimens are similar to that of the same vessel as described by MILLER, et al. (1964) in dog, GHOSHAL (1975) as well as WILKENS and NUNSTER (1981) in some domestic animals and in rabbit by AHMED, et al. (1984).

The inferior (caudal) mesenteric artery in man gives off left colic; sigmoid and superior recta arteries as recorded by WILLIAMS and WARWICK (1980). The sigmoid branches which reported by ABDALLA, et al. (1980) as wll as WILLIAMS and WARWICK (1980) in man are present also in ruminant animals and distribute inthe sigmoid colon which is present only in this species of animals as mentioned by WILKENS and MUNSTER (1981).

The marginal artery reported by WILLIAMS and WARWICK (1980) in man is similar in distribution to the longitudinal anastomotic vessel which joins the colic branches of the middle colic artery and described in two cases of the present work.

COLON RESECTION

The arterial vasculature following the operation depending upon its localization either cranial or caudal to the level of the caudal mesenteric artery. In the present work the area of operation was about 2-3 cm cranial to the level of origin of the caudal mesenteric artery, so the arterial blood comes from side branches of both left and middle colic arteries. In inversion technique the angiograms demonstrated comparatively deficient vascularity at the anastomotic site and also crossing over of vessels at a few points. In a similar study performed on the small intestine of the calves, SINGH, (1981) observed that the intestinal anastomotic line was completely avascular up to the third post-operative day. They also found that the crossing over and anastomosis of newly proliferated vessels across the anastomotic line was observed within ten days post-operative, the matter which was not observed in colon anastomosis of this study up to one month post-operative. Proximal and distal parts to the area of anastomosis are supplied by side branches from both the left and middle colic arteries towards the site of anastomosis, but the two branches not communicate each other up to one month post-operative, and the anastomotic site was observed completely avascular. SINGH, et al. (1981) and CANALIS and RAVITCH (1968) observed early vascularization within the third to the seventh post-operative day. Earlier vascularization at the third day were observed by SINGH, et al. (1981) on angiographic studies. In man DU-PLESSIS (1975) stated that the marginalartery can maintain the vitality of the left (descending) colon even after the inferior (caudal) mesenteric artery has been ligated at its origin.

In gastrointestinal surgery, the anastomotic complications such as leakage and dehiscence are serious problems. Many factors has been implied as causing these complicatios such as tension over the anastomosis, disturbed blood supply, local trauma, obstruction and infection (IRVIN and GOLIGHER, 1973 as well as JIBORN, et al. 1978).

Fortunately, colon anastomosis performed in the present work was sealed off across the anastomosis. Five out of twenty dogs, were died due to leakage resulting in severe diffuse peritonitis. Similar results were recorded by HANSON and NIXON (1986) in horses who found severe peritonitis from leakage and impaction were the most common post-operative complications. MELLISH (1966) stated that serosa-to-serosa suture is important in avoiding leakage at the anastomosis. Some cases of the present work showed stenosis of the lumen of colon. This stenosis may be due to the inverting technique used. The inverting anastomosis results in an intraluminar shelf. This shelf had sloughed away 7 days following anastomosis as shown by HRGREAVES and KEDDIE (1968). MELLISH (1966) stated that serosa-to-serosa suture is important in avoiding leakage at the anastomosis. In another study, JIBORN, et al. (1978) concluded that a continuous suture in the colon anastomosis results in functional obstruction during the first week of healing even through great care is taken to prevent narrowing of the lumen when the anastomosis are constructed.

The suture techniques for colon anastomosis have been discussed in the literature in the last two decades. Most of th investigations favor the inverting technique based

on both experimental (HARGREAVES and KEDDIE, 1968; IRVIN and EDWARDS, 1973; TANTAWY, et al. 1979) and clinical surgery (GOLIGHER, et al. 1970). In this respect, IRVIN and EDWARDS (1973) estimated the tensile strength of both everting and inverting anastomosis and stated that the tensile strength of the everting anastomosis had actually diminished by 7 days after operation, whereas the bursting pressure had increased by this time in inverting anastomosis and the latter were significantly stronger than everting anastomosis.

It was though that two layers inverting anastomosis is the better and safe method, however, is associated with stenosis or obstruction more than the one-layer method. HARGREAVES and KEDDIE (1968) suggested that the temporary transverse colostomy is beneficial in relieving this obstruction.

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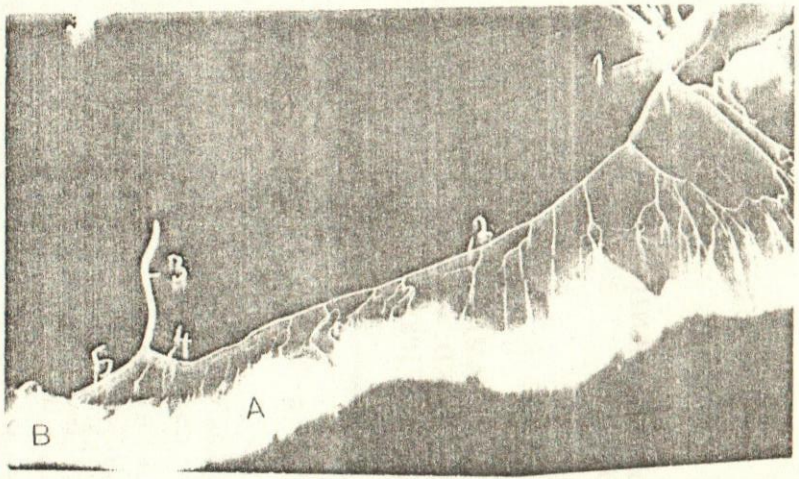
LEGENDS OF FIGURES

Fig. (1, 2): Radiographs of the arterial vasculature (injected with barium sulphate 40%) of the desanding colon before surgical resection (Fig. 1) and after removal of 4 cm from the colon (Fig. 2). A- Colon descendens. B- Rectum. C-Site of surgical resection.
1) A. mesenterica cranialis. 2) A. colica media.
3) A. mesenterica caudalis. 4) A. colica sinistra.
5) A. rectalis cranialis.

Fig. (3 A, B): Barium enema of the dogs one month following resection of 4 cm (A) and 6 cm (B) of the descending colon.

3a



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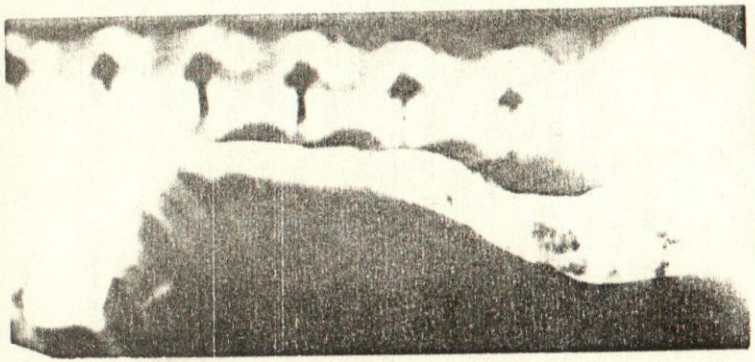
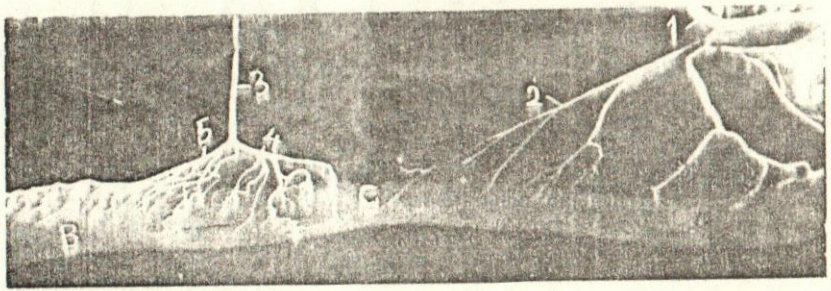


3b



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