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EQUINE LAPAROTOMY

With special reference to intestinal surgery

A thesis presented

By

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To

My Father,

My Mother,

And

My Brothers

(Mohammed and Bahaa)

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Introduction

INTRODUCTION

Applied surgery in equines has important advances in our country in the last two decades. The laparotomy for exploratoration and therapy has allowed for the recovery of horses presenting acute abdominal syndrome, which causes strong economic losses. Although the surgical therapy is not always reachable to every veterinarian and horses owners, it remains a procedure, which may allow keeping of some valuable horses.

Since the 1970s there have been major advances in knowledge about the pathophysiological mechanisms involved with various forms of colic, in surgical and anesthetic techniques, and in critical care of the pre- and postoperative colic patient; these have been partly responsible for increasing the survival rates ***(Mair and Smith, a-2005).***

Although the majority of colic cases resolve either spontaneously or with simple medical treatment, a high percent (up to 10%) prove fatal unless treated surgically ***(Hillyer, Taylor and French , 2001)***.

Eggleston, Mueller, Neuwirth, Harmon, and Quandt (2000) stated that, despite of improvements in diagnostic, anesthetic, and surgical techniques, long-term survival rates for cases requiring surgery, only approach 50–60%.

From a point of importance of colic surgery in equine and its complications, peritoneal fluid evaluation is an important aspect in diagnosis of acute abdominal diseases and follows up after abdominal surgery in horses. In this sense, this study was planned to compare the effects of experimental exploratoration of the abdomen, jujenal resection and anastomosis, enterotomy of the colon, and typhlotomy on the concentration of total protein, fibrinogen, and the cellular composition of the peritoneal fluid, and determine at which the peritoneal fluid values return to normal.

Review Of Literatures

REVIEW OF LITERATURES

The ventral midline celiotomy

The decision for exploratory laparotomy should based on history, clinical signs[abdominal distension, reduced faecal output, progressive abdominal pain and abdominal pain unresponsive to medical therapy (analgesia, fluid therapy and nasogastric administration of paraffin oil)] and results of additional diagnostic procedures: nasogastric intubation, transrectal palpation, abdominal ultrasonography, abdominal radiography and peritoneal fluid analysis, are considered suggestive of an intestinal lesion that required surgical intervention ***(White-a, 1990 and Moore and Medical, 1997)***

Hickman (1985) mentioned that, the ventral midline celiotomy is only comparatively recently that it has been employed routinely in clinical cases. Without doubt the ventral midline celiotomy is the most versatile approach and is used now universally for colic surgery.

Brad and Allen (1988) stated that, when the diagnosis of intestinal obstruction is unknown, the ventral midline approach should be used because it offers the best opportunity for exploring the gastrointestinal tract and intestinal manipulation. They added that the animal needs to be balanced exactly in dorsal recumbancy, this reduces the stress on the incision and facilitates abdominal exploration and wound closure.

Hay (1999) mentioned that, starting the incision in the linea alba near the umbilicus is more preferable as the linea alba is wider at that location, so it minimize the chance of an unplanned paramedian incision.

Mair, Divers, Ducharme, (2002) said that, the incision starts at the umbilicus and extends anteriorally for 30 cm. After cauterization of cutaneous and subcutaneous blood vessels, the incision is extended to the subcutaneous tissue.

Freeman, Rötting and Inoue, (2002) stated that, the standard ventral midline incision extends for 25 to 30 cm from a point 2.5 cm cranial to the umbilicus. He added that a more cranial approach would also be indicated if preoperative information suggested a lesion in the cranial part of the abdomen, such as diaphragmatic hernia, gasterodudenal lesion, renal or uretral surgery in a foal. A more caudal incision is required for cesarean section, surgery of the bladder and umbilical component and for access to lesions in the distal part of small colon. Caudal incision in male horses requires a paramedian skin incision around the prepuce and reflection of the skin edges laterally to expose the body wall.

Mair, et. al. (2002) advised that, once the linea alba has been incised over 2-4 cm, a long handled forceps is placed into the abdomen (still outside the peritoneum) and directed cranially while lifting the linea alba. This serves as a guide and protects viscera from accidental injury during the approach, the incision is then extends cranially taking care to stay in the linea alba.

Huskamp (1977) stated that, the very heavy abdominal viscera exert considerable pressure directly upon the site of a midline laparotomy incision, and the stress is increased the further forward the incision extends. ***Noorrsdy (1979)*** added that midline incision heals more slowly than paramedian or flank incision because of the relative lack of vasculature to the linea alba.

Freeman, et. al. (2002) stated that, layers of the abdominal wall should not be undermined or separated during incision or closure, because this is traumatic, creates dead space, and could reduce blood flow to wound margins.

Abdominal exploration

Prior to manipulation of the small intestine, 1 liter of 1% solution of carboxymethylcellulose can be placed into the abdomen to prevent serosal irritation during manipulation; this is recommended in foals but optional for adult, ***(Mair, et. al. 2002).***

Southwood and Baxter (1997) stated that, if the small intestine is distended, it's best to identify the ileum and exteriorize the small intestine starting distally until the lesion is found. The apex of the cecum is exteriorized and pulled caudally exposing the dorsal and lateral bands of the cecum. Tracking the dorsal band rostrally, the iliocecal fold is identified and followed toward the base of the cecum until the ileum is found and identified by its thicker wall and the anti-mesenteric attachment of the iliocecal folds.

Mair, et. al. (2002) said that, while manipulation of the small intestine, the intestinal wall itself is grasped while taking care not to pull on the mesentery, which is especially friable in foals. The small intestine is exteriorized until the obstruction is localized, or the duodenum is reached. If the obstructed site cannot be exteriorized, one should attempt to reduce the obstruction abdominally and then exteriorize the involved intestinal segment.

Freeman (2003) said that, if the lesion cannot be seen or palpated immediately, use a systematic approach, based on tracing from fixed or easily located segments to segments that cannot be exteriorized or readily identified. He added that, limitation of the incision provides little exposure of dorsal abdomen.

Hay (1999) stated that, if the large intestine is distended and is the site of intestinal lesions, the incision is lengthened appropriately to allow safe exteriorization. Gas decompression from the cecum and the large intestine is a real possibility during manipulation and exteriorization if it is distended. The surgeon places an arm underneath the left colon while an assistant lifts and retracts the left side of the incision. The goal is to exteriorize the pelvic flexure first.

Southwood and Baxter (1997) mentioned that, if the colon is markedly distended by fluid and solid materials, enterotomy needs to be performed to empty the colon prior to further manipulation.

Southwood and Baxter (1997) and Hay (1999) said that, the small colon is exteriorized by finding its characteristic contents in the caudal abdomen and retracting it out of the abdomen.

Small intestine

Ducharme, Hackett, Ducharme, and Long (1983) noticed that, the obstruction of the small intestine represents an important cause of surgical colic in the horse and ***Mair et. al. (2002)*** stated that, small intestinal obstruction account for approximately 40% of all surgical colic cases.

Rooney (1965) and Reymond (1972) mentioned that, the causes of the intussusception are often unknown, but it is suspected to occur because of increased peristalsis, adjacent to an area of segmental atony or because of local changes in the bowel wall such as an interruption of the longitudinal muscle layer.

Horny and Funk (1971) approved that, hypertrophy of the distal ileum (iliocecal valve) may cause intestinal obstruction. This case is usually associated with mucosal lesion, *Strongylus larvae* migration or neurogenic stenosis with prolonged closure of iliocecal valve and iliocecal intussuception.

Tennant, Wheat and Meagher (1972) stated that, small intestinal intussusception most frequently involves terminal part of ileum or close to the ileocecal junction.

Pearson, Pinsent, Denny, and Wareman (1975) determined that, the condition which precipitate excessive peristalsis are important predisposing factors for intestinal intussusception, these include enteritis, heavy ascarid burden, mesenteric arteritis and sudden dietary change.

Mcllwraith (1978) said that, simple obstruction of small intestine may occur when the long pedicles of mesenteric lipoma encircle the small intestine. Laparotomy is needed to confirm the diagnosis. Usually distention present at the preobstructed region of small intestine, and there will be an evidence of chronic duration. So normal motility may not return to the bowel cranial to obstruction following removal of lipoma. In such case resection and anastomosis of this non functional part of intestine may be necessary.

Moore and White (1982) stated that, displacement is a common mechanical cause for small intestinal obstruction in horses. Other causes of partial or complete mechanical obstruction of small intestine include volvulus, intussusception and internal herniation.

Tate, Ralston, and Kock (1983) reported that, small intestinal volvulus is produced by 180 degree or greeter rotation of a segment of jejunum and /or ileum about the long axis of mesentery. They noticed that rotation of up to 180 degree may occur physiologically without producing disturbance.

Boulton and Williamson (1984) and Gift, Gaughan and DeBowes (1993) said that, jejunal intussusception have also been associated with intralumenal or intramural masses such as leiomyomas, granulomas, carcinoids and papillomas.

Embertson, Colahan, Brown, Peyton, Scheider, and Granstedt (1985); Parks, Doran, White, Allen and Baxter (1989); Hanson, Baird and Pugh (1995); and White, and Dabareiner (1997) approved that feed impaction of the ileum is the most frequently identified condition of simple small intestinal obstruction.

Hornas and Schumacher (1985) said that, impaction of the small intestine is a physical blockage of small intestine by foreign material or generalized impaction of small intestine with *Parascaris equarum* which prevent the normal progression of foecal materials through the intestine. The relief of impaction occurs by massaging of the small intestine toward the cecum, it may need enterotomy or intestinal resection and anastomosis.

Mac Donald, Pascoe, Stover, et. al. (1989) said that, herniation of the small intestine through a mesenteric rent is considered to be the most common cause of strangulating obstruction of small intestine in horses.

Huskamp (1998) noticed that, simple intraluminal obstructions of the duodenum or jejunum are much less common, although feed impactions occasionally occur within the jejunum. ***Paker, Dodman, and Clayton (1974)*** found that, foreign body obstruction of the jejunum has been only occasionally reported.

Robertson (1982) said that, poor prognosis after surgical correction of small intestinal obstruction may be expected if the clinical signs have been observable for greater than 24 hours. While ***Johnston and Morries (1987)*** mentioned that, horses with small intestinal obstruction that have clinical signs for longer than 12 hours had poor survival rate.

Horses with lesions involving the small intestine and cecum had lower survival rates (75.2 and 66.7%, respectively) than those with large colon or small colon lesions (89.9 and 100%, respectively) ***(Mair, et. al.-a, 2005).***

Owen, Sheard, and Hilbert (1975) said that, the intussusceptions can be treated by reduction alone, but in some conditions it is recommended that resection of all intussusceptions is apparently viable.

Tate, et. al. (1983) stated that treatment of volvulus involves surgical reduction and intestinal evacuation. After laparotomy, the volvulus part is discolored, thickened and distended, and the direction of the volvulus is usually ascertained by palpating mesentery at the base of the twisted part. Rotating all affected loop in the appropriate direction performs correction of the volvulus. Following reduction, the non-viable bowel should be resected and an end-to-end anastomosis is performed. It is important to know that resection of greater than 50% of the small intestine is not indicated and patient should be euthanized.

McDonald, et. al. (1989) stated that, small intestinal strangulation in horses is a challenging disorder to treat because of complications following jejunal resection and anastomosis that are associated with high mortality (51%). However, ***Semevolos, Ducharme, and Hackett (2002)*** mentioned that, better survival rates (91%) following small intestinal resection and anastomosis, possibly attributable to improved surgical and anesthetic techniques and control of ilues and endotoxemia.

Jmai, Anthony, and Kart (2000) stated that large mesenteric defects are less likely to cause strangulating obstruction than a small defect but to avoid the potential recurrence of intestinal obstruction through a mesenteric defect, it is recommended to close all mesenteric defects intraoperativly.

Eggleston, Mueller, Neuwirth, Harmon and Quandt (2000) noticed that, the most common postoperative complications include intra-abdominal adhesions, anastomotic leakage, ileus, and peritonitis.

Fugaro and Coté (2001) stated that, the angle of bowel transaction should be approximately 50-60 degree from the mesenteric attachment to create a large stoma and to improve antimesenteric blood flow. If the angled transaction is in a straight line across the bowel, a sharp point is created at the mesenteric margin that can be difficult to appose.

Boom and Velden (2001) reported that, stay sutures through the mesenteric and antimesenteric edges of both segments draw them into alignment and maintain them at similar diameters throughout closure. The mesenteric border must be apposed first, because this area is prone to rapid edema formation that can obscure the seromuscular layer and prevent its full inclusion in the anastomosis.

Dean and Robertson (1985) proved that, the hand-sewn, end-to-end, inverting anastomosis provides a tight seal and low incidence of adhesion formation as compared to the described appositional anastomosis. ***The same authors*** have demonstrated that, inverting intestinal anastomosis results in decreased perianastomotic adhesion formation because inversion of the serosa minimizes peritoneal exposure of bacteria laden mucosa and suture material. In contrast, the use of single layer appositional anastomosis in horses has been associated with an unacceptably high incidence of adhesion formation. ***The same author and Baxter, Hunt and Tyler, et. al. (1992)*** added that, appositional anastomotic techniques including the Gambee, Simple interrupted, and Crushing suture patterns result in a greater stomal diameter and more accurate tissue alignment; however, they have been associated with a greater than 50% incidence of intraabdominal adhesion formation due to exposed mucosa and suture.

Pascoe and Peterson (1989); McIlwraith and Robertson (1998) and Freeman (1999) proved that, the use of an inverting suture pattern in the seromuscular closure reduces adhesion formation at the anastomosis site.

Baxter, et al. (1992) reported that, a greater than 40% reduction in stomal diameter was recorded with two-layer inverting anastomoses compared to less than 33% reduction in stomal diameter with single layer appositional anastomosis.

Eggleston, et. al. (2000) said that, the ideal small intestinal anastomosis for use in the horse would provide a maximal stomal diameter without increasing the incidence of perianastomotic adhesions, and be relatively simple and quick to perform.

Freeman, Hammock, Baker, et. al. (2000) stated that, an interrupted or continuous Lambert pattern is the preferable suture pattern in anastomosing the small intestine, using 3-0 PDS, with bites preferably 6 but up to 8 mm wide, passing within less than 1 mm from the cut edge, and 6 to 8 mm apart. This pattern creates minimal inversion and sufficient serosal apposition to obtain a rapid seal. ***The same authors*** reported that, penrose drains can be applied at 10 to 15 cm from each side of the anastomosis site, although they are not essential if the bowel is completely emptied. This distance is selected to prevent trauma to critical area of the anastomosis and Penrose drains are less traumatic than Doyen's clamps.

The large intestine

Foerner (1982) reported that, cecal intussusceptions were recorded as a rare condition. On the other hand, ***Freeman, Ferrante, and Palmer (1992)*** reported that cecal impactions are the most common causes of cecal obstruction, accounting for 2-5% of colics and the case fatality rate of 43% is predominately caused by rupture.

Halsbeek (1971) and Boles (1975) recorded that, Impaction is the most frequent cause of cecal obstruction. ***Blood, Hhenderson, and Radositis (1979)*** said that cecal impaction in old horses has been attributed to poor detition, feeding coarse rouphage, and general deplitation during the winter.

Blood, Hhenderson, and Radositis (1979) stated that, the pathogenesis of cecal impaction remains obscure. Bowel impaction may develop following feed overload or poor intestinal motility. The chronically distended colon may loss its motor function while remaining its absorptive function, leading to inspissation of feed material leads to impaction.

Campbell, Colahan, Brown, Grandstedr, et. al. (1984) mentioned that, diagnosis of cecal impaction is most reliably made by rectal palpation and the other methods of physical and laboratory evaluation did not revealed any abnormalities.

Hopper (2001) said that, large colon volvulus (LCV) represents 17% to 21% of colic cases that require exploratory celiotomy and this prevalence increased to 26% to 34% in areas with a concentrated broodmare population.

Freeman (2003) stated that, a large ventral midline incision is often needed to exteriorize the enlarged cecum. In horses with cecal dysfunction, a massive distention of the cecum is found, occasionally with a thickened, hyperemic wall and a nearly empty ventral colon.

Sellers, Lowe, and Brondum (1979) noticed that, large colon impaction often develops at the sites of narrowed luminal diameter such as pelvic flexure or just proximal to the transverse colon in the right dorsal colon. The pelvic flexure has been identified as a region of resistance to aboral flow and is probable pacemaker site for impaction. While ***Sullin (1990)*** reported that, the causes of impaction of the large colon are the poor quality feed, old age, debilitation, poor dentition, parasites, overeating, inadequate water intake, and limited exercise have been implicated.

White-c (1990) reported that horse with large colon impaction usually has a history of mild, intermittent abdominal pain. Diagnosis is made on basis of transrectal palpation of an indictable mass in the pelvic flexure or left ventral colon. He added that methods of treatment of impaction include injection of saline into the bowel and intraoperative massage of the impacted portion.

Intraluminal obstructions of the descending or ascending colon are the most common findings at exploratory laparotomy in horses with colic ***(Ragle, Snyder, Meagher, and Honnas, 1992; and McClure, Kobluk, Voller et. al., 1992)***. The descending colon and pelvic flexure in particular appear prone to obstruction ***(Ragle, et. al. 1992; McClure, Kobluk, Voller et al., 1992 and Dart, Snyder, Pascoe, Farver and Galuppo, 1992),*** and reported obstructions include faecaliths ***(Ragle, Snyder, Meagher, and Honnas, 1992 and McClure, Kobluk and Voller et al., 1992),*** enteroliths ***(Ragle, et. al. 1992 and Cohen, Vontur and Rakestraw , 2000),*** and sand ***(Peloso, Coatney, Caron and Steficek, 1992).*** Surgical treatment of these conditions in miniature horses has been reported to carry a favorable outcome, with survival rates of 75% to 87%., ***(Ragle, Snyder, Meagher, and Honnas, 1992; and McClure, Kobluk, Voller et al., 1992).*** and other complications after exploratory laparotomy reported in miniature breeds include laminitis, enteritis, peritonitis and incisional infection ***(Ragle, Snyder, Meagher, and Honnas, 1992; and McClure, Kobluk, Voller et al., 1992).***

Sheta, Farag, Elzomar, Mostafa, Berbish, and Hamouda (1995) stated that Faecal impaction, foreign bodies, enterolithiasis, incarcination, and adhesion have caused obstruction of small colon of the horse. Occlusive verminous arteritis of the caudal mesentery and intraluminal hematoma are also implicated.

Some clinicians have reported success with medical therapeutic measures for cecal impaction but ***Hekmati and Shahrasbi (1974)*** stated that, the cases of cecal impaction usually need surgical intervention.

Foerner (1982) and Campbell, et. al. (1984) advised that, surgical intervention may be limited to laparotomy, exposure of the cecum, and injection of saline solution. Manual massage can be performed to break the impacted mass and distribute the injected fluid.

Alicia, Ted, and Ken (1986) reported that, large colon resection and anastomosis has a high risk of peritoneal cavity and incisional wound contamination. But recommended resection and anastomosis of large colon is a reasonable treatment.

White et. al. (1997) said that, exploratory celiotomy is indicated when pain becomes uncontrollable, the colonic impaction does not appear to resolve, the horse's cardiovascular status deteriorates, or peritoneal fluid protein and WBC`s increase. Surgery for colon impactions includes a ventral midline celiotomy and emptying the colon by enterotomy at the pelvic flexure. This can be difficult and life threatening because the colon can tear during attempts to lift the obstructing mass through the abdominal incision.

Seim (2002) mentioned that, the need for colonic surgery is relatively uncommon and such intervention is frequently avoided due to the possibility of catastrophic operative and postoperative complications (i.e., leak and fecal peritonitis). The major indications for colonic surgery are intussusception, neoplasia, megacolon, and traumatic wounds (especially abdominal bite wounds). Several factors associated with anatomy and function of the colon may predispose it to operative and postoperative complications.

Beard, Robertson and Getzy (1989) stated that, enterotomies performed adjacent to the teniae of the colon are more intraoperative hemorrhage. due to severance of large blood vessels in its wall. Although closure of enterotomies in the teniae is more easer because of thicker tissue margin, maintain the lumenar diameter and minimal interruption of the blood supply, it was recommended that enterotomies should not be performed through the teniae due to lack of vascularity. ***Sheta, et. al. (1995)*** added that, although more hemorrhage occurred at the incision site adjacent to the teniae, all incisions healed without complications.

White et. al. (1997) stated that, enterotomies in the small colon for impaction removal are performed through the antimesenteric longitudinal band and closed with a double layer inverting suture, using synthetic absorbable material. Compared with enterotomies through the sacculation, enterotomies through the antimesenteric taenia are easier and quicker to perform, cause less hemorrhage and less inflammation, maintain a larger lumen diameter, and are stronger at 96 hours after surgery. ***The same author*** advised that, the enterotomy site of the colon is lavaged with sterile physiologic solution before, during, and after enterotomy closure.

For closure, ***Freeman (2003)*** advised that, the intestine at each end of the enterotomy is stabilized in Babcock clamps or by stay sutures. The first layer of closure is a continuous Lambert pattern with size 2-0 polydioxanone suture material.

Saunders, Diclementi and Ireland (1977) stated that the use of larger tissue bite results in slightly stronger closure than does use small ones and in addition is less likely to cause tissue tearing.

Jansen, Beeker and Kamp (1981) reported that, the rate of mucosal healing that is not sutured is directly related to the accuracy of the apposition of the submucosal layer, and in instance of perfect submucosal apposition, unsutured mucosa will heal as early as 10 days post operatively.

Varma, Johnson and Ferguson (1981) noticed that, polyglactin 910 and polyester were the most two predominant suture material used in horse. Polyglactine is a braided copolymer of lactic acid. The major concern with its use is its strength in the tissue, which is reduced by 60% in 18 days.

Richards, Balch and Alderate (1983) mentioned that, the optimal suture pattern is one with good tensile strength that does not inhibit wound healing or promotes wound infection and is well tolerated by the patient.

Closur of the celiotomy incision

Swanwick and Milne (1973) mentioned that suturing of the peritoneum actually increase the incidence of adhesion after surgery. Clinical experience in humans and horses confirmed that, there was no detrimental effects result when the peritoneum itself is left unsutured during routine surgery.

Miar, et. al. (2002) stated that, the peritoneum is thin, tears easily and is difficult to suture. However the belief that failure to close peritoneum defects will inevitably lead to adhesions, has been largely disproved. He added that, the peritoneum is only closed in standing laparotomy to minimize the possibility of air escaping from the abdomen postoperatively and reaching the subcutaneous tissue.

Varma, et. al. (1981) noticed that, polygalactin-910 and polyester were the most two predominant suture material used in horses. Polygalactin is a braided copolymer of lactic acid. The major concern with its use is its strength in the tissue, which is reduced by 60% in 18 days.

Scheidel and Hohl (1987) mentioned that, for closure of midline incisions in humans, chromic catgut is associated with an unacceptably high risk of evisceration and incisional hernia, regardless to suture techniques used.

Gibson, et. al. (1989) said that, closure of equine ventral midline incisions with catgut increases the risk of herniation 55 times over other suture material.

Trostle, Wilson, Stone, et. al. (1994) said that, there is no known suture material as strong as the linea alba. The materials' strength in descending order is: 5 polyester multifilament braided, 2 polyglycolic acid multifilament braided, 3 polyglactin-910 multifilament braided, 2 polydioxinone monofilament, 2 polypropylene monofilament, 1 polyglycolate monofilament, and 2 nylon monofilament. ***The same author*** stated that, the monofilament sutures are weaker and have a higher rate of knot slippage because of their lower co-efficient of friction, but absorbable monofilament suture materials may be acceptable in contaminated wound in lighter weight animal.

Trostle and Hendrickson (1995) mentioned that, the non-absorbable suture materials should be avoided, as many equine abdominal surgeries are clean-contaminated or contaminated procedure (where the risk of incisional contamination increased), infected non-absorbable suture materials create permanent suture sinuses and form a persistent nidus for infection. Absorbable suture materials are therefore preferred, although their multifilament nature increases the risk of suture sinus formation, but when the suture material degrades the infection resolves.

Honnas and cohen (1997) reported that, polygalactin-910 sutures had an increased risk of incisional infections when compared with polydioxinone sutures

Eggleston, et. al. (2000) mentioned that, the linea alba was closed with *3 Polyglactin 910* in a simple continuous suture pattern and the subcutaneous tissues and skin apposed with *2-0 PDS* in a continuous subcuticular suture pattern.

Magee and Galuppo (1999) said that, a continuous suture pattern allows the biomechanical forces to be more evenly distributed over the entire incision line, is quicker to perform than interrupted pattern and is significantly stronger than the inverted Cruciate pattern.

Freeman et. al. (2002) mentioned that, the continuous pattern also place less suture in the tissues and therefore should incite less foreign body reaction and reduce the risk of infection, compared with interrupted pattern.

Mair and Smith (2005) said that, the linea alba was closed using a simple continous suture of double-stranded 5 metric polyglactin 910 (Vicryl). Wound was lavaged with sterile saline after closure of the linea alba and before closure of the subcutaneous tissue. Crystalline benzyl penicillin was applied topically to the wound prior to closure of the subcutaneous tissue.

Saunders and Diclementi (1977) and Calvin, Normand and Lumsden (1989) reported that, the factors contribute to acute dehiscence in human being and horses include absorbable sutures weakening at a time when wound strength is mainly dependant on suture strength, suture breakage owing to increase abdominal pressure or violent recovery, knot slippage or untying and improperly placed suture cutting through tissue. The acute dehiscence was the most alarming and potentially fatal complication observed in the horse.

Saunders, Diclementi and Ireland (1977) said that, the use of larger tissue bites results in slightly stronger closure than does use small ones and in addition is less likely to cause tissue tearing.

Trostle (1994) and Trostle (1998) advised that, the incision edges should be pulled into snug apposition, but tissue should not be tied too tightly, because this will strangulate the edges and cause foci of incisional necrosis.

Mair and Smith (2005) stated that, application of a stint bandage was associated with a higher rate of wound complications than if no stint was applied; however, application of an incise drape over the wound for recovery was associated with a lower rate of wound complications than for horses that had no protective covering of the wound.

Postoperative complications

Dunphy (1974) and Peacock (1984) said that, the high incidence of incisional problems is associated with ventral midline incision for surgical treatment of colic in horses. Horses that have multiple surgeries have a much higher incisional problems rate.

Brad and Allen (1988) mentioned that, complications associated with ventral midline incision in equines include swelling, drainage, local infection, dehiscence, herniation, suture sinuses, hematoma within rectus abdominal muscle sheath, and peritonitis.

Survival after small intestinal surgey in the horses has improved from earlier data and the most common causes of death during hospitalization in large retrospective studies were anastomotic leakage ***(Mac Donad, Pascoe, Stover, et. al., 1989)***, septic peritonitis ***(Phillips and Walmsley,1993)***, postoperative ileus ***(Boom and Velden, 2001)***, adhesions and peritonitis ***(Fugaro, Coté, 2001)***, and shock. ***(Ducharm, et al., 1983).***

Loesch, Rodgerson, Haines and Watt (2001) noticed that, postoperative complications directly attributable to the small intestinal anastomosis were minimal.

Mair and Smith (2005) concluded that, the most common short-term post operative complications following colic surgery were pain, incisional drainage, ileus, endotoxaemiac shock and jugular thrombophlebitis. Some factors that appeared to predispose to these complications were identified.

Hau, and Simmons (1978) said that heparin administration improves survival in experimental animals with septic peritonitis.

Hau, Payne and Simmons (1979), proved that vasoactive substance, released after peritoneal trauma, increase vascular permeability and exudation of fibrinogen-rich plasma. Injury to tissue stimulates release of tissue thromboplastin and activation of the coagulation cascade. A large amount of activated thrombin converts fibrinogen to fibrin, which, in turn, is deposited on peritoneal surface. This fibrinous deposits may be quickly resorbed or undergo fibrinous transformation.

MacHarg and Bectit, (1983) Conversion of fibrinogen to fibrin can also be suppressed by a specific antiprotease, antithrombin III (AT III). The activity of AT III is greatly enhanced by binding of glycoprotein cofactor and heparin.

Sullin, Stashak and Mero (1985) stated that heparin, a cofactor of AT III, has been used therapeutically to prevent adhesion formation.

Hanson, Nixon, Meyer, et. al. (1992) said that normal physiological Ringer's solution (22 ml/kg) containing 1 i.u of sodium heparine/ml and 1000 i.u of potassium penicillin were instilled into the abdominal cavity after manual exploration of the abdomen, intestinal resection and anastomosis, enterotomy of colon, and typhlotomy.

The peritoneum is composed of a single layer of mesothelial squamous cells overlying loose connective tissue and adipose tissue (***Hosgood 1986).*** Inflammation of the peritoneum of the horse may occur as a primary condition or, more commonly, as a secondary complication and may be associated with either infectious or non-infectious disease ***(Ricketts, 1987 and Trent, 1995)*** and is characterized by exudation of serum fibrin, and protein into the peritoneal cavity ***(Semrad, 1992).***

Semrad (1992) said that, contamination of the abdomen and injury to the mesothelial cells initiate an inflammatory response and a cascade of events that results in the release of histamine and other vasoactive substances from peritoneal mast cells, vasodilatation and hyperemia, an increase in peritoneal and vascular permeability, and an influx of protein-rich fluid, macrophages, polymorphonuclear cells, and natural antibodies into the peritoneal cavity.

Phillips and Walmsley (1993) found that, generalized septic peritonitis was recorded in 9 of 149 horses (6%) undergoing exploratory laparotomies for colic. The most frequent fatal complications that occurred in this study were generalized septic peritonitis and bowel obstruction caused by adhesions. However, eight of the nine horses with peritonitis had preoperative abscessation, rectal tear, or advanced bowel ischemia.

Hawkins, Bowman, Roberts and Cowen (1993) mentioned that, diffuse septic peritonitis requires specific therapy and is potentially life threatening unless treatment is instituted early. The early recognition of postoperative peritonitis is therefore important, he added that, some or all of the following signs and findings should alert the clinician to the possibility of septic peritonitis (depression, abdominal pain, ileus, gastric reflux, intestinal distention, fever, anorexia, tachycardia, leucopenia, hypoproteinemia, and diarrhea). None of these findings is specific to peritonitis and all of them can be seen in varying degrees in association with other postoperative complication. Therefore analysis of peritoneal fluid should be performed in cases suspected of being affected by septic peritonitis.

Mair, et. al. (2002) stated that, all horses will develop low-grade aseptic peritonitis following colic surgery, and peritoneal fluid total nucleated cell counts and total protein concentrations are likely to be elevated. In most cases this will be mild and self-limiting. He added that, the presence of one or more of the following abnormalities should be considered significant for peritonitis (numerous toxic and degenerate neutrophils, free bacteria in the field, phagocytized bacteria within neutrophils or macrophages, fibrin particles, food particles and plant materials).

Analysis of Peritoneal fluid

Blckford, et. al., (1986) said that the primary use of abdominal paracentesis in horses, however, has been in establishing a different diagnosis for acute abdominal crises. Various diseases states have been correlated with trends in color, turbidity, WBCs count, RBCs count, plasma protein concentration, enzyme changes, and shifts in the cytologic distribution of peritoneal fluid. These changes have been used as an aid to determine the need for surgery and to provide a prognosis for life.

Root, Keizer and Perry (1967); Traver, Moore, Coffman, et. al. (1977); Valdez, Scrutchfield, and Taylor (1979) and Dyson (1983) stated that, serial peritoneal fluid evaluation is a useful indicator for assessing the response of peritonitis and abdominal trauma to medical treatment.

The abdominocentesis using teat canula technique is safe ***(White-b, 1990)*** with no complications even after repeated procedures ***(Tulleners, 1983; Schumacher, et. al., 1985 and Juzwiak, et. al., 1991).***

Michael (1992) advised that, careful should be taken to prevent free blood caused by the trauma of the collection technique from entering the abdominal fluid sample

Tulleners (1983) stated that analysis of peritoneal fluid has been used for the diagnosis and prognosis of abdominal diseases in horses such as intestinal obstructions, cecal and colon impaction, and peritonitis.

Blackford, Schneiter and VanSteenhouse, et. al. (1985) said that the interpretation of abdominal fluid findings has not always been as diagnostically or prognostically constant and accurate.

Coffman and Trischler (1972); Dyson (1983); and Mair, Hillyer and Taylor (1990) stated that leukocytosis with neutrophilia, increased plasma fibrinogen and alkaline phosphatase activity were observed in horses with naturally acquired peritonitis.

Ricketts (1987); Clabough and Duckett (1992); and Semrad (1992) found that, early in the disease process the elevation of white cell count is caused primarily by an increase in polymorphonuclear cells. In chronic cases mononuclear cells and macrophages increase in relation to the polymorphonuclear.

In the study by ***Wilson & Gordon (1987)*** they recorded that fibrinogen values in peritoneal fluid higher than 0.1g/dl indicated vascular damage and/or inflammatory injuries, ***the same author*** added that, the increase of total protein in the peritoneal fluid, higher than 2.5g/dl, was a consequence of increasing vascular permeability in abdominal viscera. While ***Hawkins, et. al. (1993) and Mendes, Marques, Iturrino, and Avlia, (2000)*** stated that the evaluation of plasma fibrinogen was of little value for the prognosis of equine peritonitis.

The peritoneal fluid varies in quantity, color (serosanguineous, turbid, floculent, purulent), and character (transudate, exudate, or modified transudate) ***(Clabough & Ducketts, 1992).*** In a study of 30 horses with peritonitis, peritoneal fluid of all animals contained increased leukocytes, ranging in number from $11.2x10^3/mm^3$ to $385x10^3/mm^3$. Most of these cells were neutrophils ranging in frequency from 52% to 99%. Eosinophils were detected in only two horses ***(Dyson, 1983).*** Peritoneal protein levels are elevated ***(Clabough & Duckett 1992).***

Semrad (1992) found that protein sequestration and fluid exudation into the peritoneal cavity lead to hypoproteinemia and dehydration.

Swanwick and Wilkinson (1976) found that, microscopic examination of cells in a smear of the fluid was more useful, as phagocytosis and abnormal cell types indicating infection or inflammation could be seen readily, and a diagnosis based upon these findings.

Steer and Lewis (1983) found that, neutrophils are the most common and important cell type in peritoneal effusions. They are attracted to the peritoneal cavity by chemotactic stimuli and act in the primary cellular defense mechanisms against invading microorganisms. They stated that mononuclear cells are part of the normal surveillance cell population and are proportionally overrun in the inflammatory process.

In experimental work by ***Blackford, et. al. (1985) and Santschi, Grindem, Tate, et. al. (1988)*** they have been stated that, a notable postoperative inflammatory response occurs in the peritoneal fluid following simple manipulation of the abdominal viscera and this response is greater than that following opening and closing the abdomen without manipulation of the viscera.

Surgical manipulation of the abdomen creates a significant and rapid postoperative peritoneal inflammatory reaction. The critical mediator of this reaction seemed to be manipulation of the abdominal viscera and damage to other mesothelial surfaces (i.e., celiotomy). A significant difference was noticed in the total peritoneal nucleated cell counts and total protein values for horses undergoing exploratory celiotomy ***(Blackford, et al., 1985 and Santschi, et al., 1988)*** compared with horses undergoing laparoscopy or celiotomy without exploratory surgery ***(Blackford, et. al., 1985 and Fischer, Lloyed, Carlson, et. al., 1986).***

Blackford, et. al. (1986) and **Santschi, Grindem, Tate, and Corbett,** ***(1988)*** said that, exploratory laparotomy without enterotomy will result in an elevated peritoneal nucleated cells count for up to 14 days after surgery. The total nucleated cell count of peritoneal fluid can increased up to 400x109/l (400 000 cells/μl) with more than 90% neutrophils in healthy horses following surgery without enterotomy. Likewise the total protein concentration may exceed 3.5g/l in such normal horses recovering from surgery.

Hanson, et. al., (1992) mentioned that additional manipulation of the peritoneum associated with resection and anastomosis of 2 isolated segments of intestine may be of little consequence, compared with the trauma induced during a simple exploratory celiotomy.

Michael (1992) stated that, exploratory celiotomy in normal horses, results in peak nucleated cell counts (within 5 days), more than 50000 cells/ μl.

Mair, et. al. (2002) mentioned that, the most consistently useful indicators of sepsis include plasma to peritoneal glucose concentration difference of more than 50 mg/dl, peritoneal fluid PH less than 7.3, peritoneal glucose concentration less than 30 mg/dl, and peritoneal fibrinogen concentration more than 2g/l (200 mg/dl). Localized area of peritonitis may become 'walled off' by fibrin; this may result in relatively normal-looking peritoneal fluid in samples obtained from the ventral abdomen. The absence of specific abnormalities in the peritoneal fluid should not, therefore, rule out the presence of peritonitis and clinical judgment becomes more important than dependence on laboratory test results.

Blackford, et. al. (1985) and ***Santschi, et. al. (1988)*** stated that, a significant downward trend in total nucleated peritoneal cell count was not evident until the fifth postoperative day. While ***Schneider, et. al. (1988) and Hanson, et. al., (1992)*** proved that, the cell count decreased after the first postoperative day.

Hanson, et. al. (1992) mentioned that the peritoneal fluid values didn`t return to normal up to 7 days after intestinal resection and anastomosis and they advised by further studies needed to determine when the abdominal fluid values return to normal.

Materials And Methods

MATERIALS AND METHODS

Twenty-four apparently healthy adult donkeys of both sexes, of age (3-7 years), and weight (90-150 kg) were used. All animals were evaluated clinically normal. They had been treated for internal and external parasites using ivermectine 1% *(Equiven paste[1])* and allowed to become accustomed to the surrounding conditions and the available feeding for 2 weeks prior to the study.

These animals were divided into four equal groups (I, II, III, and IV), six animals of each.

- **Group I:** for ***exploratory celiotomy*** with only manual exploration of the viscera *"as a control group"*.
- **Group II:** for ***exploration and jejunal resection and anastomosis***.
- **Group III:** for ***exploration and typhlotomy (enterotomy of the cecum).***
- **Group IV:** for ***exploration and enterotomy of the colon.***

1. Anesthesia and Preoperative Technique:

Food was withheld for 12 hours before surgery. All metallic instruments needed for surgery were previously sterialized by hot air oven at 180°C for 20 minutes. Towels, gowns and dressing materials were sterilized by autoclaving.

An intravenous canula was applied in the jugular vein, on a clipped and sterilized skin, to facilitate administration of medications and fluid therapy before, during, and after surgery.

1 EQUIVEN............THE EGYPTAIN CO. FOR CHEMACALS & PHARMACEUTICALS *(ADWIA)*.

One hour before induction of anesthesia, administration of *(sodium penicillin G* [1], 22,000 IU/kg, IV), gentamicin sulfate (*Gentamicin 10%* [2], 6.6 mg/kg, IV), and phenylebutazone (*Buta-fenil* [3], 2-4 mg/kg, IV) was initiated. Animals were premidecated by I.V injection of xylazin HCl 2% *(xylaject* [4]*)* in a dose of 1 mg/kg.

Just before operation, an abdominocentesis was performed in standing sedated animal after a small subcutaneous bleb of local anesthesia was made over the intended site of abdominocentesis *(at the ventral abdominal wall, just caudal to the xiphoid)*. A scalpel blade size 14 is then used to make stab incision in the skin over the linea alba. Sterile metal teat canula was forced at the incision through the body wall into the peritoneal cavity. The canula is manipulated to enter the fluid plane. A care should be taken to prevent free blood, caused by the trauma of the technique, from entering the abdominal fluid sample.

Induction of anesthesia obtained by *Thiopental sodium* [5], (8.8 mg/kg BW 5% solution IV*)*. Insertion of an endotracheal tube was done blindly via the mouth after application of mouth gague in dorsal recumbency with extension of the neck rostrally. Maintenance of general anesthesia was obtained using inhalation anesthesia. Oxygen alone is used as carrier gas, stable maintenance of anesthesia is usually achieved with end-tidal concentration of 1.5-2% halothane *(new-Flutane* [6]*)* vaporized in oxygen 1.5 L/minute using a semiclosed method. After induction of anaesthesia, about 20-35 ml of halothane were required to maintain anesthesia for 1 hour in a donkey of about 150 kg body weight.

1 SODIUM PENICILLIN G........MISR CO. FOR PHARM. IND. S. A. E.
2 GENTAMICIN 10%.................THE NILE CO. FOR PHARMACEUTICALS & CHEMICAL INDUSTRIES CAIRO A. R. E
3 BUT-AFENIL.........................LABORATORIOS TORNEL, S. A.
4 XYLAJECT.......... THE EGYPTAIN CO. FOR CHEMACALS & PHARMACEUTICALS (ADWIA).
5 THIOPENTAL SODIUM......EGYPTAIN INTERNATIONAL PHARM INDUSTIES COMPANY. A.R.E.s (E.I.P.I.CO)
6 NEW-FLUTANE...................... KAHIRA PHARM. & CHEM. IND. CO. CAIRO.

In a dorsal recumbent animal, the area of operation *(the ventral-most portion of the abdominal wall just caudal to the xiphiod cartilage)* was clipped, shaved, prepared aseptically using bovidone iodone 10% *(betadine[1])*, and draped with sterile towel fixed in position using sterile towel clamps. ***(Fig. 1)***

2. Intraoperative Management:

In all groups, sodium chloride 0.9% solution was injected during surgery in a dose of 10 ml/kg/hour.

Ringer's solution (22 ml/kg) containing 1 i.u of calcium heparin *(cal. Heparin [2])* /ml and 1000 i.u of *sodium penicillin* were instilled into the abdominal cavity after manual exploration of the abdomen to prevent adhesion formation.

2.1. Group I (exploratory celiotomy):

The animals of this group were exposed to laparotomy and exploration of the abdominal viscera only.

A ventral midline laparotomy incision was made of about 25-30 cm in length, beginning 2 cm just anterior to the umbilicus and extending forward toward the xyphiod, (Fig. 2). The incision passed through the skin, subcutaneous tissue, and linea alba, (Fig. 3).

Once the linea alba has been incised over 2-4 cm, a long handled forceps was placed into the abdomen (still outside the peritoneum) and directed cranially while lifting the linea alba., the incision was then extended cranially taking care to stay in the linea alba. The peritoneum was penetrated by finger pressure to open the abdominal cavity.

1 BETADINE.................THE NILE CO. FOR PHARMACEUTICALS & CHEMICAL INDUSTRIES CAIRO A. R. E.
2 CAL-HEPARINE.................AMOUN PHARMACEUTICAL CO. S.A.E

The following structures were explored on the left side include the stomach, left kidney, spleen, left colon, and small colon. Structures on the right side include the liver, duodenum, right kidney, right colon, and cecum.

Following the systematic approach in abdominal exploration, based on tracking from fixed or easily located segments to segments that cannot be exteriorized or readily identified as ***Freeman (2003)*** said, the apex of the cecum was grasped, lifted from the abdomen, and pulled caudally.

The dorsal cecal band, ***(Figs. 4, 5)***, was grasped and followed into the abdomen where the ileum forms the iliocecal fold at its entry into the cecum. The ileum was identified by its thicker wall and the antimesenteric band/mesentery ***(Figs. 6, 7)***. Palpation of the iliocecal fold helps to locate the iliocecal opening.

The ileum was lifted from the abdomen and followed orally to initiate examination of the jejunum, duodenum, and stomach. The jejunum was differentiated from the ileum by its thin wall and the ananstmosing arcades of its blood supply ***(Fig. 8, 9)***.

To examine the mesenteric root of the small intestine, a part of the jejunum was stretched from the abdomen while the other hand is used to slide down the mesentery to the dorsum of the abdomen. The attachment of the mesentery occurs midline at the level of the first lumber vertebra.

The lateral band of the cecum ***(Fig. 4, 5, 6)*** was followed to the cecocolic fold, which attached to the right ventral colon. The large colon should be lifted carefully after widening of the ventral midline incision. Placing the colon over the forearm helps to elevate it and minimizes the risk of seromuscular tears or rupture.

The colon exteriorized and examined during exploratory laparotomy ***(Fig. 10).*** The transverse colon is palpated by following the right dorsal colon aborally or the small colon orally ***(Fig. 11).*** It was found in the center of the abdomen just cranial to the mesenteric stalk and cannot be exteriorized. The rectum was located in the pelvic inlet and is found by following the small colon aborally.

The spleen and renosplenic space are palpated on the left side lateral to the incision by passing the hand dorsally between the outside of the spleen and the abdominal wall.

The stomach and part of the liver lie on the left side of the donkey in the cranial part of the abdomen. The greater curvature of the stomach can be visualized in the abdomen if the incision is made on the ventral midline just behind the xiphoid or if the stomach is severely distended. The duodenum and pylorus are located on the right side of the abdomen and are best palpated from the animal's left side. The duodenum is attached to the body wall by the mesoduodenum and is normally thin and pliable (easily bended). The pylorus normally muscular and thick and can be visualized via a ventral midline incision just behind the xiphoid.

The diaphragm is palpated cranial to the stomach and liver. The epiploic foramen or space is palpated on the animal's right side along the visceral surface of the liver between the vena cava and the portal vein. To find the epiploic foramen, stand on the left side of the animal and insert the right hand through the most rostral commissure of the incision, and direct it with the arm at right angles to the incision along the right body wall. When the fingertips encounter the edge of the liver, trace the fingers medially along the visceral surface of the liver. Ignore the fissure separating the right lobe from the caudate lobe and draw the back of the fingertips along the caudate lobe until you encounter a 1 to 3 finger wide slit between the caudate lobe and the portal vein. This is the epiploic foramen and intestine usually passes through this from left to right.

The following segments of the adult donkey's gastrointestinal tract cannot be exteriorized: any part of the stomach, the entire duodenum, first 25 to 30 cm of jejunum, distal 25 to 30 cm of ileum, ileocecal junction, transverse colon, base of cecum, cecocolic junction, terminal part of the right dorsal colon, and terminal part of the small colon.

Closure of the abdomenal wall was performed in a routine manner by closing the linea alba using *(Vicryle [1])* No. 2 in a simple continuous pattern, but in two or three sections. Lavage of the wound with sterile saline was performed after closure of the linea alba and before closure of the subcutaneous tissue. *(Sodium penicillin G)* was applied topically to the wound prior to closure. Subcutaneous layer closed by *(Vicryle)* No. 0 in continuous pattern ***(Fig. 12)***. Skin was closed using (*silk)* No.2 in continuous pattern. The sutured incision was then covered by sterile gauze.

1 VICRYLE.......................................ETHICON *(JOHNSON AND JOHNSON INTL)*

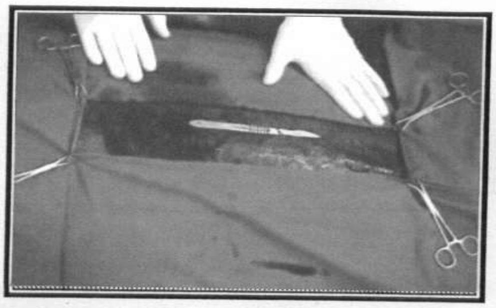


Fig. 1: Four corner draping after preparations for aseptic surgery.

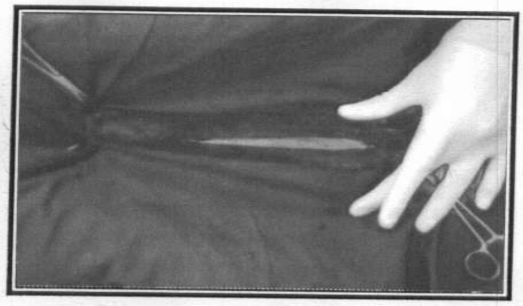


Fig. 2: Skin incision beginning 2 cm just anterior to the umbilicus and extending forward toward the xyphiod

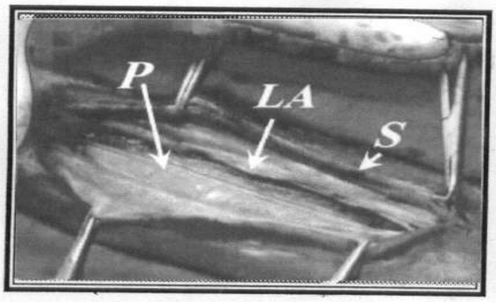


Fig. 3: Linea alba incision with intact peritoneum S = skin, LA = linea alba, P = peritoneum

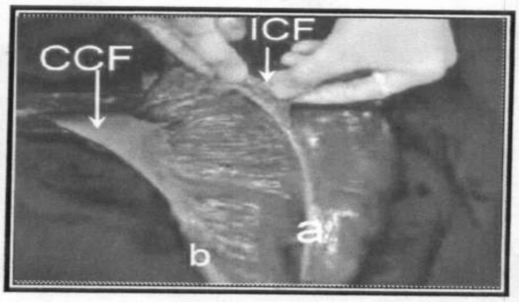


Fig. 4: Important anatomic landmarks used to orient and locate critical parts of the intestinal tract (cranial is to the left). a = dorsal taenia of the cecum b = lateral taenia of the cecum ICF = iliocecal fold, CCF= cecocolic fold.

Fig. 5: CCF attaches the lateral tenia of the cecum with lateral tenia of the right ventral colon ICF attach the dorsal tenia of the cecum with the antimesenteric border of the ileum.
ICF = iliocecal fold, CCF = cecocolic fold, C = cecum

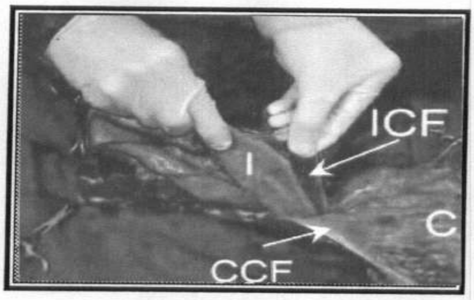


Fig. 6: Intraoperative exposure of the ileum C = cecum, I = ileum, ICF = iliocecal fold. CCF = cecocolic fold.

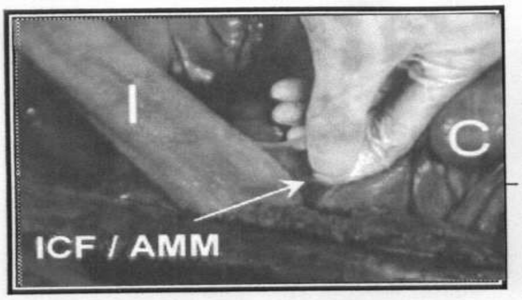


Fig. 7: C = cecum, I = ileum, ICF = iliocecal fold, AMM = antimesenteric mesentery

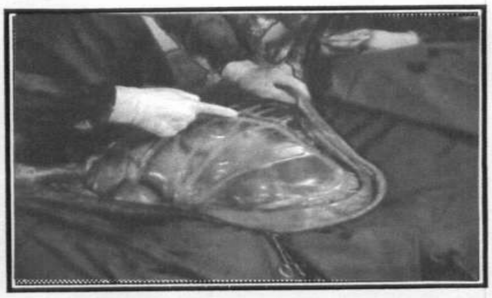


Fig. 8: Exteriorization of the ileum.

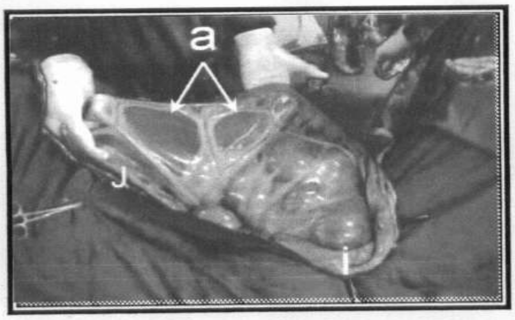


Fig. 9: Exteriorization of the ileum and jejunum. J = jejunum, I = ileum, a = blood supply of the jejunum. Arrows refer to the ananstmosing arcades of jejunal blood supply

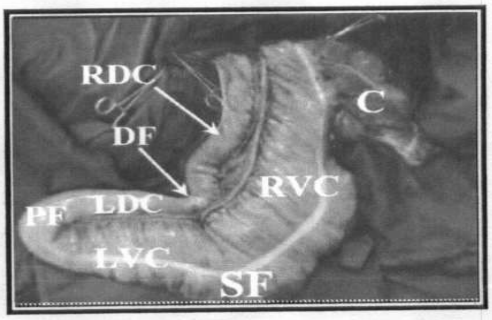


Fig. 10: Exteriorization of the large colon C = cecum, RVC = right ventral colon, SF = sternal flexure, LVC = left ventral colon, PF = pelvic flexure, LDC = left dorsal colon, DF = diaphragmatic flexure, RDC = right dorsal colon

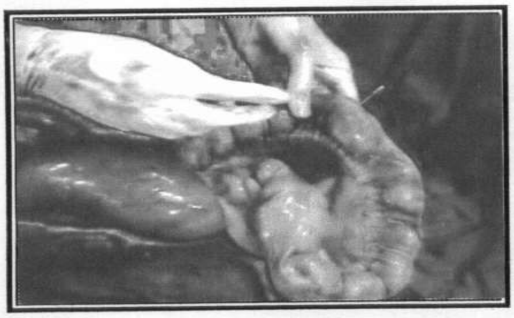


Fig. 11: Transverse colon

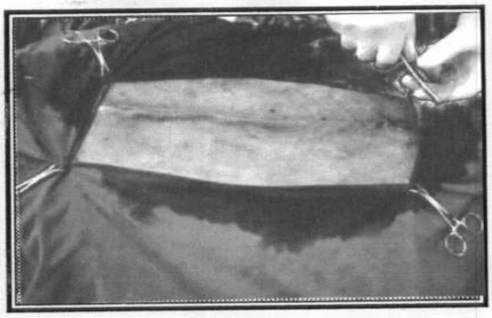


Fig. 12: Closure of the subcutaneous layer.

2.2. Group II (jejunal resection and anastmosis):

The animals in this group were exposed to ventral midline laparotomy and the exploration of the abdominal viscera was done routinely by the same manner as in group I.

Jejunal resection and anastomosis was performed after exteriorization of the jejunum. Tow Doyen (intestinal) clamps were applied on the anticipated resection sites and 30 cm of the jejunum was resected. The mesenteric blood supply of the resected part was occluded by double ligations on each before transection.

Mesenteric resection site was performed beyond the remaining vessels by 1-2 cm to prevent their unplanned puncture during closure of the mesentery. (The cut end of the mesentery must be away from the mesenteric vessel by 1-2 cm) ***(Fig. 13)***.

Jejunal resection was performed with angle of transection equal to 50-60 degree from the mesenteric attachment ***(Fig.14)*** and stay sutures were applied through the mesenteric and antimesenteric edges of both segments.

Closure of the mesenteric borders was performed firstly before closure of the jejunum, but 10-15 cm of the mesentery toward the jejunum lifted un-sutured. ***(Fig. 15)***.

Closure of the jejunum was performed in 2 stages. The first one was suturing of the mucosa in hemi-circumferential simple continues suture pattern using *vicryle No.2/0*, ***(Fig. 16)***. The second one was seromuscular with hemi-circumferential Cushing suture pattern using the same suture material with the same size, ***(Fig. 17, 18)***. The mucosa was meticulously folded below the seromuscular layer with each throw to minimize mucosal exposure.

Closure of the abdominal wall was performed as previously mentioned in group I.

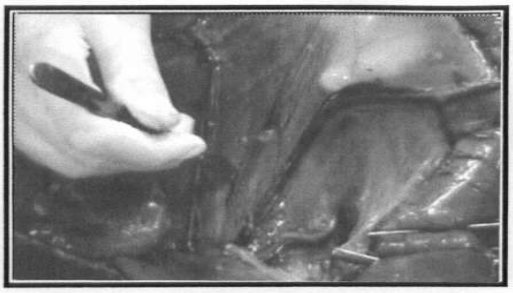


Fig. 13: *Cutting the mesentery beside the mesenteric vessel by 1-2 cm to facilitate closure of mesenteric defect without unplanned puncture of these vessels*

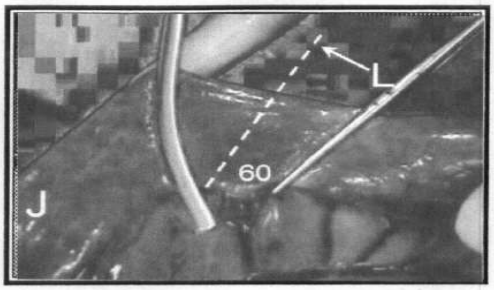


Fig. 14: *The line of transaction (broken line) is angled 60° to the mesentery. L = transaction line, J = jejunum.*

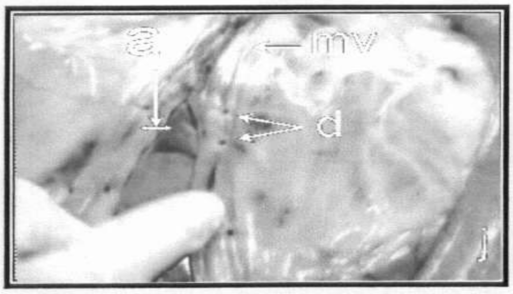


Fig. 15: *J = jejunum, mv = mesenteric vessel, d = double legation of the mesenteric vessel with no. 00 synthetic absorbable suture material, a = the cut end of the mesentery must be away from the mesenteric vessel by 1-2 cm.*

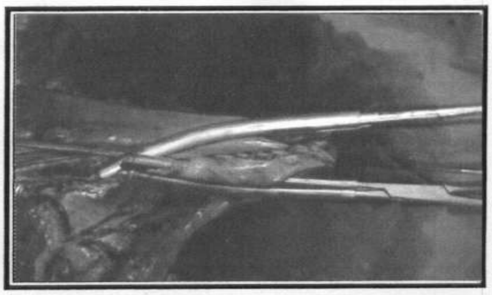


Fig. 16: *Hemi-circumferential continuous suture pattern in the mucosal layer of the jejunum.*

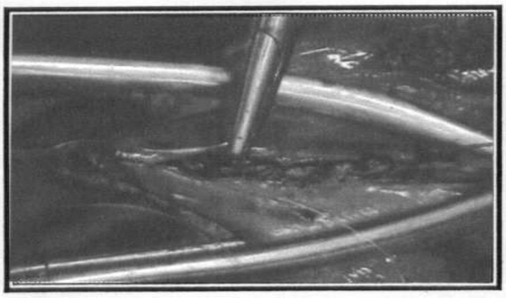


Fig. 17: *Hemi-circumferential Cushing suture pattern in the seromuscular layer of the jejunum.*

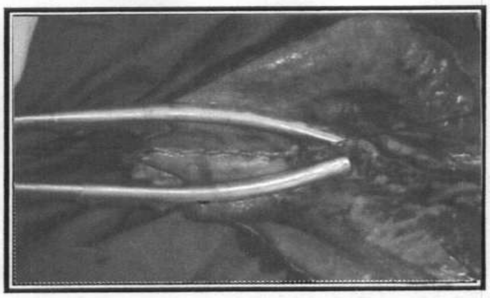


Fig. 18: *Closure of the seromuscular layer of the jejunum with continuous Cushing suture pattern using 00 synthetic absorbable suture material.*

2.3. Group III (typhlotomy):

Typhlotomy was performed in addition to the ventral midline incision and abdominal exploration in this group. Cecal apex was exteriorized to be isolated from the abdominal incision and other abdominal viscera to avoid contamination. The apex was gently manipulated out of the incision to the left side of the abdomen. Sterile drapes were used to isolate the cecal apex from the incision and other abdominal viscera to avoid contamination. The animal was tilted to facilitate drainage away from the abdominal incision.

Stay sutures were placed at the ends of anticipated typhlotomy site *(located midway between the lateral and ventral cecal bands at the cecal apex)* ***(Fig. 19)***. 10-12 cm incision was made into the cecal apex, ***(Fig. 20)***.

Cecum tilted to the animal's left side and cecal evacuation wasperformed. After evacuation, the typhlotomy site was copiously lavaged with sterile physiological solution before, during, and after typhlotomy closure.

The closure was performed in two inverting layers. The first one was continuous Lambert pattern with *Vicryle No. 2/0* ***(Fig. 21)***. The Lambert pattern was placed so that the bites come within 1 to 2 mm of the cut edge of the bowel, are approximately 8 mm wide, and are approximately 10 mm apart. The Lambert pattern was over sewn with a Cushing pattern, taking care with the Cushing to make sure that this layer is close to the Lambert pattern so that, there was minimal tissue inversion and luminal stenosis ***(Fig. 22)***. The site of typhlotomy after closure shown in ***(Fig. 23)***.

Closure of the abdominal wall was performed as previously mentioned in group I.

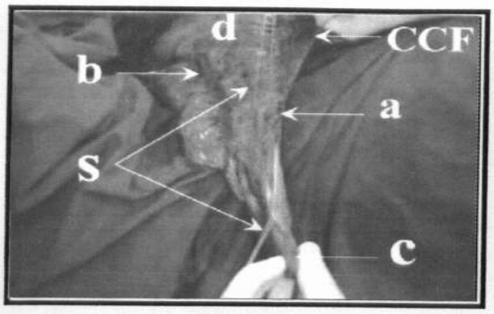


Fig. 19: The anticipated site of typhlotomy (enterotomy of the cecum) between the lateral and ventral cecal taenae at the cecal apex
a =lateral cecal band, b = ventral cecal band, c = cecal apex, d = cecal base, s= stay suture, CCF = cecocolic fold.

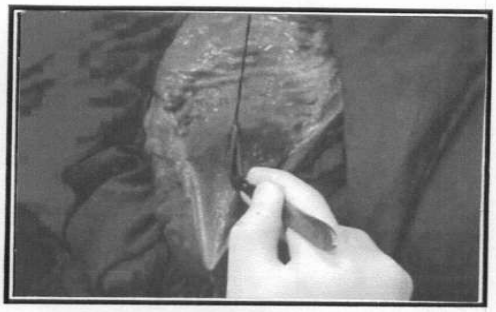


Fig. 20: Typhlotomy (enterotomy of the cecum)

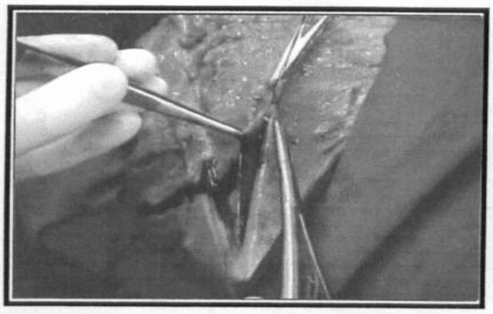


Fig. 21: Lambert inverting suture pattern, the first layer in enterotomy closure

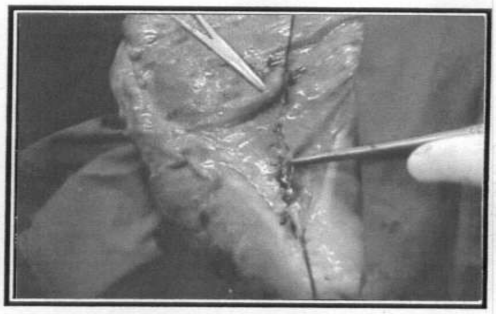
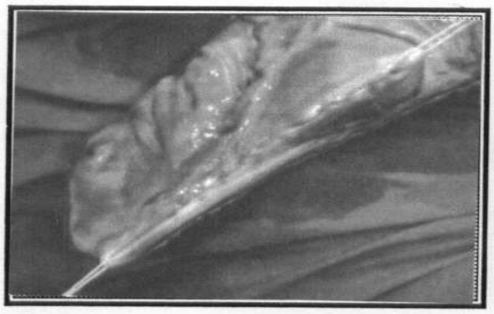
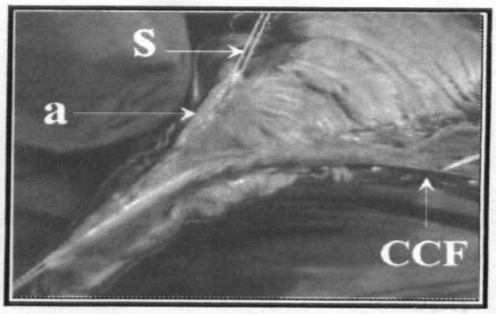


Fig. 22: Cushing suture pattern, the second layer in enterotomy closure



A



B

Fig. 23 A,B: a = The site of enterotomy after closure by two inverting layers Using synthetic absorbable suture materials No 00 or 000, s = stay suture, CCF = cecocolicfold

2.4. Group IV (enterotomy of the colon):

The animals in this group were exposed to ventral midline laparotomy and the exploration of the abdominal viscera was done routinely by the same manner as in group I. And enterotomy of the colon was performed.

The colon was exteriorized by cradling the colon over the surgeon's forearms when lifting it, and by use of the surgeon's flat hand rather than fingers when rotating or handling a segment deep in the abdomen and placed between the rear legs, so that the pelvic flexure can be placed in a dependant position, ***(Fig. 24)***.

A gentle, rotating motion should be used to move the colon. Filling the deep part of the abdomen with saline can facilitate exteriorization of the colon.

Stay sutures were placed at the ends of anticipated enterotomy site *(located at the pelvic flexure but more in the left dorsal colon adjacent to the antimesenteric taenia)*, ***(Fig. 25)***. This incision was extended 10-12 cm in length in a longitudinal manner, ***(Fig. 26)***.

Colon evacuation was performed. After evacuation, the site of enterotomy was lavaged with sterile physiological solution during, and after enterotomy closure.

The closure was performed as mentioned in closure of the cecum, ***(Fig. 28)***. The site of enterotomy after closure shown in ***(Fig. 29)***.

Closure of the abdomen done as previously mentioned in group I.

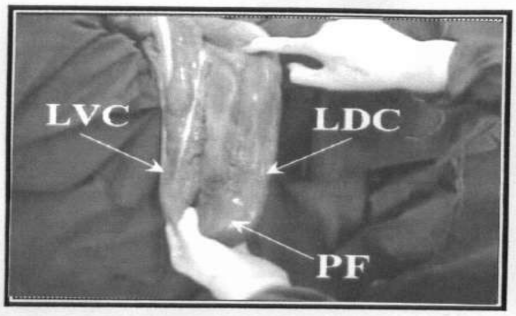


Fig. 24: *Exteriorization of the pelvic flexure*
LVC *= left ventral colon,*
PF *= pelvic flexure,* ***LDC*** *= left dorsal colon.*

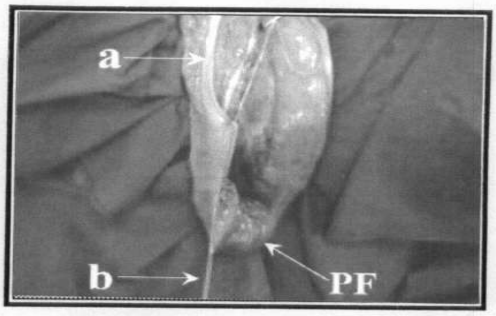


Fig. 25: *The anticipated site of enterotomy of the colon (in the pelvic flexure slightly toward the Left Ventral Colon and beside its antimesenteric band)*
a *= antimesentric band of the Left Ventral Colon,* ***b*** *= stay suture,* ***PF*** *= pelvic flexure*

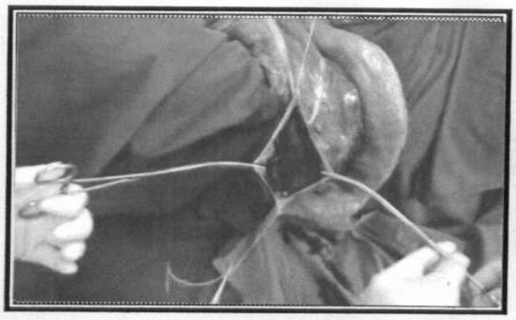


Fig. 26: *Enterotomy of the colon*

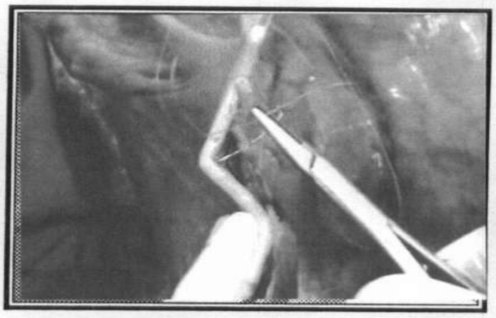


Fig. 27: *Lambert inverting suture pattern, the first layer in enterotomy closure*

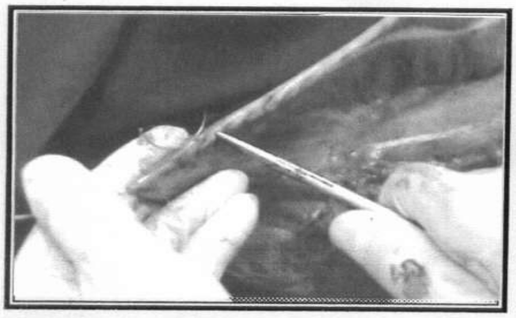
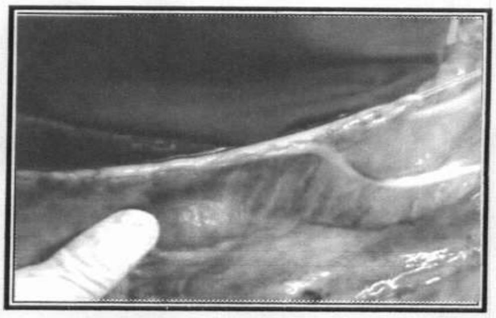


Fig. 28: *Cushing suture pattern, the second layer in enterotomy closure*



'ig. 29: *The site of enterotomy after closure by two inverting layers*
sing synthetic absorbable suture materials No 00 or 000

3. Postoperative Management:

Each animal was injected with 3000 i.u of antitetanic serum (Tetanus Anti-toxin [1]) S.C or I.M.

Fluid therapy (5-6 liters of lactated Ringer's solution) was given I.V for 12 hours after surgery.

Rectal temperature, pulse rate, respiratory rate, and clinical observation were recorded every 2 hours during the initial 12 hours postoperative period and every 4 hours thereafter.

Additional analgesia (analgin) was provided to animals which demonistrating overt signs of pain as necessary.

Procaine penicillin *(22000 i.u/kg, q 12 h IM)*, gentamycine sulfate *(2.2 mg/kg, q 8 h I.V)*, calcium heparin *(40 i.u/kg, q 8 h I.V)*, and phenylebutazone *(5 mg/kg, q 8 h, I.V)* were administered for 72 hours after surgery. The duration of parental antibiotic therapy varied from 3-5days.

Hay was provided following the intravenous fluid therapy. And because the intestinal resection and anastomosis, typhlotomy, and enterotomy, are a more complicated surgery than exploratory celiotomy, in groups II, III, and IV animals were not returned to full feed (3 flakes of hay 2 times/day) until 48 hours after surgery, whereas the animals in group I were on full feed 24 hours after surgery.

4. Peritoneal Samples Collection:

On the day 0, 1, 3, 5, 7, 10, 15, 20, 25, 30, and 35 following surgery, peritoneal fluid was collected by ordinary method using teat canula as mentioned before, ***(Fig. 30)***.

1. TETANUS ANTI-TOXIN........EGYPTAIN COMPANY FOR PRODUCTION, SERA AND DRUGS, EGYVAC.

Each sample was divided into two tubes, the first one containing sodium citrate (3.8 %) as anticoagulant [1 ml sod. citrate 3.8 % / 9ml peritoneal fluid] this tube was used for hematological evaluation (total WBCs count, RBCs scout) and fibrinogen determination. The second tube containing peritoneal fluid (about 4 ml) used to determine peritoneal fluid protein concentration.

Peritoneal fluid was evaluated for peritoneal fluid protein concentration, fibrinogen, concentration nucleated cell count, and RBCs count. Samples were stained (H&E) for evaluation of morphologic features (% of neutrophils).

(Fig. 30)

The canula was manipulated trying to enter a fluid plane. And Careful should be taken to prevent free blood caused by the trauma of the collection technique from entering the abdominal fluid sample

5. Determination of biochemical parameters.

5.1. Determination of total peritoneal fluid protein (TPFP)

Total protein was determined colorimetrically using (Shimadz-UV-1601, Tokyo, Japan) at 570 nm according to the method of ***Peters (1968)*** using kits purchased from bioMerieux (France).

5.2. Determination of peritoneal fluid fibrinogen (PFF)

Fibrinogen is measured according to Cooper and Douglas (1991). The method based on that citrated plasma is brought to coagulate with a large excess of thrombin. Here the coagulation time depends largely on the fibrinogen contents of the specimen.

In this investigation, sodium citrate (3.8 %) was added to peritoneal fluid in a ratio of 1: 9 to prevent coagulation.

6. Determination of cellular contents of peritoneal fluid

6.1. White blood cells

The total leucocytic count was carried out according to (Wintrobe, 1967). The sample was diluted into 1:20 by Turk's solution.

Procedure:

1- By using, white pipette, a sample was pipetted till mark (0.5) and completed to mark (11) with Turk's solution.

2- The content of pipette was mixed by shaking .

3- By using the improved Neubaur haemocytometer, drop of the diluted sample was counted in 4 large squares (N).

4- The count of leucocytes obtained was calculated as follows:

$WBCs/mm^3 = N/4 \times 20 \times 10$

(Where 20 is the dilution factor and 10 is the depth of the slide)

= count expressed in $10^3/mm^3$

6.1.1. Total peritoneal fluid nucleated cells count

Total leukocytic count was estimated using Neubauer haemocytometer according to ***(Jain, 1993).***

6.1.2. Differential leucocytic count

Stained with H&E satin. The differential leucocytic count was performed according to ***(Schalm, et. al., 1975).***

6.2. Red blood cells

Total erythrocytic count was estimated using Neubauer haemocytometer according to ***(Jain, 1993)***.

7. Statistical analysis

All data were subjected to statistical analysis according to Snedecor and Cochran (1980). Using one way ANOVA test Treatment were compared by the lost significant difference test (LSD) at $P<0.05$ level of probability.

Results

RESULTS

Intraoperative Results

Group I (*exploratory celiotomy*)

The long mesentery of the jejunum, small colon were allowed complete exteriorization of each respective segment for direct visual inspection, palpation or surgical manipulation. Most of the cecum and large colon could be exteriorized through the midline incision and made it available for inspection, palpation, or surgical manipulation.

The mesenteric and ligamentous attachement of the cecal base, right ventral and dorsal colon, transverse colon, oral and aboral small colon, and that of the rectum, limit complete mobilization of these portions from those segments. Similarly the suspending ligaments of the stomach and comparatively short mesoduodenum allowed for palpation only during exploratory surgery.

During exploration, the following segments of the gastrointestinal tract cannot be exteriorized: any part of the stomach, the entire duodenum, first 25 to 30 cm of jejunum, distal 25 to 30 cm of ileum, ileocecal junction, transverse colon, base of cecum, cecocolic junction, terminal part of the right dorsal colon, and terminal part of the small colon.

It was best for the right handed surgeon to stand on the left side of the animal during equine abdominal exploration when ventral midline laparotomy is used.

Group II (*Exploration and jejunal resection and anastomosis*)

Resection of the small intestine at an angle of 50-60° from the mesenteric attachment created a large stomal diameter and gave the small intestine its normal curvature after anastomosis.

Two-layers hemi-circumferential, continuous for mucosal layer and Cushing for seromuscular, is more suitable method for end to end anastomosis of the resected jejunum, this was due to the easiness of performance and due to the results of peritoneal analysis which revealed that there was no evident of food particles or RBC indicating that there was no leakage or hemorrhage.

Group III (*Exploration and typhlotomy*)

Incision in the cecal apex between the lateral and ventral cecal bands allowed good evacuation of the cecal contents as it is the most lower part toward the gravity.

Double inverting layers of Lambert and Cushing suture patterns provide maximum apposition and make no luminal stenosis. To achieve minimal tissue inversion and luminal stenosis, the Cushing layer putted close to the Lambert layer.

Group IV (*Exploration and enterotomy of the colon*)

Enterotomies performed adjacent to the teniae was associated with more intraoperative hemorrhage due to severance of large blood vessels in the wall of the colon. Moreover, all incisions healed without complications, and this detected by the analysis of peritoneal fluid erythrocytic count (PFRBCC).

Rupture of the colon can be avoided by working through a large abdominal incision, by decompression of the colon before exteriorizing it, by cradling the colon over the surgeon's forearms when lifting it, and by use of the surgeon's flat hand rather than fingers when rotating or handling a segment deep in the abdomen.

Filling the deep part of the abdomen with saline can facilitate exteriorization of the colon by reducing friction, creating more room, and allowing the colon to float upwards specially when being tympanic.

The most convex part of the pelvic flexure allows optimal drainage from the ventral and dorsal colons.

Before enterotomy in the colon, the colon placed between the rear legs so that the pelvic flexure can be placed in a dependant position.

Postoperative Results

Donkeys normally regain their feet strength about 30 min following termination of anesthetic regime used in this study. Most animals show a measure of incoordination after recovery from anesthesia and they should not be allowed to walk within 10-15 min of standing up.

Two animals in *Group II* and 1 animal in *Group III* had signs of abdominal discomfort and pain in the 1st postoperative day requiring further analgesic treatment in the first three postoperative days, and all cases cured well.

Temperature was increased in the first three days in 2 animals in group II 2°C over than normal, but decreased again by end of the third day after injection of additional antipyretic drugs.

There were no incisional wound complications except an inflammatory swelling was present around the wound in 3 animals in *Group I*, 3 animals in *Group II*, 2 animals in *Group III*, and 3 animals in *Group IV*. This swelling was disappeared after 5-6 days without additional treatment, except daily exercise.

Biochemical Results

The results of peritoneal fluid evaluation in all groups showed that, all values (protein, fibrinogen, WBCs and RBCs) were significantly higher than normal on the first postoperative day

Peritoneal fluid protein

All groups showed significant increase in the total peritoneal fluid protein (TPFP) in the 1st postoperative day by similar ratio. This increase still continued up to the 3rd postoperative day in group I, and up to the 5th postoperative day in group II, III, and IV.

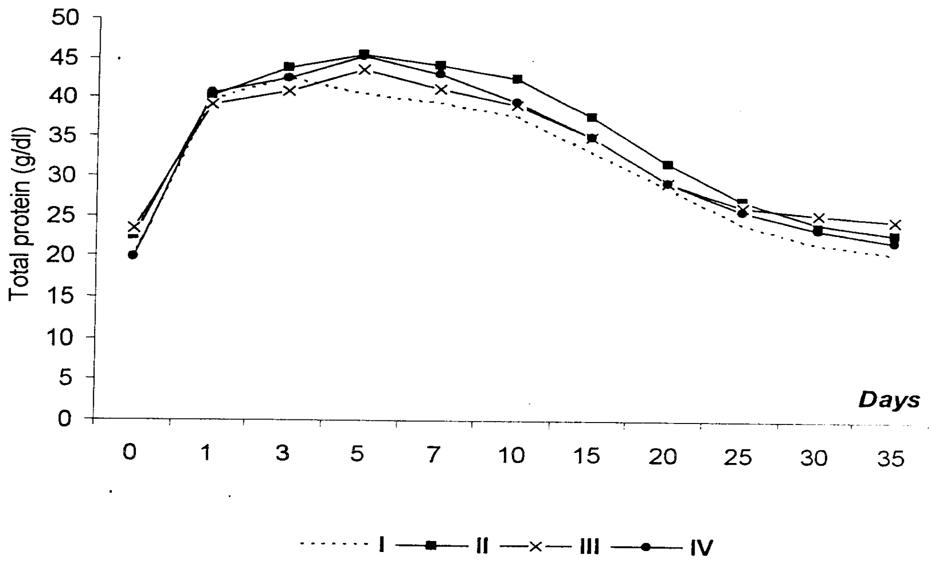
TPFP value for all groups didn't decrease significantly after its increase in the 1^{st} postoperative day, these values decreased by the 5^{th} postoperative day in group I and by the 7^{th} postoperative day in groups II, III, and IV, and reach its naomal values in the $30^{th\ and}$ 35^{th} postoperative day in all groups as shown in table (1) and figure (31).

Table 1: *Peritoneal fluid total protein (g/l)*

Groups	*days*										
	Baseline	*1st day*	*3rd day*	*5th day*	*7th day*	*10th day*	*15h day*	*20h day*	*25th day*	*30th day*	*35th day*
I	19.62 ± 0.98 **c**	39.77 ± 1.02 **a**	42.60 ± 0.84 **ab**	40.52 ± 0.61 **b**	39.38 ± 0.73 **c**	37.63 ± 0.62 **b**	33.05 ± 0.88 **b**	28.40 ± 0.74 **b**	24.02 ± 0.87 **a**	21.60 ± 0.59 **b***	20.47 ± 0.91 **b***
II	22.52 ± 0.80 **ab**	40.22 ± 0.89 **a**	43.80 ± 1.23 **a**	45.47 ± 0.95 **a**	44.20 ± 1.23 **a**	42.45 ± 1.15 **a**	37.63 ± 1.09 **a**	31.71 ± 1.31 **a**	27.03 ± 1.19 **a**	24.23 ± 0.55 **ab***	22.85 ± 0.46 **ab***
III	23.45 ± 1.10 **a**	39.23 ± 0.51 **a**	40.87 ± 1.23 **b**	43.60 ± 1.37 **a**	41.25 ± 1.25 **bc**	39.22 ± 1.36 **b**	34.95 ± 1.16 **ab**	29.28 ± 1.46 **ab**	26.20 ± 1.02 **a**	25.20 ± 0.81 **a***	24.53 ± 0.72 **a***
IV	19.85 ± 1.28 **bc**	40.60 ± 0.55 **a**	42.47 ± 0.49 **ab**	45.30 ± 0.74 **a**	42.98 ± 1.17 **ab**	39.48 ± 0.98 **b**	34.93 ± 1.13 **ab**	29.12 ± 1.78 **ab**	25.58 ± 1.10 **a**	23.43 ± 1.11 **ab**	21.82 ± 1.06 **ab***

Values are means ± standard errors.
Number of observations per mean = 6.
Means within the same column (groups within period) followed by a similar letter do not differ significantly at P = 0.05.
Means in the same row (periods within group) followed by an "*" do not differ from the baseline value at P = 0.05.

Fig. 31: Peritoneal fluid total protein



2. Peritoneal fluid fibrinogen

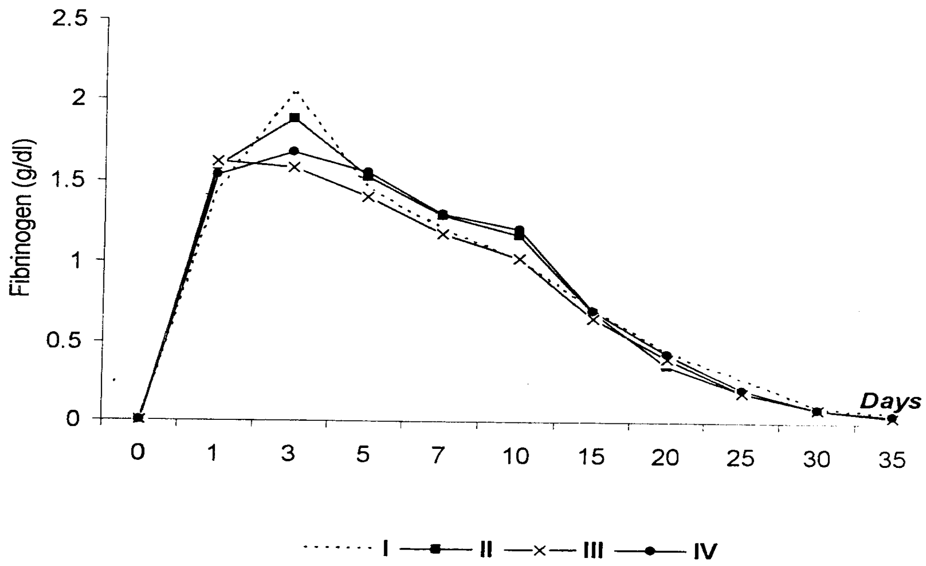
A difference in fibrinogen concentration was not detected between the 4 groups. Fibrinogen concentrations were significantly higher than normal on the 1st postoperative day and decreased not significantly till reach its normal values at 35th postoperative day, as shown in table (2) and figure (32).

Table 2: *Peritoneal fluid fibrinogen (g/l)*

Groups	days										
	Baseline	1st day	3rd day	5th day	7th day	10th day	15th day	20th day	25th day	30th day	35th day
I	0	1.43 ± 0.30 **a**	2.04 ± 0.22 **a**	1.45 ± 0.26 **a**	1.21 ± 0.23 **a**	1.02 ± 0.20 **a**	0.71 ± 0.12 **a**	0.44 ± 0.07 **a**	0.27 ± 0.06 **a***	0.09 ± 0.02 **a***	0.06 ± 0.01 **a***
II	0	1.59 ± 0.22 **a**	1.88 ± 0.18 **ab**	1.53 ± 0.17 **a**	1.29 ± 0.15 **a**	1.17 ± 0.14 **a**	0.69 ± 0.07 **a**	0.36 ± 0.04 **a**	0.19 ± 0.03 **a***	0.08 ± 0.02 **a***	0.04 ± 0.01 **a***
III	0	1.62 ± 0.21 **a**	1.58 ± 0.21 **b**	1.40 ± 0.20 **a**	1.18 ± 0.19 **a**	1.03 ± 0.16 **a**	0.66 ± 0.10 **a**	0.40 ± 0.06 **a**	0.19 ± 0.02 **a***	0.08 ± 0.02 **a***	0.04 ± 0.01 **a***
IV	0	1.54 ± 0.20 **a**	1.68 ± 0.18 **ab**	1.55 ± 0.18 **a**	1.30 ± 0.18 **a**	1.21 ± 0.18 **a**	0.70 ± 0.07 **a**	0.43 ± 0.07 **a**	0.21 ± 0.04 **a***	0.08 ± 0.02 **a***	0.05 ± 0.01 **a***

Values are means ± standard errors.
Number of observations per mean = 6.
Means within the same column (groups within period) followed by a similar letter do not differ significantly at P = 0.05.
Means in the same row (periods within group) followed by an "*" do not differ from the baseline value at P = 0.05.

Fig. 32: Peritoneal fluid fibrinogen



3. Total peritoneal fluid WBCs

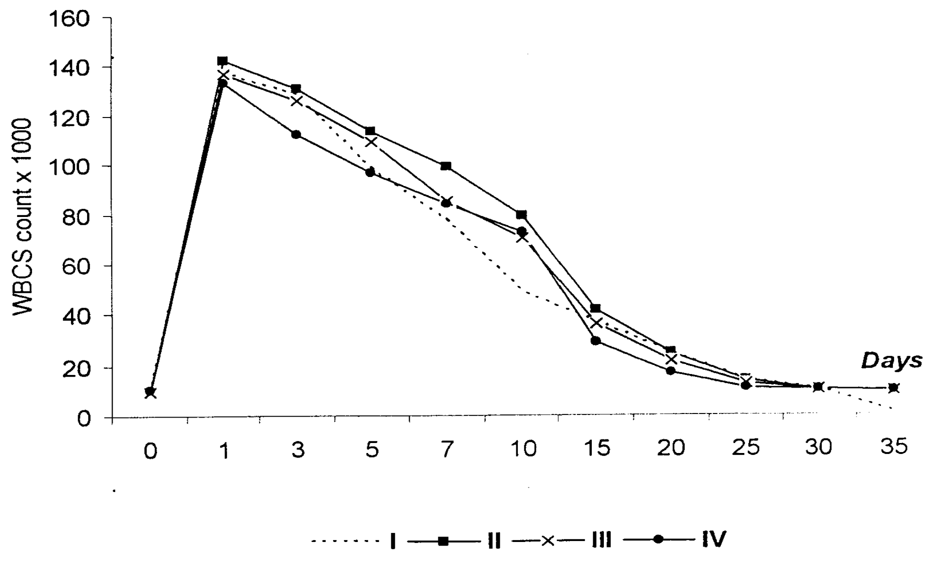
There is a significant difference between group I, compared with groups II, III, and IV over the course of the evaluation, a significant increase in the total nucleated cell count was evident for all groups in the 1st postoperative day. By the 3rd postoperative day, the total nucleated cell count for all groups had decreased significantly. All values decreased nonsignificantly from the 4th postoperative day till reach its normal values at the 25th and 30th postoperative day, as shown in table (3) and figure (33).

Table 3: *Peritoneal fluid total leukocytic count (cell/μl)*

Groups	days										
	Baseline	*1st day*	*3rd day*	*5th day*	*7th day*	*10th day*	*15th day*	*20th day*	*25th day*	*30th day*	*35th day*
I	9.73 x 103 ± 2.30 x 102 a	1.37 x 105 ± 4.06 x 103 a	1.28 x 105 ± 5.02 x 103 a	9.85 x 104 ± 5.73 x 103 b	7.70 x 104 ± 2.56 x 103 b	4.85 x 104 ± 4.57 x 103 b	3.66 x 104 ± 3.75 x 103ab	2.45 x 104 ± 2.30 x 103a	1.38 x 104 ± 1.16 x 103a*	1.01 x 104 ± 2.81 x 102a*	1.00 x 103 ± 2.47 x 102a*
II	9.65 x 103 ± 3.37 x 102 a	1.42 x 105 ± 5.93 x 103 a	1.31 x 105 ± 5.46 x 103 a	1.13 x 105 ± 6.46 x 103 a	9.88 x 104 ± 5.47 x 103 a	7.95 x 104 ± 3.77 x 103 a	4.13 x 104 ± 2.98 x 103a	2.44 x 104 ± 2.65 x 103a	1.37 x 104 ± 1.08 x 103a*	9.91 x 103 ± 2.48 x 102a*	9.67 x 103 ± 2.48 x 102a*
III	9.62 x 103 ± 3.32 x 103 a	1.36 x 105 ± 3.77 x 103 a	1.26 x 105 ± 5.53 x 103 a	1.09 x 105 ± 4.08 x 103 a	8.54 x 104 ± 3.07 x 103 b	6.99 x 104 ± 2.76 x 103 a	3.60 x 104 ± 2.49 x 103ab	2.15 x 104 ± 2.36 x 103a	1.23 x 104 ± 9.71 x 102a*	9.89 x 103 ± 2.80 x 102a*	9.76 x 103 ± 2.96 x 102a*
IV	9.97 x 103 ± 3.49 x 102 a	1.33 x 105 ± 5.30 x 103 a	1.08 x 105 ± 2.58 x 103 b	7.67 x 104 ± 1.34 x 104 c	8.03 x 104 ± 3.35 x 103 b	7.23 x 104 ± 3.48 x 103 a	2.86 x 104 ± 2.66 x 103b	1.69 x 104 ± 1.26 x 103a*	1.10 x 104 ± 3.15 x 102a*	1.01 x 104 ± 2.94 x 102a*	9.82 x 103 ± 2.05 x 102*

Values are means ± standard errors.
Number of observations per mean = 6.
Means within the same column (groups within period) followed by a similar letter do not differ significantly at P = 0.05.
Means in the same row (periods within group) followed by an "*" do not differ from the baseline value at P = 0.05.

Fig. 33: Peritoneal fluid total leukocytic count



4. Neutrophils %

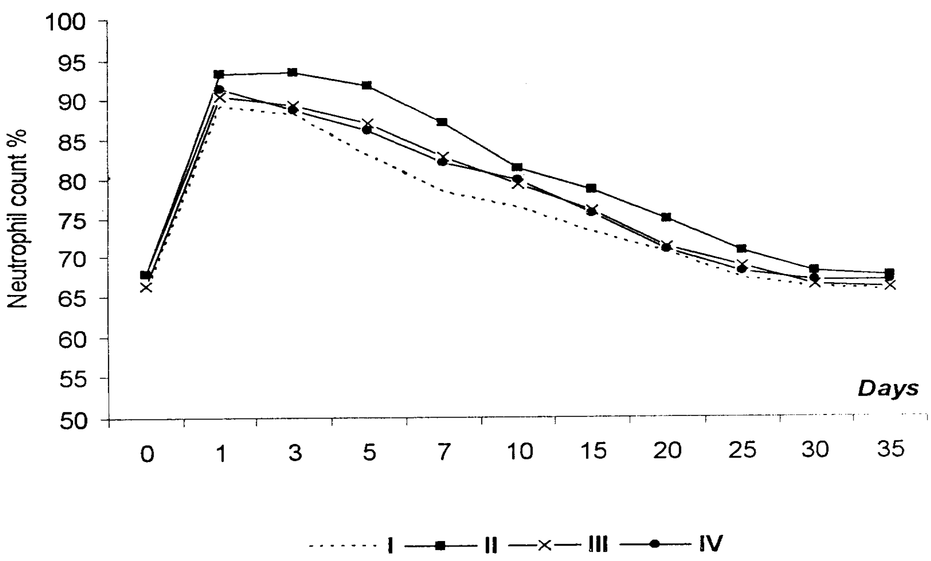
A similar significant increase in the percentage of neutrophils was evident on 1^{st} postoperative day for all 4 groups. A nonsignificant decrease was evident during the postoperative course of the evaluation till reach the normal values at the 35^{th} postoperative day, as shown in table (4) and figure (34).

Table 4: *Peritoneal fluid neutrophil count (%)*

Groups	*days*										
	Baseline	*1st day*	*3rd day*	*5th day*	*7th day*	*10th day*	*15th day*	*20th day*	*25th day*	*30th day*	*35th day*
I	65.31 ± 1.15 **a**	89.17 ± 0.60 **b**	88.17 ± 1.11 **b**	83.00 ± 0.82 **c**	78.17 ± 1.17 **c**	76.17 ± 1.35 **b**	73.00 ± 1.24 **b**	70.50 ± 1.06 **b**	67.00 ± 0.82 **b***	65.83 ± 0.87 **a***	65.50 ± 1.02 **a***
II	67.83 ± 1.70 **a**	93.17 ± 1.01 **a**	93.50 ± 0.72 **a**	91.67 ± 0.42 **a**	87.00 ± 0.63 **a**	81.33 ± 0.67 **a**	78.50 ± 0.43 **a**	74.67 ± 0.42 **a**	70.67 ± 0.49 **a***	68.00 ± 1.00 **a***	67.50 ± 1.28 **a***
III	66.17 ± 1.72 **a**	90.50 ± 1.02 **ab**	89.33 ± 0.88 **b**	87.00 ± 0.93 **b**	82.83 ± 0.91 **b**	79.17 ± 1.01 **a**	75.83 ± 0.70 **ab**	71.17 ± 0.54 **b**	68.67 ± 0.84 **ab***	66.33 ± 1.15 **a***	65.83 ± 1.19 **a***
IV	67.67 ± 1.26 **a**	91.33 ± 1.23 **ab**	88.83 ± 1.76 **b**	86.17 ± 1.78 **b**	82.00 ± 1.34 **b**	79.67 ± 1.33 **a**	75.50 ± 1.38 **ab**	70.83 ± 1.30 **b**	68.00 ± 0.73 **ab***	66.83 ± 0.65 **a***	66.83 ± 0.65 **a***

Values are means ± standard errors.
Number of observations per mean = 6.
Means within the same column (groups within period) followed by a similar letter do not differ significantly at P = 0.05.
Means in the same row (periods within group) followed by an "*" do not differ from the baseline value at P = 0.05.

Fig. 34: Peritoneal fluid neutrophil count



5. Peritoneal fluid RBCs

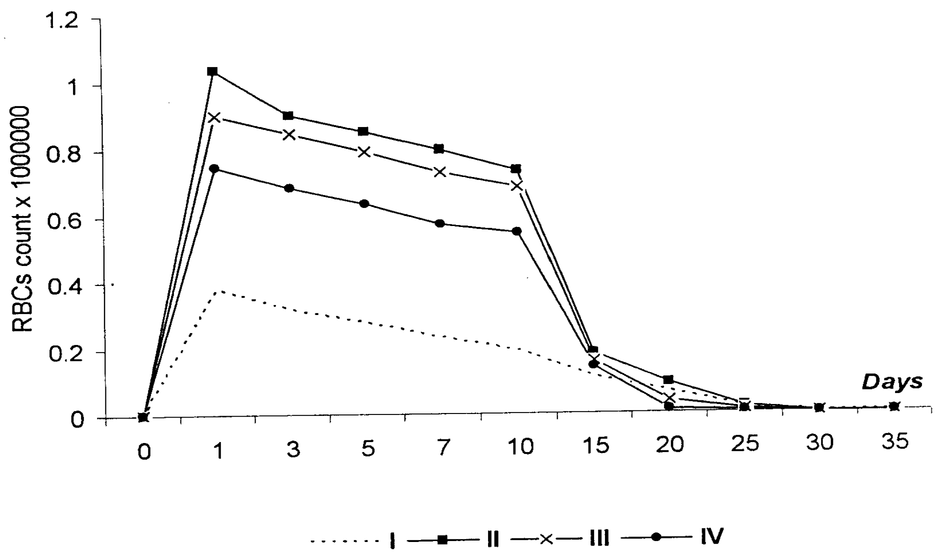
Peritoneal fluid erythrocytic count (PFRBCC) increase significantly in all groups from the normal value. But there was a significant increase in PFRBCC in group II, III, and IV than that of group I along the course of evaluation. The value of PFRBCC decreased significantly along the course of evaluation till reach its normal value at the 30th postoperative day. as shown in table (3) and figure (35).

Table 5: *Peritoneal fluid erythrocytic count (cell/µl)*

Groups	Baseline	1st day	3rd day	5th day	7th day	10th day	15th day	20th day	25th day	30th day	35th day
I	4.23 x 102 ± 59.07 a	3.79 x 105 ± 4.75 x 104 b	3.14 x 105 ± 4.42 x 104 b	2.75 x 105 ± 4.57 x 104 b	2.30 x 105 ± 4.85 x 104 b	1.88 x 105 ± 3.18 x 104 b	1.10 x 105 ± 1.99 x 104 b	6.07 x 104 ± 1.56 x 104 b	1.25 x 104 ± 2.68 x 102 b	5.88 x 102 ± 59.8 a*	5.10 x 102 ± 42.8 a*
II	4.05 x 102 ± 72.67 a	1.03 x 106 ± 8.20 x 104 a	8.97 x 105 ± 3.46 x 104 a	8.47 x 105 ± 3.86 x 104 a	7.94 x 105 ± 3.47 x 104 a	7.31 x 105 ± 3.47 x 104 a	1.79 x 105 ± 1.71 x 104 a	8.90 x 104 ± 8.75 x 103 a	2.01 x 104 ± 1.78 x 103 a	7.38 x 102 ± 80.3 a*	5.57 x 102 ± 40.4 a*
III	4.24 x 102 ± 54.75 a	8.98 x 105 ± 5.82 x 104 a	8.42 x 105 ± 4.69 x 104 a	7.93 x 105 ± 4.67 x 104 a	7.27 x 105 ± 4.44 x 104 a	6.83 x 105 ± 4.88 x 104 a	1.58 x 105 ± 1.48 x 104 b	3.81 x 104 ± 6.58 x 103 b	1.01 x 104 ± 2.44 x 103 b	5.58 x 102 ± 48.0 a*	5.08 x 102 ± 31.1 a*
IV	4.44 x 102 ± 57.23 a	7.45 x 105 ± 3.94 x 104 a	6.84 x 105 ± 3.80 x 104 a	6.34 x 105 ± 3.76 x 104 a	5.73 x 105 ± 3.27 x 104 a	5.45 x 105 ± 3.59 x 104 a	1.40 x 105 ± 1.46 x 103 c	1.05 x 104 ± 5.88 x 103 c	4.09 x 103 ± 1.75 x 103 c	5.14 x 102 ± 51.8 a*	4.82 x 102 ± 49.2 a*

Values are means ± standard errors.
Number of observations per mean = 6.
Means within the same column (groups within period) followed by a similar letter do not differ significantly at P = 0.05.
Means in the same row (periods within group) followed by an "*" do not differ from the baseline value at P = 0.05.

Fig. 35: Peritoneal fluid erythrocytic count



Discussion

DISCUSSION

Surgery in equine has important advances in the last two decades. The medical therapy and laparotomy have allowed for the recovery of horses presenting acute abdominal syndrome, which causes strong economic losses. Although the surgical therapy is not always reachable to every veterinarian and horses owners, it is a procedure, required for recovery of valuable horses.

In the present study, it has been found that, the ventral midline incision allowed easy, rapid access to the abdominal cavity with the minimum of hemorrhage and no injuries of muscles or nerves. Also it allowed direct inspection of more than 75% of the length of the digestive tract in adult animal. These results were agreed with that mentioned by ***Hickman (1985).***

In agreement with ***Brad and Allen (1988),*** the animal must be balanced exactly in dorsal recumbancy; this reduces the stress on the incision and facilitates abdominal exploration and wound closure.

It was preferred to start the incision in the linea alba near the umbilicus, as the linea alba is wider at that location. Therefore, avoiding the unplanned paramedian incision, as mentioned by ***Hay (1999).***

There was no need for undermining or separation of abdominal wall layers during incision or closure, which could be traumatic, creates dead space, and reduces blood flow to wound margins, this agreed with that discussed by ***Freeman (2003)***.

Once the linea alba has been incised over 2-4 cm, a long handled forceps is placed into the abdomen (still outside the peritoneum) and directed cranially while lifting the linea alba. This serves as a guide and protects viscera from accidental injury during the approach, this agreed with ***Mair, et. al. (2002)***

More cranial elongation of the ventral midline incision may be indicated to explore the dorsal abdomen, while caudal elongation indicated to explore the pelvic cavity and distal part of the small colon, this agreed with ***Mair et al (2002)***, who mentioned that, the limitation of the ventral midline incision is poor exposure of the structures in the pelvic cavity and dorsal abdomen.

The following segments of the adult horse's gastrointestinal tract cannot be exteriorized: any part of the stomach, the entire duodenum, first 25 to 30 cm of jejunum, distal 25 to 30 cm of ileum, ileocecal junction, transverse colon, base of cecum, cecocolic junction, terminal part of the right dorsal colon, and terminal part of the small colon. These results coincide with those mentioned by ***Freeman (2003)***.

Stay sutures through the mesenteric and antimesenteric edges of both small intestinal segments draw them into alignment and maintain them at similar diameters throughout closure. This agreed with ***Boom and Velden (2001).***

In the present study, the small intestinal mucosa was apposed with 2-0 vicryle in a hemi-circumferential simple continuous pattern and the seromuscular layer was inverted with 2-0 vicryle using a hemi-circumferential continuous Cushing's pattern. Each suture line was interrupted and tied at the mesenteric and anti-mesenteric borders to prevent a purse string affect. This technique was much better as it provided maximum apposition, maximum stomal diameter, minimal exposure of suture material and minimal exposure of the folded mucosa. Similar results were recorded also by ***Eggleston, et. al. (2000)***, and disagreed with ***Dean, and Robertson, (1985); Baxter, Hunt, Tyler, et. al. (1992).*** The results obtained from this study revealed that closure of the intestinal mucosa was important step during anastomosis.

The using of inverting suture pattern in the serromuscular closure minimizes suture material and mucosal exposure, this result was in agreement with ***Dean et. al. (1985).***

The angle of bowel transection was approximately 50-60 degree from the mesenteric attachment; this creates a large stoma and improves antimesenteric blood flow. This result was agreed with ***Fugaro, and Coté, (2001)***, who explained that if the angled transection is in a straight line across the bowel, a sharp point is created at the mesenteric margin that could be difficult to appose.

Stabilization of the enterotomy end was done by Babcock clamps or by stay sutures and the closure was done in two layers, the first layer of closure was by continuous Lambert pattern and covered by the Cushing layer. The two layers were putted close to each other, so that, minimal tissue inversion and luminal stenosis were obtained. These results were in agreement with ***Freeman, (2003).***

Enterotomies through the antimesenteric tenia are easier and quicker to perform, which cause less hemorrhage and less inflammation, maintain a larger lumen diameter, and are stronger. But it is recommended that enterotomies should not be performed through the teniae due to lack of vascularity. These observations were in agreement with that mentioned by ***Beard, Robertson, and Getzy, (1989)*** and disagreed with ***White, and Dabareiner, (1997).***

All incisions that made adjacent to the taeniae healed without complications, and this detected by the analysis of peritoneal fluid erythrocytic count (PFRBCC). This agreed with, ***Beard, Robertson, and Getzy (1989) and Sheta, Farag, Elzomar, Mostafa, Berbish, and Hamouda, (1995)***, who added that although more hemorrhage occurred at the incision site adjacent to the teniae, all incisions healed without complications.

The most convex part of the pelvic flexure allows optimal evacuation of the ventral and dorsal colons after exteriorization of the pelvic flexure, but the enterotomy should be placed more in the left ventral colon to prevent luminal stenosis by the suture line.

It is not necessary to close the mucosa of both colon and cecum, as the mucosa alone provide little holding strength for the overall closure. This agreed with the results of ***Jansen, Beeker and Kamp (1981)***.

Leaving the peritoneum unsutured during routine closure of the abdominal wall in the present study made no harmful effects on the results of peritoneal fluid analysis and postoperative signs, and this agreed with ***Swanwick and Milne (1973)*** who stated that suturing of the peritoneum actually decreasing the incidence of adhesion after surgery. He added that, the clinical experience in humans and horses confirmed that no detrimental effects result when the peritoneum itself was left unsutured during surgery. ***Mair et al, (2002)*** said that the peritoneum is only closed in standing laparotomy to minimize the possibility of air escaping the abdomen postoperatively and reaching the subcutaneous tissue.

Closure of the linea alba by synthetic absorbable suture materials had no effect on the clinical picture of peritoneal fluid and make no incisional contamination. This agreed with ***Trostl, and Hendrickson (1995)*** who mentioned that, the non-absorbable suture materials should be avoided, as many equine abdominal surgeries are clean-contaminated or contaminated procedure.

Absorbable suture materials are preferred, although their multifilament nature increases the risk of suture sinus formation, but just the suture material degrades the infection resolves. These results disagreed with ***Rubin and***

Maplesden (1977) and Schumacher (1981) who mentioned that, because aponeurosis takes several months to attain its pre-operative strength, the non-absorbable suture materials have considerable advantages in midline closure.

Continuous suture pattern allowed the biomechanical forces to be more evenly distributed over the entire incision line, quicker to perform than interrupted pattern. This was in the same line with the results mentioned by ***Magee and Galuppo, (1999)*** who added that, the continuous suture pattern is significantly stronger than the interrupted cruciate pattern.

The continuous pattern also place less suture materials in the tissues and therefore should incite less foreign body reaction and reduce the risk of infection, these results agreed with ***Freeman, et. al. (2002)***.

Trostle (1994) and Trostle (1998) mentioned that, the incision edges should be pulled into snug apposition, but tissue should not be tied too tightly, because this will strangulate the edges and cause foci of incisional necrosis. This result was agreed with that obtained in this study.

Peritoneal fluid reflects the pathophysiological state of the parietal and visceral mesothelial surfaces. Our findings indicate that additional manipulation of the peritoneum associated with resection and anastomosis of the small intestine, typhlotomy, or enterotomy of the colon may be of little consequence, compared with the trauma induced during a simple exploratory laparotomy. Animals had a postoperative peritoneal fluid inflammatory response. All values were significantly increased in the 1st day following surgery in all groups. The total peritoneal nucleated and RBC count was significantly decreased after the 3rd postoperative day, whereas the total protein and fibrinogen concentrations, and percentage of neutrophils were decreased by the 5th postoperative day. Values returned to normal limits by 25th - 35th

postoperative day. These findings support those of other studies (**Blackford et al. 1985; Santschi et al, 1988; and Hanson, 1992**) indicating that, surgical manipulation creates a significant and rapid postoperative peritoneal inflammatory reaction.

The critical mediator of the peritoneal fluid reaction seemed to be manipulation of the abdominal viscera and damage to other mesothelial surfaces. A significant increase was noticed in the total peritoneal nucleated cell counts and total protein values for animals undergoing exploratory laparotomy, (**Blackford et al. 1985; Santschi et al, 1988 and Hanson, 1992**) compared with horses undergoing laparoscopy or celiotomy without exploratory surgery, (**Blackford et al. 1985 and Fischer, et al.1986**). This support the suggestion that the size of laparotomy wound as well as the extent of manipulation of viscera strongly affect the postoperative inflammatory response. Our results were coincided with the above authors.

Total peritoneal nucleated cell values in this study and in the studies performed by (**Blackford et al. 1985; Schneider, et al. 1988 and Hanson, 1992**) remained significantly higher than preoperative values. Despite that, a significant downward trend in total nucleated peritoneal cell count was not evident until the 5th postoperative day.

Peritoneal erythrocytic count (PRBCC) increase significantly in all groups from the normal value. But there is a significant increase in PRBCC in group II, III, and IV than that of group I along the course of evaluation. This is due extensive manipulation of intestine and opening the gut in groups II, III, and IV. These results were in the same line with that of **Blackford, et al. (1985)**.

Neutrophils are the most common and important cell type in peritoneal effusions. This was agreed with ***Steer, and Lewis, (1983)*** who stated that, neutrophils are attracted to the peritoneal cavity by chemotactic stimuli and act as one of the primary cellular defense mechanisms against invading microorganisms.

Percentage of neutrophils was increased sharply on the 1st postoperative day and stayed high in all groups and decreased none significantly over the postoperative course, similar results were reported also by **Blackford, et. al (1985) and Hanson (1992).**

The results of peritoneal fluid evaluation in all groups showed that, additional manipulation of the peritoneum associated with resection and anastomosis of the small intestine, typhlotomy, or enterotomy of the colon may be of little consequence, if compared with the trauma induced during a simple exploratory laparotomy.

All values (total protein, fibrinogen, WBCs, neutrophils and RBCs) were significantly higher than normal on the 1st postoperative day. These values were decreased significantly after 5th postoperative day *(except total peritoneal fluid protein which begine to decrease at the 7th postoperative day)*, till reach its normal values at 25th – 35th postoperative day.

Summary

SUMMARY

Twenty-four apparently healthy adult donkeys of both sexes, of age (3-7 years), and weight (90-150 kg) were used in this study. The animals were divided into four equal groups (I, II, III, and IV), six animals of each.

- **Group I:** for ***exploratory celiotomy*** with only manual exploration of the viscera *"as a control group"*.
- **Group II:** for ***exploration and jejunal resection and anastomosis***.
- **Group III:** for ***exploration and typhlotomy (enterotomy of the cecum).***
- **Group IV:** for ***exploration and enterotomy of the colon.***

On the day of surgery (0 day), 1^{st}, 3^{rd}, 5^{th}, 7^{th}, 10^{th}, 15^{th}, 20^{th}, 25^{th}, 30^{th}, and 35^{th} postoperative days, peritoneal fluid was collected by ordinary method using teat canula.

Peritoneal fluid was evaluated for peritoneal fluid protein concentration, fibrinogen, concentration nucleated cell count, and RBCs count. Samples were stained by (H&E) for evaluation of morphologic features (percent of neutrophils).

The present result revealed that, the ventral midline incision allowed easy, rapid access to the abdominal cavity with the minimal hemorrhage and no involvement of muscles or nerves. Also the ventral midline approach allowed direct inspection of more than 75% of the length of the digestive tract in adult donkeys but provided poor exposure of the structures in the pelvic cavity and dorsal abdomen.

Peritoneal fluid reflects the pathophysiological state of the parietal and visceral mesothelial surfaces. Our findings revealed that additional

manipulation of the peritoneum associated with resection and anastomosis of the small intestine, typhlotomy, or enterotomy of the colon may be of little consequence, compared with the trauma induced during a simple exploratory laparotomy.

All values (total protein, fibrinogen, WBCs, neutrophils and RBCs) were significantly higher than normal on the 1^{st} postoperative day. These values were decreased significantly after 5^{th} postoperative day *(except total peritoneal fluid protein which begine to decrease at the 7^{th}postoperative day)*, till reach its normal values at 25th – 35th postoperative day.

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Arabic Summary

الملخص العربى

يمثل المغص فى الخيول كابوسا سيئا ليس فقط لمالكى الخيل ولكن ايضا للأطباء البيطريين ذلك لأنه فى بعض الأحيان لا يمكن التفرقه بين حالات المغص التى تستجيب للعلاجات الدوائيه و بين تلك التى تتطلب التدخل الجراحى السريع للحفاظ على الحيوان. لذلك لابد و أن نتعامل مع حالات المغص بجديه فى كل الحالات.

من هذا المنطلق اجري هذا البحث بقسم الجراحه بكليه الطب البيطرى جامعة طنطا على ٢٤ حيوانا بالغا من كلا الجنسين لدراسة تأثير عدد من أهم عمليات المغص فى الخيول (قطع جزء ووصله من الصائم- فتح القولون- فتح الزائده الدوديه) على مكونات السائل البريتونى و مقارنته بالسائل البريتونى قبل وبعد عملية فتح البطن الأستكشافيه وإجراء العمليات الجراحية فى الأمعاء.

قسمت الحيوانات إلى أربعة مجاميع فى كل منها ستة حيوانات حيث تم استخدام طريقة فتح البطن من منتصف أسفل البطن فى كل هذه المجاميع..

المجموعة الأولى:

اجري فيها شق بطنى وسطى استكشافى فقط.

المجموعة الثانيه:

اجري فيها شق بطنى وسطى استكشافى ثم عمل قطع ٢٥-٣٠ سم من الصائم (اللفائفى) ووصل الأمعاء بعد ذلك.

المجموعة الثالثة:

بعد الاستكشاف تم عمل فتح فى الأعور و افراغ محتوياته ثم خياطته مرة أخرى.

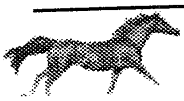
المجموعة الرابعة:

بعد الاستكشاف تم عمل فتح فى القولون الكبير و افراغ محتوياته ثم خياطته.

تم تجميع عينات من السائل البريتونى فى اليوم ١، ٣، ٥، ٧، ١٠،١٥، ٢٠، ٢٥، ٣٠، ٣٥ بعد العملية و يتم تحليل العينات كالتالى: قياس نسبة البروتين الكلى- قياس نسبة الفيبرينوجين - قياس عدد كرات الدم البيضاء - قياس عدد خلايا النيتروفيل - قياس عدد كرات الدم الحمراء.

اثبتت نتائج الدراسه التجريبيه أن عملية شق البطن الوسطى فى عمليات المغص فى الخيليات هى أنسب الطرق حيث أنها تتيح رؤية أكثر من ٧٥% من من محتويات البطن و سهلة الأداء. هذا بالاضافه الى عيوب الطرق الأخرى.

عادت الحيوانات الى طبيعتها و تناول كمية الأكل الطبيعيه لها فى اليوم الثانى بعد العمليه باستثناء حيوانات المجموعه الثانيه و التى استردت قدرتها الطبيعيه على الأكل فى اليوم الثالث بعد العمليه.



اثبـــتت النـــتائج أن هناك ارتفاع نسبى فى كل نتائج تحاليل السائل البريتونى فى اليوم الأول بعـــد العملـــيه فـــى المجموعات الثانيه، الثالثه، و الرابعه. وهذا الأرتفاع لا يختلف نسبيا عن ذلك الأرتفـــاع فـــى المجموعه الأولى. مما يؤكد ان عمليات المغص فى الخيول لا يزداد تأثيرها بشكل ملحوظ على محتوى السائل البريتونى عنه فى عمليات فتح البطن الأستكشافيه فقط.

مما سبق يمكن استخلاص الأتى:

- أن شـــق الـــبطن الوسطى فى عمليات المغص فى الخيليات هو أنسب الطرق سواءا كانـــت العمليه استكشافيه أو غير ذلك من عمليات المغص حيث أنها تتيح رؤية أكثر من ٧٥% من محتويات البطن فى الخيليات.
- ان عملـــيات المغص فى الخيول لا يزداد تأثيرها بشكل ملحوظ على محتوى السائل البريتونى عنه فى عمليات فتح البطن الأستكشافيه فقط.
- أن الارتفـــاع فـــى نتائج التحليل للسائل البريتونى يكون ملحوظا فى اليوم الأول بعد العملـــيه ثم يبدأ فى التناقص نسبيا عند اليوم الثالث فى المجموعة الأولى وعند اليوم الخـــامس فى المجموعات الثانيه، الثالثه، و الرابعه. ويعود الى الصوره الطبيعيه فى اليوم ٣٠-٣٥ بعد العمليه.

إهداء

إلى والدي الحبيب

والدتي الغالية

أخوتي الأعزاء

(محمد وبهاء)

بسم الله الرحمن الرحيم

قرار لجنة الحكم والمناقشة

قررت لجنة الحكم والمناقشة فى جلستها بتاريخ ٢٧ / ٧ / ٢٠٠٦ ترشيح السيد ط.ب./**علاء الدين غازى عبد السلام أحمد** للحصول على درجة الماجستير فى العلوم الطبية البيطرية (جراحه بيطريه).

" فتح البطن فى الفصيله الخيليه بالاشاره الخاصه الى جراحه الأمعاء "

وتتكون لجنة الحكم والمناقشة من السادة :

أ.د/ أحمد عبد المنعم قناوى
أستاذ الجراحة والتخدير والأشعة
كلية الطب البيطرى جامعة الأسكندرية

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كلية الطب البيطرى
قسم الجراحه

فتح البطن فى الفصيله الخيليه

بالاشاره الخاصه الى جراحة الأمعاء

رسالة مقدمه من

ط.ب/ علاء الدين غازى عبد السلام أحمد

بكالوريوس العلوم الطبيه البيطريه
(جامعة طنطا-٢٠٠٣)

للحصول على

درجة الماجستير فى العلوم الطبيه البيطريه
(الجراحه البيطريه)

تحت إشراف

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