INTRODUCTION

The donkey is a member of the horse family that belongs to Kingdom *Animalia*, Phylum *Chordata*, Class *Mammalia*, Order *Perissoductyla*, Family *Equide*, Genus *Equus* and Species *Equus asinus* (Wilson, 1981).

The world donkey population is estimated to about 44 million; half is found in Asia, just over one quarter in Africa and the rest mainly in Latin America (Fielding and Starkey, 2004). An estimated 39 million donkeys live in the developing world and 36% of this number is found in Africa (Swai and Bwanga, 2008). The estimation of equine number in Sudan is 750.000 donkeys, 26.400 horses and 630 mules (Wilson, 1981).

Donkeys play a vital role in rural economies through the provision of draught power and transport. Compared to other equidae species, donkeys contribute the major proportion of readily available transport needs of poor women and men living in hostile environments, enabling them to integrate into social and economic processes (Swai and Bwanga 2008). In Sudan the most common role of donkeys is the transport, whether riding, pack, transport, or pulling carts. They may also be used for farm tillage, threshing, raising water and milling (Tamador *et al.*, 2011).

Equide particularly donkeys have been totally neglected despite their prominent role in both rural and urban society of the country. Hence, research on donkeys has lagged far behind other domestic species. Therefore, strengthening research to get maximum output from this species without violating its welfare requires urgency.

The small intestine of the donkeys is subject to obstructions from a variety of causes. In most causes of obstruction result in vascular occlusion which leads rapidly to irreversible tissue changes in the obstructed segments of gut. Unless the donkey is referred for surgery very early in the course of the condition, resection of the compromised bowel is usually imperative, other types of obstructions, while causing no ischemia of bowel, require some form of bypass anastomosis with or without resection, to restore normal flow of ingesta along the alimentary tract. In an attempt to determine the best method for surgical removal of devitalized jejunum lesions, twelve donkeys underwent a double jejunum resection and end-to-end anastomosis.

An intestinal anastomosis becomes necessary when a segment on the gastrointestinal tract is resected for benign or malignant indications and gastrointestinal continuity needs to be restored (Chen, 2012). Resection and anastomosis are usually required in cases intussusceptions, mega colon, neoplasia, and obstruction or trauma. Complication associated with resection and anastomosis are the major cause of death in the animals requiring abdominal surgery, complication occur mainly due to lack of strict asepsis, poor surgical techniques, improper suture material and poor suturing method commonly encountered problems for intestinal anastomosis are the frequency of breakdown and leakage of intestinal contents in the terminal colon as compared to other intestinal segments (Kachiwal and Kalhoro, 2003). In this study experimental model was designed to compare between SSCLS group with SSIS group for jejunal anastomosis in Sudanese donkeys. However the two main kinds of suture patterns which may be chosen in performing jejunal anastomosis never before had been studied in donkeys as general and Sudanese donkeys specially.

Objectives:

I) General Objective:

To assess the efficacy of two jejunum anastomosis suture patterns using the donkeys as an experimental model.

II) **Specific Objectives : To**

1- Evaluate the SSCLS and SSIS suture patterns techniques in donkeys

2-Invstigte the physiological, haematological and biochemical parameters associated with each technique for jejunum anastomosis under field condition.

3- Detect the efficacy of SSCLS and SSIS jejnual anastomosis in terms of time consumed, anastomatic leakage, wound infection, mortality rate, adhesions degree and wound healing.

4- Report on the advantages and disadvantages of SSCLS and SSIS jejnual anastomosis in donkeys.

CHAPTER ONE

LITERATURE REVIEW

1.1. Anastomosis Historical Background:

In regard to the method of intestinal anastomosis, many studies have been preformed since Lembert recognized in (1826) the necessity for inverted, serosa to serosa appositions to establish the safe anastomosis of the intestine; his concept was refined clinically by Diefenbach (Nagaya, 1971). Ten years later and was strengthened by the clinical success of Billroth (Nagaya, 1971). In 1877 Lembert's method has proved so effective that only minor variations in the techniques have been introduced since, but as surgical method and techniques improved, a more questioning attitude has prevailed (Nagaya, 1971). For example Sako and Wangensteen in 1951 compared open, close, single, and two row anastomosis and recommended the close one row anastomosis, although all methods were satisfactory. Gambee in (1951) suggested an anastomatic end to end intestinal anastomosis using only one row interrupted suture; this method has proved quite satisfactory. Weinberg in (1963) also supported and on appositions reporting a series of more than 1.000 pyloroplasties, no leaks or breakdown of anastomosis occurred. Healey *et al*. (1964) studies inverted, everted and end to end on anastomosis in dogs.

In horses, Hanson *et al*. (1998a) used an appositional one row suture pattern compared with an inverting 2-row suture pattern and an appositional 2-row suture pattern. Hanson *et al*. (1998b), used a simple interrupted suture pattern that excluded the mucosa and over sewn with an inverting suture was compared with a triangulated double-row pattern of stainless steel staples, Mendez-Angulo *et al*. (2010) used a continuous Lembert suture pattern. And sutures techniques used in goats by Al-Timmemi *et al*. (2010) used one row of serosubmoucosal interrupted sutures compared with one row of horizontal mattress interrupted sutures, Also in dogs Al-Qadhi and Al-Hasan (2013) were conducted simple interrupted suture pattern with continuous Lembert suture pattern, and Kachiwal and Kalhoro (2003) were used an appositional 2-row suture patterns than with an inverting 2-row suture patterns, Ali (2011) performed interrupted intra luminal knotting versus extra luminal, and Azevedo *et al*. (2008) were conducted sero-submucosal stitches tied in the lumen, over the submucosa; sero submucosal stitches tied in the exterior of the organ, over the serosa; total stitches tied in the lumen, over the mucosa; and total sutures tied in the exterior, over the serosa (Gambee's stitches)and Crha *et al*. (2008) conducted anastomosis used manual single row approximation technique and two row inverting technique of the intestinal wall suture. Sutures techniques in rats were conducted by Krasniqi *et al*. (2009) used Halsted, Gambee and Gambee–Halsted technique.

1.1.2. Definition of Anastomosis:

Anastomosis it is a surgical connection to provide a channel between organs structures, anastomosis are often used joint segments of bowel; they are also commonly used in the repair of nervous and blood vessels (Hurov, 1978). Intestinal anastomosis is an important surgical procedure that connects two sections of the intestine once a diseased portion has been removed. A key concern is to prevent leakage at the anastomosis site and subsequent peritonitis, but this complication can be avoided if the procedure is done correctly and preventive measures are taken (Al-Qadhi and Al-Hasan, 2013).

1.1.3. Anastomosis Techniques:

An anastomosis is a significant tissue injury given that the surgeon must first divide all of the blood vessels feeding the proposed resection site; all row of the intestinal wall are divided meaning that their entire thickness from mucosa to serosa is disrupted and then tissues are approximated with sutures (Shogan *et al*., 2014).

End to end anastomosis can be classified into three types: single or double row inverting sutures which may be interrupted or continuous (e.g., Lembert, Connell or Cushing); single row everting sutures; and single row approximating sutures (e.g., simple interrupted crushing type and Gambee sutures) Edwards (1986).

1.1.4. Anastomosis in Small Intestine:

In horses, side-to-side anastomosis of the jejunum is often preferred, to avoid postoperative stenosis (Kersjes *et al*., 1995). Al-Timmemi *et al*. (2010) conducted study, a comparison of two anastomatic techniques in the jejunum of the goat and a new technique for intestinal end-to-end anastomosis in dogs study by Ali (2011).

1.2. Anatomy of Digestive System in Equine:

The digestive tract consists basically of along muscular tube, made up of six basic parts the oesophagus, the stomach, the small intestine, the cecum, the large colon, and the small colon (Gregory, 2008).The entire digestive system is completely unique to the horse and can be spilt in to two parts, fore gut and hind gut, in simple term the horses digestive tract is a tube beginning at the lips and ending at the anus, the role of which is to breakdown food into substances which can be absorbed into the bloodstream and utilised by the horse (Pilliner and Davies, 2002).

1.2.1. Small Intestine:

The small intestine has three parts: duodenum, jejunum, and ileum; by and large it follows the general mammalian pattern (Budras *et al*., 2008). The length of the small intestine in the horse is approximately 20-27m, with a capacity of 55-70 litters; it runs between the stomach and the caecum (Pilliner and Davies, 2002).

1.2.2. Jejunum:

The jejunum continues from the duodenum and leads into the ileum. It is the longest part of the small intestine and is highly coiled. It has digestive and absorptive functions (Wiki Vet, 2016).

The jejunum is about 25 m (70 feet) long; it is shorter in life. Owing to its long mesentery, jejunal coils can be found in many parts of the abdominal cavity; most of them, however, reside near the left flank, ventral to the pelvic inlet, and to the left of the cecum (Budras *et al*., 2008).

1.2.3. Topographic Anatomy of Jejunum:

The jejunum is confined to the left dorsal part of the abdomen. It is restricted to this position by the large cecum on the right, and ascending colon ventrally on both sides (Wiki Vet, 2016). The upper part of the flank is occupied by a mixture of descending colon and jejunum. The former has two bands (teniae) of which the free one as well as the sacculation (fecal balls) is prominent. The jejunum is without bands. Below these coils lie the caudal parts of the left colon; the left dorsal has a smaller diameter than the left ventral; both become confluent in the pelvic flexure which, shielded by the thigh, lies in front of the pelvic inlet often extending across the median to the right (Budras *et al*., 2008), the jejunum measures 17 to 28 m in adult horses and is situated mainly in the left dorsal quadrant of the abdomen, between loops of small colon (Auer and Stick, 2006).

1.2.4. Blood Supply of the Jejunum:

The arterial supply from the cranial mesenteric artery is carried in arcades in the long meso-jejunum (40 to 60 cm), which allows the jejunum much mobility. Each vascular arcade is composed of a major jejunal vessel, an arcuate vessel that forms a loop with the next jejunal vessel, and severeal vasa recta that pass from the arcuate vessels to the intestinal wall. Veins run parallel to the arterial supply and enter the portal vein to provide venous drainage, a branch from the cranial mesenteric artery that travels along the ileum to anastomosis with the jejunal arteries (Auer and Stick, 2006).

1.2.5. Physiology of the Jejunum:

The jejunum is the middle section of the small intestine and is mainly involved with the absorption of the most basic products of carbohydrate and protein digestion monosaccharide and amino acids (Wiki Books, 2015).

1.3. Physiological Parameters:

Physiological parameters changes after laparoscopic Gastrojejunostomy in dog was study by Tavakoli *et al*. (2007), who reported that there were no significant differences between body temperature, heart rate and respiratory rate in gastrojejunostomy in dogs. Also Nazifi *et al*. (2000), who reported that the mean temperature, respiration rate and pulse rate of the experimental animals were 39.6 ±0.68C°, 20.9 ±2.9 and 91.4 ±15 per min, respectively following surgery in goats.

1.4. Haematological Examination:

1.4.1. Red Blood Cells (RBCs)

The normal range of the red blood cells in donkeys was studied by Al-Hadithy *et al*. (2016) who reported that the average (mean) of the red blood cells in males and females were 4.69 to 7.6×10^6 cells/mm^3 ($6.06 \pm0.02\times10^6$ cells/mm^3), 4.59 to 8.5×10^6 cells/mm^3 ($6.29 \pm0.25\times10^6$ cells/mm^3).The changes in the red blood cells in the comparative between two suturing techniques in intestinal anastomosis were finding contradictory results. Holmer *et al*. (2014) reported that there were no relevant changes in red blood cell count in rats on days 2 to 6 after anastomosis, while Hanson *et al*. (1992) who reported that the resection and anastomosis group had a significantly higher mean total RBC count over the entire 7-day postoperative evaluation than did horses that underwent celiotomy alone.

1.4.2. White Blood Cells (WBCs):

The normal range of the white blood cells in donkeys was studied by Al-Hadithy *et al*. (2016) who reported that the average (mean) of the white blood cells in males and females were 5700 to 14100 cells/mm^3 (10990 ±860 cells/mm^3), 5400 to 15300 cells/mm^3 (10821±800 cells/mm^3) respectively and also in horses Jansson (2016), who reported that the total nucleotide cells count in normal peritoneal fluid should be less than $5x10^9$/l in horses. The changes in white blood cells in the comparative between two suture techniques in intestinal anastomosis were finding contradictory results. Holmer *et al*. (2014), who reported that on day 1, leukocyte counts were decreased with a marked left shift in the differential counts, whereas on study days 2 to 6 leukocyte counts were increased, Dilawer *et al*. (2009) reported that no significant differences in white blood cells (WBCs) count in animals underwent 70% (group A), 80%(group B) and 100% (group C) resection and anastomosis of jejunum compared with control at day 15, 60 and 75, while WBCs count in group A was significantly higher than control at day 30 and 45. And WBCs count of group A, B and C was significantly higher than control at day 90.

1.5. Blood Biochemical Parameters:

1.5.1. Blood Glucose Concentration:

The normal range of serum glucose concentration measured parameters in Iraqi healthy racing horses by Hasso *et al*. (2012), who reported the range and mean values ± standard error of serum glucose concentration were: 3.3 – 6.71 μmol/l. Ismail *et al*. (2010), who reported that increased in blood glucose level in different animal species as a results of using xylazine alone or in combination with other drugs; Ghurashi (2016), who reported that the increase in glucose level attributed to the effect of xylazine in donkeys. The hyperglycemia was observed by Singh *et al*. (2006), who suggested that increase might be attributed to the stress induced gluconeogensis as a result of anesthesia and increased production of glucose in liver, in addition many investigations into the hyperglycemic effects of xylazine were studied in various species (Brikas *et al*. 1987; Eigler *et al*. 1979; Hsu and Hummel., 1981), explained that hyperglyceamia might be due to inhibition of insulin release by stimulation of alpha-2 adrenoceptors in pancreatic beta- cells (Angel and Langer,1988).

1.5.2. Total Protein (TP):

According to Jansson (2016) the normal peritoneal fluid has a total protein content of less than 1.5 g/dl, above 2.5 g/dl is regarded as abnormal in horses, the changes in blood protein in the comparative between two suture patterns in intestinal anastomosis were finding contradictory results. Holmer *et al*. (2014) reported that no relevant changes in total protein in rats on days 2 to 6 after anastomosis, while Hanson *et al*. (1992), reported that resection and anastomosis had a significantly lower total protein concentration on the first postoperative day evaluation than did horses that underwent celiotomy alone, however, Tavakoli *et al*. (2007), reported that no significant differences in total protein in both groups underwent one layer suture pattern in gastrojejunostomy compared with to two layer suture patterns technique in dog.

1.5.3. Albumin (ALB):

Changes in blood albumin in the comparative between two suture patterns in intestinal anastomosis were finding contradictory results. Holmer *et al*. (2014) reported that no relevant changes in blood albumin in rats on days 2 to 6 after anastomosis. Also Tavakoli *et al*. (2007) reported that no significant differences in albumin in both groups underwent one layer suture pattern technique in gastrojejunostomy compared with to two layer suture pattern technique in dog.

1.5.4. Blood Urea Nitrogen (BUN):

Contradictory results were reported in literature concerning the effect of xylazine on blood urea nitrogen level. Significant decrease in urea level was reported to occur as a result of using xylazine in mares (Kullmann *et al*. 2014); no significant elevation was reported by Ismail *et al.* (2010) in mares. On the other hand, the increased in BUN during anesthesia with propofol and xylazine in camels may be attributed to an increased hepatic urea production from amino-acids degradation (Eigler *et al.*, 1979); Geehan (2014) reported that significant differences were observed in blood urea nitrogen in premedicated anesthetized camels.

1.5.5. Blood Total Lipids (mg %):

The normal range of serum lipid concentration profile measured parameters in Iraqi healthy racing horses by Hasso *et al*. (2012), who reported range and mean values ± standard error of serum lipid concentration were: 5.17 ±0.07 µmol/l, and Demuner *et al*.(2015), how reported that total splenectomy did not induce increased plasma lipids levels in mice.

1.6. Consumption Time:

The consumption time to intestinal anastomosis were recorded in severeal studies. Burch *et al*. (2000) who reported 20.8 minutes to construct in a single-row anastomosis versus two-row group, Dandi *et al*. (2015), who reported that the mean duration required for single layer anastomosis was shorter than double layer anastomosis. Also Rahul *et al*. (2015) reported significant shorter time duration of intestinal anastomosis for the single row group compared with double row. Other study on human beings was conducted by Yao *et al*. (2016), revealed that surgical anastomatic time using the new hand-sewn anastomosis was relatively short compared with the stapled anastomosis. And in the study conducted by Mehmoud *et al*. (2012) reported that mean of time taken for anastomosis was shorter in single row interrupted extra-mucosal anastomosis than double row anastomosis. also Auletta *et al*. (2011) evaluated three suture patterns for anastomosis of the equine small intestine and was recorded the time spent in the execution of the Lembert single row was significantly less than that for both Gambee and Lembert double row, Burch *et al*. (2000), reported that the single-row continuous anastomosis requires less time to construct as compared with the two-row technique, also Dandi *et al*. (2015), reported that the single layer interrupted extra-mucosal technique required significantly less duration for anastomosis compared with double layer anastomosis.

1.7. Pathology Findings:

1.7.1. Mortality Rate:

The mortality rate in the comparative between two suture patterns in intestinal anastomosis was finding contradictory results. Pathak *et al*. (2014), reported that uncontrolled sepsis caused death in one animal (3.12%) patient in the single row anastomosis techniques. But Rahul *et al*. (2015) who found similar result of mortality rate in single row intestinal anastomosis does not carry any increased when compared to double row intestinal anastomosis, in man (El-Badawy, 2014), reported that mortality rate was higher in leakage group than no leakage after gastrointestinal surgery.

1.7.2. Wound Infection

As reported by Pathak *et al*. (2014), wound infection after anastomosis was observed higher percentage in single row anastomosis techniques compare with double row anastomosis technique. Rahul *et al*. (2015), who reported insignificant in site infection as a result of the single row compared with double row intestinal anastomosis.

1.7.3. **Anastomatic Leakage**:

The anastomatic leakage was reported to occur in two patients (3.1%) in the single-row group and one patient (1.5%) in the two-row group (Burch *et al*., 2000). Pathak *et al.* (2014) who reported that anastomatic leakage were showed in three patients (9.37%) in single row anastomosis techniques and two patients (6.67%) in double row anastomosis technique. Also Rahul *et al*. (2015) reported insignificant in the anastomic leakage as a result of the single row intestinal anastomosis compared to double row intestinal anastomosis. Yao *et al*. (2016)

reported the anastomatic leakage was lower in the new hand-sewn anastomosis group compared with the stapled anastomosis group (0/80 vs. 1/70). And in the study conducted by Mehmoud *et al.*(2012), reported anastomatic leakage occurred in two (6.6%) patients in single row interrupted extra-mucosal anastomosis and in one (3.3%) patient in double row anastomosis, and Dandi *et al*. (2015), who reported that no significant difference in anastomatic leak rate in single layer interrupted extra-mucosal technique as conventional double layer technique.

1.7.4. Degree of Adhesions Formation:

The degree of Adhesion formation in the intestinal anastomosis was assessed in many studies. Kuebelbeck *et al*. (1997), reported rates of adhesion formation were higher in horses that did not have omentectomy initially.

Also in the horses the adhesion formation was seen higher in appositional single row suture pattern compared with an inverting 2-layer suture pattern (Hanson *et al*. 1998a), while Al-Qadhi and Al-Hasan (2013) reported that adhesion at anastomatic site with omentum was more severee in the appositional end-to-end jejunal anastomosis using simple interrupted suture technique when compared with the inverted end-to-end jejunal anastomosis using continuous Lumbert suture pattern. Also Ali (2011) who reported in dogs the intra-abdominal adhesions was associated minimal degrees of adhesion formation in end-to-end appositional by simple interrupted stitches, with their knots tied intra-luminally as compare with by the same appositional method, but the stitches were tied extra-luminally. In goats, Al-Timmemi *et al*. (2010) who reported that significant adhesion between anastomatic area and surrounded tissues which were observed in one row of horizontal mattress interrupted sutures pattern.

Kachiwal and Kalhoro (2000), reported adhesions at the incision site significantly higher with appositional 2-row suture patterns than inverting 2-row suture patterns.

1.8. Histopathological Findings:

1.8.1. Degree of Wound Healing:

The wound healing in the comparative between two suture patterns in intestinal anastomosis was assessed by severeal investigators, Al-Timmemi *et al*. (2010), reported that the histological evaluation in the one row of sero-submoucosal interrupted sutures showed almost all parameters such as epithelial recovery and repair of submucosal-mucosal row demonstrated better healing compared to the one row of horizontal mattress interrupted sutures.

1.9. Ultrasonographic Evaluation:

1.9.1. Lumen Diameter:

Effect of intestinal anastomosis on lumen diameter was studies by different researchers who reported different or contradictory results, Hanson *et al*. (1998a), reported that no difference in lumen diameter between the inverting two row suture patterns and the appositional single row suture pattern techniques. Kachiwal and Kalhoro (2000) reported that lumen diameters it is not statically different at 10^{th} and 20^{th} day after surgery but were significantly larger than inverted two rows at 30^{th} day after surgery compared with appositional two row suture pattern. Reinertson (1976) conducted study comparison of three techniques for intestinal anastomosis in Equidae and reported the modified Gambee technique was associated with minimal constriction of the bowel lumen, and Semevolos *et al*. (2007), conducted in vitro bursting pressures of jejunal enterotomy closures in Llamas and resulted that the use of a Lembert pattern reduced intestinal diameter more than a Cushing pattern regardless of suture material or size.

1.9.2. Jejunum Wall Thickness:

The normal ultrasonographic findings of the abdominal organs and urogenital tract study conducted by Desrochers (2005), who reported that wall thickness of the duodenum and jejunum should be less than 0.3 cm. The effect of anastomosis in jejunum wall thickness was studies by many researchers who reported contradictory results, Haber and Stern (2000), who reported that mean wall thickness of the jejunum was 0.8 mm ± 0.1 mm. Maximum wall thickness reached 1.2 mm at the age range of 20 to 29 years. In horses, evaluation of three techniques for end-to-end anastomosis of the small colon conducted by Hanson *et al*. (1998a), who reported that histological evaluation revealed that the appositional single row suture pattern had no intestinal inversion. However, a wide full-thickness deposition of dense fibrous connective tissue in the sub mucosal and muscular layer was evident. The inverting 2-row suture patterns and the appositional 2-row patterns had pronounced inversion of the anastomatic layers along the nontaenial portion of the anastomosis, with minimal deposition of fibrous connective tissue between the anastomatic layers.

1.10. Bursting Pressure (mmHg):

Effect of intestinal anastomosis on the bursting pressure was studies by many researchers who reported contradictory results, Hanson *et al*. (1998a), reported differences in bursting pressure were not evident between the inverting 2-row suture patterns compared with the appositional single row suture pattern, Hamza (2009), reported that no significant differences of bursting pressure in single row by cross mattress interrupted and similar fashion with the site of anastomosis was covered by free omentum and pedicle omentum suture technique at 15 and 30 days post operation, while Al-Qadhi and Al-Hasan (2013) in the horses, reported that the bursting pressure was significantly lower in the all steroidal subgroups at 7 and 15 days compared with the control subgroups. Also in the study conducted by Al-Timmemi *et al*. (2010), reported that bursting pressure was higher in the one row of sero-submoucosal interrupted sutures than the one row of horizontal mattress interrupted sutures. And Auletta *et al*. (2011), reported bursting pressure significantly higher in lembert single row than Gambee and Lembert double row. Gandini and Bertuglia (2006) reported that bursting pressure of stapled anastomosis was significantly less than hand-sewn technique. Semevolos *et al*. (2007) reported bursting pressure significantly higher for enterotomies closed with polydioxanone than polyglactin 910, however, no difference between Lembert and Cushing over sewn patterns.

1.10.1. Degree of jejunal Stenosis:

The stenosis degrees in the comparative between two suture techniques in intestinal anastomosis were finding contradictory results. Ali (2011), reported stenosis degrees were found minimal degrees in end-to-end appositional by simple interrupted stitches, with their knots tied intra-luminally as compare with by the same appositional method, but the stitches were tied extra-luminally in dogs, Hamza (2009) who reported showed lowest mean of the degree of anastomatic stenosis in single row by cross mattress interrupted suture pattern covered by pedicle omentum, while the highest mean in single row by cross mattress interrupted suture pattern covered by free omentum. Al-Timmemi *et al*.

(2010) who reported that stenosis degree lower in one row sero-submoucosal interrupted sutures than one row horizontal mattress interrupted sutures.

CHAPTER TWO
MATERIALS AND METHODS

2.1. Study Area

This study was conducted in Tamboul area, in the east of Gezira State about 150 km south of Khartoum State during may to July 2017.

2.2. Experimental Animals:

Twelve clinically healthy (3 females and 9 males) donkeys of different breeds, 7 ±4.1 years of age, and weighing 93 ±7.8 kg were allowed to adapt to the surroundings for a minimum of 3 weeks before surgery. They were dewormed with anthelimentic 2 weeks before commence of the experiment. Forty eight hours before surgery, each donkey was given 2 litres of mineral oil and 100 gram Rum Acid (water soluble supplement). The Tetanus antitoxin 1500 IU/ML for prophylactic was given one day before surgery and Amoxicillin 150 mg (Betamox150mg, Norbrook, U.K) 7 mg/kg, IM was given half an hour before the surgery. Hay and grain were withheld for 12 hours before surgery, but free access to water was allowed.

2.3. Anastomosis Techniques:

The donkey skin was prepared for aseptic surgery (Figure.2.3.1), anesthetized and the impervious surgical drapes were applied. The animals were placed in right lateral recumbency on the opposite side of the surgical operation (Figure.2.3.2). An 18- to 20-cm incision through the skin, subcutaneous fascia, was performed. The external abdominal oblique muscle, internal abdominal oblique and transverse abdominal muscles were separated by blunt dissection, haemorrhage was controlled, the jejunum was exteriorized (Figure.2.3.3), and the sites for resection and anastomosis were approximately15 ±2 cm in the same diameter (Figure.2.3.4). The jejunum segments resected after mesenteric blood vessels ligation, ingesta were manually stripped aborally past both proposed anastomatic sites into the rectum (Figure.2.3.5). The lumen of the bowel was temporarily occluded with non Crushing forceps to prevent return of ingesta to the anastomatic site. Crushing forceps were placed across the bowel wall at a 60" angle to the antimesenteric border of the jejunum. The exposed segments of the jejunum were covered with moistened sterile towels. Fifteen centimetres of the jejunum was resected by transection along the crushing forceps (Figure.2.3.6). Gauze sponges were folded over the exposed intestinal lumen to minimize contamination. End-to-end anastomosis was performed using 2–0 Polyglycolic acid (Surgicryl PGA; Ethicon, UK) (Figure.2.3.7) with SSCLS group (Figure.2.3.8) and SSIS group (Figure.2.3.9). After the anastomosis, the jejunum was returned to its normal place after being washed with physiological saline (0.9% NaCl).

The peritoneum and muscular row were sutured by simple continuous pattern using 2\0 chromic cat gut suture (3.5 Metric Huaian Wanjia Medical, China) and skin then sutured with 2/0 Silk Braided (3 Metric,Y.S.U.M.China) in a simple interrupted suture pattern. All animals were provided dextrose 5% throughout the operative surgery, and Amoxicillin150mg (Betamox150mg, Norbrook, U.K) 7mg/ kg, IM was given for 7th postoperative day (POD). The animals were under human care observations for medication and distress helping. On the first post operation day, the animals were provided with only a little water. On the second and third days, they fed on green grass, and then on normal fodder. Four animals from each group were euthanized on the 15 and 30 PODs using intravenously overdose Ketamine Hydrochlorid (30mg/kg).

Figure.2.3.1: Skin prepared for aseptic surgery.

Figure.2.3.2: Animal positioned in lateral recumbency.

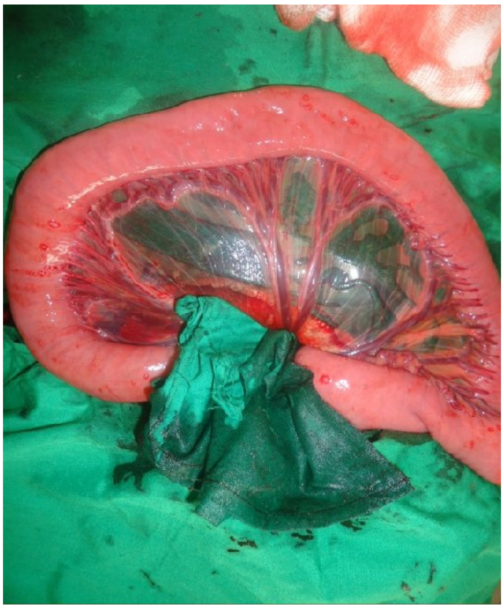

Figure.2.3.3. Jejunum exteriorized from abdominal cavity.

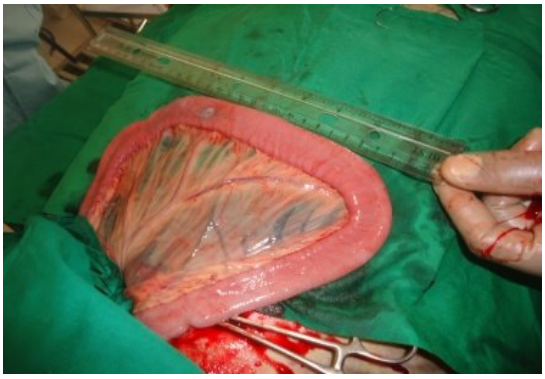

Figure.2.3.4: The length (cm) of resected portion of jejunum.

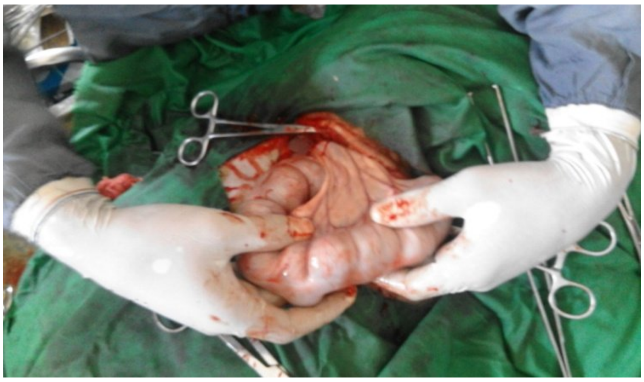

Figure.2.3.5: Jejunum ingesta manually stripped aborally past into the rectum.

Figure.2.3.6: Jejunum segment resected after mesenteric blood vessels ligation.

Figure.2.3.7: Polyglycolic acid (P.G.A) used in anastomosis suturing techniques.

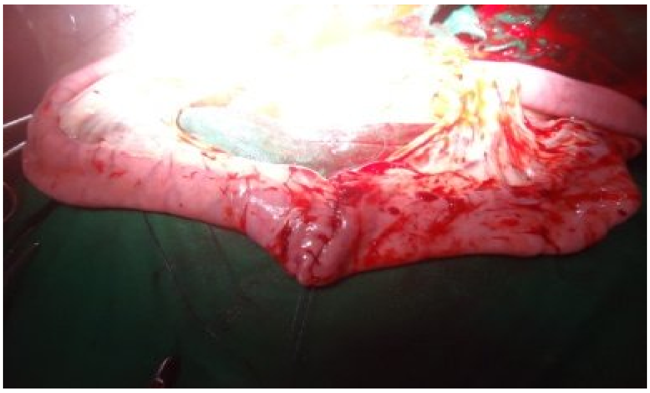

Figure.2.3.8: Serosubmucosal continuous Lembert sutures (SSCLS) pattern.

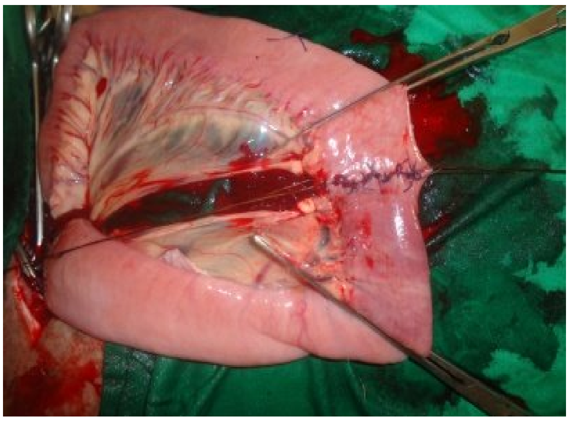

Figure.2.3.9: Serosubmucosal interrupted sutures (SSIS) pattern.

2.4. Physiological Examinations:

Physiological parameters were recorded before surgery as baseline value and then at 24, 48, and 72 hours intervals after anastomosis of jejunum in both suture patterns techniques.

2.4.1. Respiratory Rate (cycle/min):

Respiratory rate was recorded using standard method described by Kelly (1974).

2.4.2. Heart Rate (beat/min):

Heart rate was recorded by counting the heart beats over the cardiac area using a stethoscope through a whole minute of time as described by Kelly (1974).

2.4.3. Rectal Temperature (°C):

Rectal temperature was recorded by using clinical thermometer from rectum. The rectum usually empted from faeces and the thermometer lubricated before insertion in the rectum Kelly (1974).

2.5. Collection of Blood Samples:

Blood samples were collected from jugular vein using 10ml syringes before surgery as baseline value and then at 24, 48, and 72 hours intervals after anastomosis of jejunum in all suture patterns techniques and transferred into tubes coated 2.5ml were mixed with EDTA in plastic containers for haematological indices. The remaining part (2.5ml) of the blood was mixed with fluoride oxalate as anti-coagulant (AFCO-DISPO, Jordan) in plastic containers for plasma separation, for blood biochemical parameters measurements. The blood in the tubes was immediately and thoroughly mixed with the anticoagulant by gently inverting the tube several times, placed in ice, transported to the laboratory and centrifuged for five minutes at 5×1000 round/ minute using tube centrifuge (EBA20-Hettich zentrifugen, Germany). The separated plasma in each tube was harvested in labelled eppendorf tubes and was kept at -20^{0}c until analyzed.

2.5.1. Blood Analysis:

The whole blood was tested for the determination of red blood cell count (RBCs) 10 cell\ml and total white cells (WBCs) 10cell\ml used Auto Haematology Analyzer BC-2800 Mindray, Hamburg- Germany (Figure 2.5.1).

2.5.2. Blood Biochemical Analysis:

The following blood biochemical parameters: glucose concentration was recorded immediately after blood serum separation , total protein (TP), albumin (ALB) and blood urea nitrogen (BUN), and blood total lipids (mg %), using spectrophotometer (Biosystem-BTS-302) in the physiology laboratory, Faculty of Veterinary Medicine University of Al-butana (Figure 2.5.2).

Figure 2.5.1: Auto Haematology Analyzer BC-2800 Mindray.

Figure 2.5.2: Spectrophotometer devise (Biosystem-BTS-302).

2.6. Consumption Time:

The time required for the anastomosis was calculated from the beginning the first stitch bites to the end of connection between two resected bowels segments (Rahul *et al*., 2015).

2.7. Pathology Findings:

2.7.1. Mortality Rate:

During four weeks in hospital mortality was taken into account daily after surgery from end to experiment (Rahul *et al*., 2015).

2.7.2. Wound Infection:

The wound infection was defined as discharge of serosanguineous or frank pus from the wound site daily after surgery throw four weeks (Pathak *et al*., 2014).

2.7.3. Anastomatic Leakage:

Anastomatic leakage was defined as fecal discharge in the drain or from the wound or a visible disruption of the suture line during re-exploration at day 15 and 30 post surgery (Figure 2.7.3). Histopathogical diagnoses were confirmed and patients were advised necessary treatment at the time of discharge (Dandi *et al*., 2015).

Figure.2.7.3: Anastomatic leakage occurred in SSIS suture pattern group.

2.7.4. Degree of Adhesions Formation:

The gross pathological changes on anastomatic site were observed at 15 and 30 days post surgery to evaluate the intra-abdominal adhesions using a standard scale according to Hulka, *et al*., (1978). The degrees of adhesion were grades as follows: 0 point = No adhesion; 1 point = slight adhesion; 2 points = mild adhesion; 3 points = Severe adhesion (Figure 2.7.4).

Figure.2.7.4: Anastomatic site of adhesions with mesentery.

2.8. Histopathological Findings:

2.8.1. Degree of Wound Healing:

Twelve segment of jejunum (3 of both suture patterns) at 15 and 30 days post surgery were opened longitudinally and tissue were fixed in neutral-buffered l 10% formalin for 48 hours. Two sections from each segment containing the anastomatic site were made in a transverse plane across the sutured incision line. Formalin fixed tissues were processed and sectioned at 6 um and stained with hematoxylin and eosin. The anastomatic site was examined histo-pathologically for apposition of tissue planes, degree of inflammation, presence of granulation and proliferation across the defect in each of the sections selected for sectioning and staining. Evaluation of sections was graded on a scale from 1 to 5 according to Cetinkaya *et al*., (2006):

Grade 1 = fibrinopurulent exudates, grade 2 = granulation tissue less than 25%, grade 3 = granulation tissue between 25–75%, grade 4 = granulation tissue more than 75% or intestinal epithelial cells from intact intestinal glands and short villi less than 25%, grade 5 = intestinal epithelial cells from intact intestinal glands and short villi and microvilli more than 25% (Figure 2.8.1).

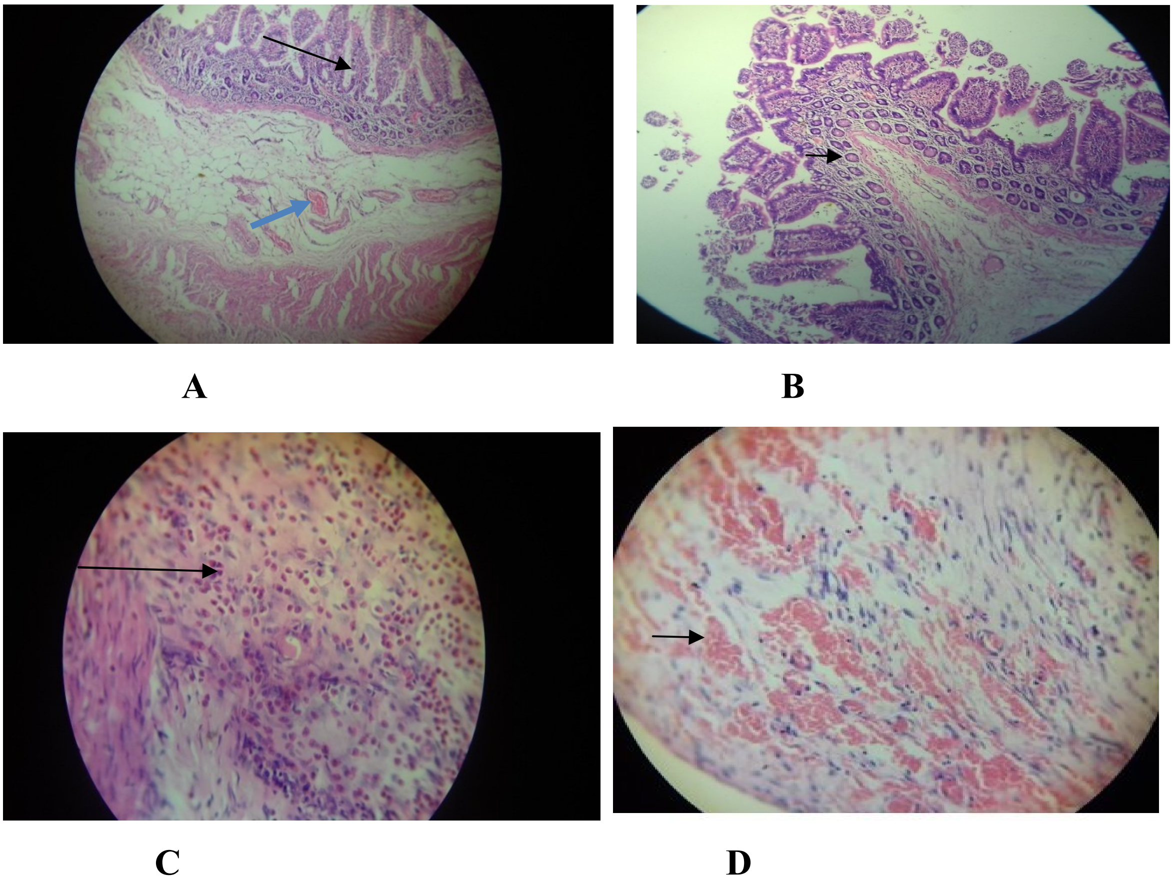

Figure.2.8.1: Histopathology photographs of experimental intestinal anastomosis in donkeys.
(A) The microvilli (thin arrow), and new blood vessels (thick arrow).
(B) The intestinal gland.
(C) inflammatory cells (predominately neutrophils and lymphocytes)
(D) The haemorrhage, H&E stain × 10.

2.9. Ultrasonographic Evaluation

2.9.1. Lumen Diameter and Jejunual Wall Thickness:

Left flank laprotomy was performed, the lumen and wall thickness of the appreciated jejunal segments were measured using ultrasonograhpic imaging as base line values, then 15 cm length of the above mentioned bowel were resected and connected by using SSCLS and SSIS suture patterns, 15 and 30 days following these surgical procedures. The lumen diameter and jejunal wall thickness (cm) were measured using the same ultrasounagraphy techniques (Aloka SSD 500_R, Aloka Co., Ltd, Tokyo, Japan), with probe model UST-660-7.5 (Aloka Co., Ltd). The images were analyzed using digital video for retrospective image computer analysis (Figure 2.9.1 and 2.9.2).

Figure 2.9.1: Ultrasound device measurement of jejunal wall row thickness.

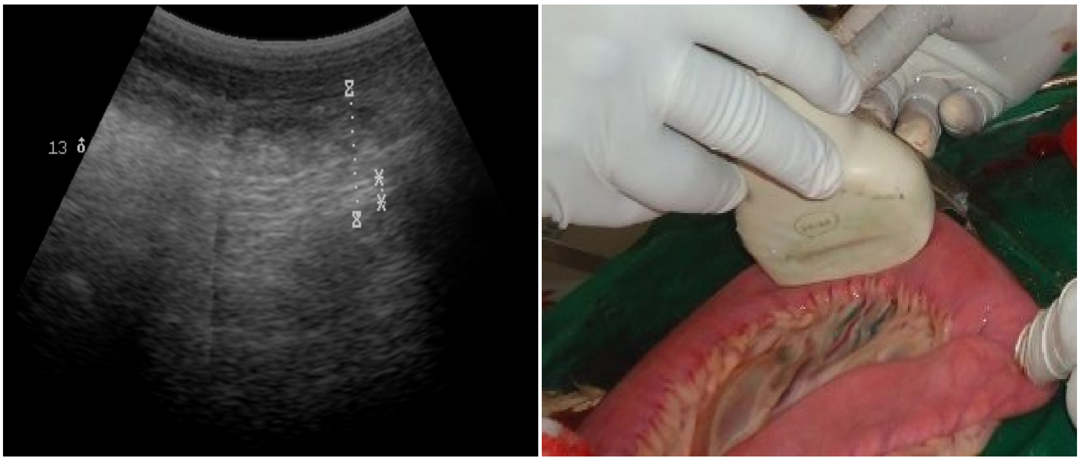

Figure.2.9.2: Measuring the jejunum lumen diameter and jejunum wall thickness.

2.10. Bursting Pressure:

The technique was a modification of various similar techniques (Hanson *et al*.1998a; Wise *et al*., 1975; and Irvin and Edward., 1973), one end of the jejunual segment was connected with sphygmomanometer (capillary 3.5 mm ±0.1, Tokyo Japan), the other end was linked to air pump and the specimen was filled with air to identify leakage or rupture in the anastomatic site. The sphygmomanometer scale reading was recorded at leakage or rupture and this represented the bursting pressure (mmHg). Three measures of the intestinal bursting pressure were taken, before surgery (as control) and on the 15 and 30 day post surgery (Figure 2.10).

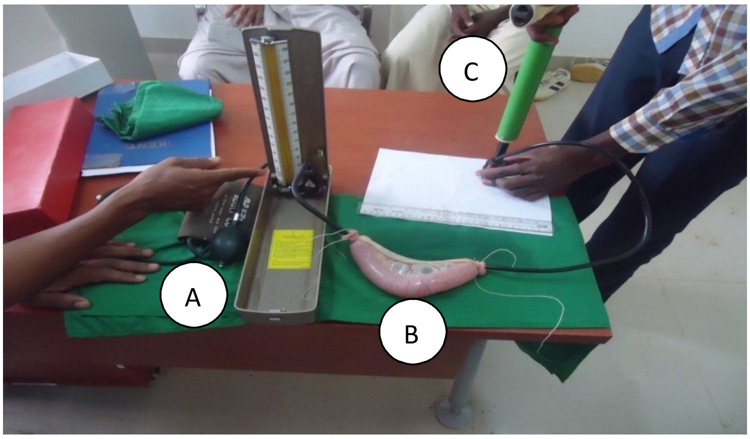

Figure 2.10: Intestinal bursting pressure test:

(A) Sphygmomanometer (capillary 3.5mm±0.1, Tokyo Japan).

(B) Jejunum specimen.

(C) Foot ball air pump.

2.11. Statistical Analysis:

The collected data was analyzed using Computer program statistical package for social science (SPSS) version 24. Descriptive statistics including frequencies as follow (mean, standard deviation, and percentage), Differences between the means of each group (SSCLS, SSIS) were analyzed by use of the Student paired t-test. The level of significance chosen was ($P \leq 0.05$).

CHAPTER THREE
RESULTS

3.1. General Observations Following Jejunal anastomosis Using SSCLS and SSIS Suture Patterns:

During this experimental study, two end to end anastomatic suture patterns were assessed. Clinically both patterns were found to be successful and reliable. All animals were returned to their normal appetite, urination and defecation with twenty-four hours post surgery.

3.2. Physiological Parameters Following Jejunal Anastomosis Using SSCLS and SSIS Suture Patterns:

3.2.1. Respiratory Rate (RR) Following Jejunal Anastomosis Using SSCLS and SSIS Suture Patterns:

As illustrated in Table (3.2.1), respiratory rate values (breath/min) were described as mean± standard deviation, no significant changes were observed between two anastomatic suture patterns in donkeys; however, slight increased was occurred in SSCLS at 72 hours following the surgery.

3.2.2. Heart Rate (HR) Following Jejunal Anastomosis Using SSCLS and SSIS Suture Patterns:

Heart rate was recorded prior to operation as baseline values and then 24, 48 and 72 hours following jejunal anastomosis, the heart rate values (beat/min) showed no significant differences between two groups, although insignificant increase was observed in both suture patterns at 24 hours following jejunal anastomosis (Table 3.2.2).

3.2.3. Rectal Temperature Values (RT) Following Jejunal Anastomosis Using SSCLS and SSIS Suture Patterns:

As depicted in Table (3.2.3) non-significant differences between SSCLS group and SSIS in rectal temperature ($^{\circ}$C) value at 24, 48 and 72hours after jejunal anastomosis in donkeys that anastomized using both suture patterns.

Table (3.2.1): Effect of two different suture patterns (SSCLS and SSIS) used for jejunal anastomosis on respiratory rate (breath/min), M±SD at intervals 0, 24, 48 and 72 hours in donkeys.

Techniques	0 day	24hr	48hr	72hr
SSCLS	28.17±4.40	28.67±11.43	28.50±5.925	25.50±6.06
SSIS	21.00±8.78	26.00±8.30	29.80±10.31	34.20±11.84
Sig	N.S	N.S	N.S	N.S

n = 12
(SSCLS): Two rows sero-submucosal continuous lembert sutures.
(SSIS): One row sero-submucosal interrupted suture.
0 day: Base line values
Sig: Significance
N.S= Non significant

Table (3.2.2): Effect of two different suture patterns (SSCLS and SSIS) used for jejunal anastomosis on heart rate (beat/min), M±SD at intervals 0, 24, 48 and 72 hours in donkeys.

Techniques	0 day	24hr	48hr	72hr
SSCLS	45.83±5.67	55.50±11.76	45.83±13.75	52.00±8.67
SSIS	44.00±7.32	57.33±15.53	46.20±13.16	47.50±6.96
Sig	N.S	N.S	N.S	N.S

n = 12
(SSCLS): Two rows sero-submucosal continuous lembert sutures.
(SSIS): One row sero-submucosal interrupted suture.
0 day: Base line values
Sig: Significance
N.S= Non significant

Table (3.2.3): Effect of two different suture patterns (SSCLS and SSIS) used for jejunal anastomosis on rectal temperature (°C), M±SD at intervals 0, 24, 48 and 72 hours in donkeys.

Techniques	0 day	24hr	48hr	72hr
SSCLS	37.48±0.63	38.32±1.01	38.00±0.90	38.42±1.11
SSIS	36.5±1.30	38.00±0.89	37.80±0.84	37.60±0.55
Sig	N.S	N.S	N.S	N.S

n = 12
(SSCLS): Two rows sero-submucosal continuous lembert sutures.
(SSIS): One row sero-submucosal interrupted suture.
0 day: Base line values
Sig: Significance
N.S= Non significant

3.3. Haematological Indices Following Jejunal Anastomosis Using SSCLS and SSIS Suture Patterns:

3.3.1. Red Blood Cell (RBCs) Count Following Jejunal Anastomosis Using SSCLS and SSIS Suture Patterns:

Red blood cells count ($x10^{12}/l$) was done before surgery as baseline values, and during three days following surgery, RBCs count was presented as mean ±standard deviation. Non-significant changes were detected between two groups in both anastomatic suture patterns (Table 3.3.1).

3.3.2. White Blood Cell (WBCs) Count Following Jejunal Anastomosis Using SSCLS and SSIS Suture Patterns:

As shown in Table (3.3.2) white blood cells count ($x10^{9}$ /l) was recorded prior to operation as baseline values and then 24, 48 and 72 hours following jejunal anastomosis, a significant rise (P value ≤ 0.05) was occurred in white cells at 48 hours post jejunal anastomosis in SSIS group compared with SSCLS group.

3.4. Blood Biochemical Parameters Following Jejunal Anastomosis Using SSCLS and SSIS Suture Patterns:

3.4.1. Blood Glucose Concentration Following Jejunal Anastomosis Using SSCLS and SSIS Suture Patterns:

As illustrated in Table 3.4.1, blood glucose concentrations (µmol/l) were measured, the baseline values ranged from 79.83 ±6.99 to 64.04 ±12.19 in SSCLS group and SSIS group respectively, a significant elevation (P value $\leq$ 0.05) in blood glucose concentration was observed in both groups at 24, 48 and 72 hours compared with base line data following the jejunal surgery.

3.4.2. Total Protein (TP), Albumin (ALB) and Blood Urea Nitrogen (BUN) Following Jejunal Anastomosis Using SSCLS and SSIS Suture Patterns:

Blood serum biochemical parameters were demonstrated in Tables (3.4.2a, 3.4.2b and 3.4.2c). No significant changes were seen in total protein (g/dl) and blood albumin (g/dl) in both suture patterns, however, blood urea nitrogen (mg/dl) showed a significant decrease (P value ≤ 0.05) at 72 hours post surgery in SSCLS group compare with the other group.

Table (3.3.1): Effect of two different suture patterns (SSCLS and SSIS) used for jejunal anastomosis on red blood Cell ($\times 10^{12}$/l), M±SD at intervals 0, 24, 48 and 72 hours in donkeys.

Techniques	0 day	24hr	48hr	72hr
SSCLS	5.37±0.95	5.37±0.95	5.67±1.46	5.46±1.40
SSIS	6.83±2.22	5.48±1.58	5.53±2.15	5.25±1.71
Sig	N.S	N.S	N.S	N.S

n = 12
(SSCLS): Two rows sero-submucosal continuous lembert sutures.
(SSIS): One row sero-submucosal interrupted suture.
0 day: Base line values
Sig: Significance
N.S= Non significant

Table (3.3.2): Effect of two different suture patterns (SSCLS and SSIS) used for jejunal anastomosis on white blood Cell ($\times 10^{9}$/l), M±SD at intervals 0, 24, 48 and 72 hours in donkeys.

Techniques	0 day	24hr	48hr	72hr
SSCLS	9.48±2.43	7.16±3.60	9.58±3.91^{a}	10.62±3.35
SSIS	8.83±1.90	9.82±2.08	14.06±1.39^{b}	12.32±1.76
Sig	N.S	N.S	*	N.S

n = 12
(SSCLS): Two rows sero-submucosal continuous lembert sutures.
(SSIS): One row sero-submucosal interrupted suture.
0 day: Base line values
Sig: Significance
N.S= Non significant
*= Significant at ($P \leq 0.05$)
Different letters in the same column indicate significant difference ($P \leq 0.05$).

Table (3.4.1): Effect of two different suture patterns (SSCLS and SSIS) used for jejunal anastomosis on blood glucose concentration (µmol/l), M±SD at intervals 0, 24, 48 and 72 hours in donkeys.

Techniques	0 day	24hr	48hr	72hr
SSCLS	79.83±6.99	107.54±15.76[a]	107.90±5.25[a]	138.60±7.51[a]
SSIS	64.04±12.19	83.62±13.80[b]	101.05±16.18[b]	161.05±16.30[b]
Sig	N.S	*	*	*

n = 12
(SSCLS): Two rows sero-submucosal continuous lembert sutures.
(SSIS): One row sero-submucosal interrupted suture.
0 day: Base line values
Sig: Significance
N.S= Non significant
*= Significant at ($P \leq 0.05$)
Different letters in the same column indicate significant difference ($P \leq 0.05$).

Table (3.4.2 a): Effect of two different suture patterns (SSCLS and SSIS) used for jejunal anastomosis on total protein (g/dl), M±SD at intervals 0, 24, 48 and 72 hours in donkeys.

Techniques	0 day	24hr	48hr	72hr
SSCLS	7.11±1.66	7.79±0.68	7.61±0.10	6.97±1.10
SSIS	7.64±0.96	6.93±0.40	6.72±0.72	7.27±0.67
Sig	N.S	N.S	N.S	N.S

n = 12
(SSCLS): Two rows sero-submucosal continuous lembert sutures.
(SSIS): One row sero-submucosal interrupted suture.
0 day: Base line values
Sig: Significance
N.S= Non significant

Table (3.4.2 b): Effect of two different suture patterns (SSCLS and SSIS) used for jejunal anastomosis on albumin (g/dl), M±SD at intervals 0, 24, 48 and 72 hours in donkeys.

Techniques	0 day	24hr	48hr	72hr
SSCLS	2.89±0.27	2.69±0.37	2.93±0.77	2.82±0.72
SSIS	2.63±0.44	2.46±0.47	2.45±056	2.30±0.31
Sig	N.S	N.S	N.S	N.S

n = 12
(SSCLS): Two rows sero-submucosal continuous lembert sutures.
(SSIS): One row sero-submucosal interrupted suture.
0 day: Base line values
Sig: Significance
N.S= Non significant

Table (3.4.2 c): Effect of two different suture patterns (SSCLS and SSIS) used for jejunal anastomosis on blood urea nitrogen (mg/dl), M±SD at intervals 0, 24, 48 and 72 hours in donkeys.

Techniques	0 day	24hr	48hr	72hr
SSCLS	32.17±13.40	33.37±14.71	39.85±13.29	26.86±23.22^{a}
SSIS	36.70±23.47	33.18±10.89	38.04±13.83	34.82±21.51^{b}
Sig	N.S	N.S	N.S	*

n = 12
(SSCLS): Two rows sero-submucosal continuous lembert sutures.
(SSIS): One row sero-submucosal interrupted suture.
0 day: Base line values
Sig: Significance
N.S= Non significant
*= Significant at ($P \leq 0.05$)
Different letters in the same column indicate significant difference ($P \leq 0.05$).

3.4.3. Blood Total Lipids (mg/100ml) Following Jejunal Anastomosis Using SSCLS and SSIS Suture Patterns:

As depicted in Table (3.4.3), total lipids were measured in blood, a significant increase (P value ≤ 0.05) was observed in SSCLS group at 72hours compared with SSIS group following surgery.

3.5. Consumption Time Following Jejunal Anastomosis Using SSCLS and SSIS Suture Patterns:

Time required to achieve anastomosis suture patterns (minutes) was recorded, it showed that suture patterns using SSCLS technique consumed significantly longer time (21.33 ±4.55min) compare with that time required to complete jejunal anastomosis in donkey using SSIS suture patterns (13.67 ±3.445min).

3.6. Pathology Findings Following Jejunal Anastomosis Using SSCLS and SSIS Suture Patterns:

3.6.1. Mortality Rate, Wound Infection and Anastomatic Leakage Following Jejunal Anastomosis Using SSCLS and SSIS Suture Patterns:

As shown in Fig 3.6.1, the mortality rate was considered as percentage (%) that calculated from the total number of each group; it found that the mortality rates were 33.3 and 16.7% in SSIS and SSCLS groups respectively. Wound infection at anastomatic site was presented as percentage (%); it showed 50% in SSCLS group versus 66.7% in SSIS group. The leakage observed at anastomatic site was occurred only in donkeys that connected by using SSIS suture pattern (16.7%), although no leakage was observed in SSCLS group (0%).

3.6.2. Degree of Adhesions Following Jejunal Anastomosis Using SSCLS and SSIS Suture Patterns:

The adhesions at the anastomatic site were scored as mild, slight and severe adhesions. Donkeys that anastomized using SSIS suture pattern showed 20% slight adhesion and 40% mild and severe adhesions at anastomatic site respectively, while animals that underwent surgery using SSCLS suture pattern showed 40% and 60% mild and slight adhesions respectively.

Table (3.4.3): Effect of two different suture patterns (SSCLS and SSIS) used for jejunal anastomosis on Blood total lipids (mg/100ml), M±SD at intervals 0, 24, 48 and 72 hours in donkeys.

Techniques	0 day	24hr	48hr	72hr
SSCLS	4.05±8.01	5.70±12.17	5.94±14.80	7.29±13.15[a]
SSIS	5.42±16.99	6.01±22.32	7.61±30.62	6.73± 25.20[b]
Sig	N.S	N.S	N.S	*

n = 12
(SSCLS): Two rows sero-submucosal continuous lembert sutures.
(SSIS): One row sero-submucosal interrupted suture.
0 day: Base line values
Sig: Significance
N.S= Non significant
*= Significant at ($P \leq 0.05$)
Different letters in the same column indicate significant difference ($P \leq 0.05$).

Table (3.5): Effect of two different suture patterns (SSCLS and SSIS) used for jejunal anastomosis on consumption time (min), M±SD at intervals 0, 24, 48 and 72 hours in donkeys.

Techniques	Time (min.)
SSIS group	13.67±3.445[a]
SSCLS group	21.33±4.55[b]
Sig	*

n = 12
(SSIS): One row sero-submucosal interrupted suture.
(SSCLS): Two rows sero-submucosal continuous lembert sutures.
Sig: Significance
*= Significant at ($P \leq 0.05$)
Different letters in the same column indicate significant difference ($P \leq 0.05$).

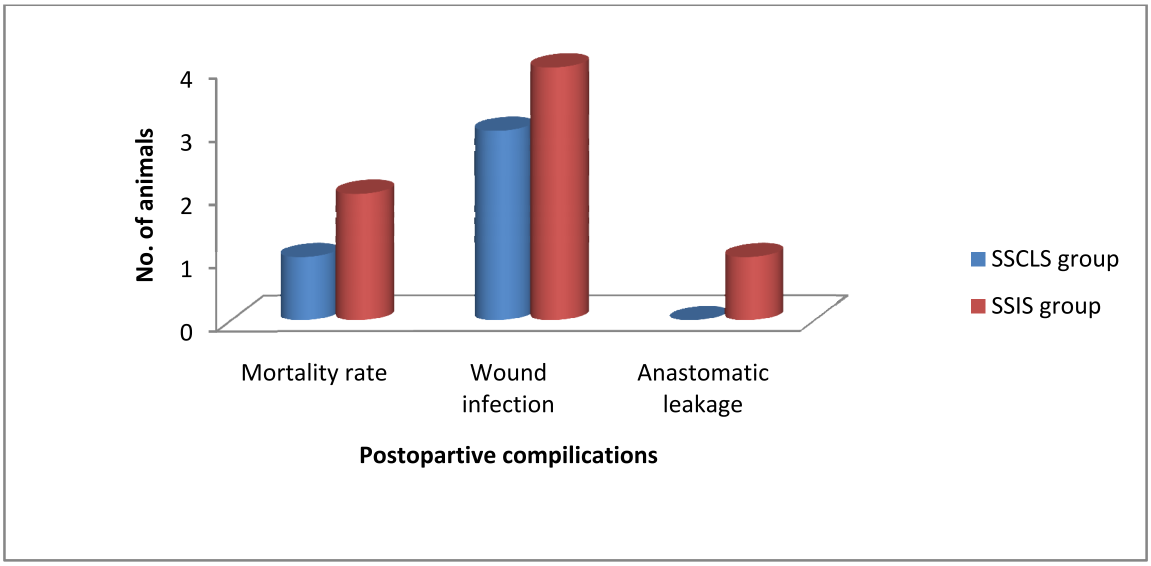

Figure (3.6.1): Mortality rates, Wound infection and Anastomatic leakage (%) for jejunal anastomosis using two rows sero-submucosal continuous lembert sutures (SSCLS) and one row sero-submucosal interrupted suture (SSIS) in donkeys.

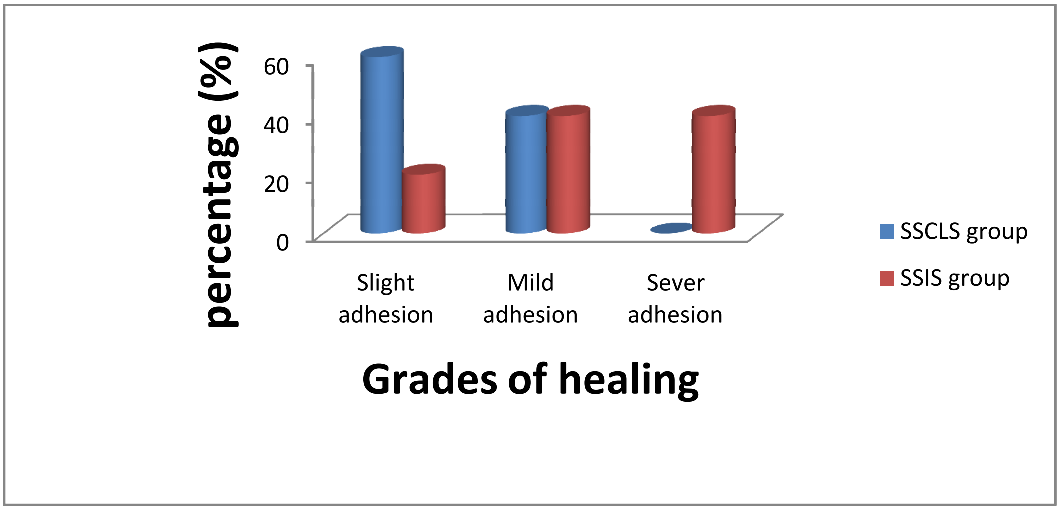

Figure (3.6.2): Adhesions degree (%) for jejunal anastomosis using two rows sero-submucosal continuous lembert sutures (SSCLS) and one row sero-submucosal interrupted suture (SSIS) in donkeys.

(SSCLS): Two rows sero-submucosal continuous lembert sutures.
(SSIS): One row sero-submucosal interrupted suture.

3.7. Histopathological Findings Following Jejunal Anastomosis Using SSCLS and SSIS Suture Patterns:

3.7.1. Degree of Wound Healing Following Jejunal Anastomosis Using SSCLS and SSIS Suture Patterns:

As showed in Figure (3.7.1), wound healing was histopathologically examined and graded at the anastomatic site at day 15 and 30 post surgery. The grades percentage (%), that obtained in SSCLS group were 33.33% grade 3 (granulation tissue had developed in the serosa and submucosa with new blood vessels), 50% grade 4 (granulation tissue had developed in the serosa and submucosa with new blood vessels or intestinal epithelial cells from intact intestinal glands and short villi) and 16.67% in grade 5 (granulation tissue had developed in the serosa and submucosa with intestinal epithelial cells from intact intestinal glands and short villi and microvilli) respectively, however, SSIS group was resulted in 20 % grade 1 (fibrinopurulent exudates, in the serosa and submucosa with new blood vessels), 60 % grade 4 (granulation tissue had developed in the serosa and submucosa with new blood vessels or intestinal epithelial cells from intact intestinal glands and short villi) and 20% grade5 (granulation tissue had developed in the serosa and submucosa with intestinal epithelial cells from intact intestinal glands and short villi and microvilli).

3.8. Ultrasonographic Evaluation Following Jejunal Anastomosis Using SSCLS and SSIS Suture Patterns:

3.8.1. Lumen Diameter Following Jejunal Anastomosis Using SSCLS and SSIS Suture Patterns:

As illustrated in Table (3.8.1) lumen diameter is measured using ultrasound imaging, normal lumen diameter (cm) values were determined prior to surgery as normal values then 15 and 30 days following surgery. After jejunal anastomosis significant decrease (P value ≤ 0.05) were observed on 30^{th} day post surgery in two rows sero-submucosal continuous Lembert sutures (SSCLS) patterns compared with One row sero-submucosal interrupted suture (SSIS) pattern group.

3.8.2. Jejunal Wall Thickness Following Jejunal Anastomosis Using SSCLS and SSIS Suture Patterns:

Jejunal wall thickness was studied prior to surgery as normal values (cm) then 15 and 30 days after jejunal anastomosis, using ultrasound imaging, a significant increase (P value ≤ 0.05) is observed in wall thickness on day 15 in both groups compared with base line values that obtained some days before surgery, however, significant decrease (P value ≤ 0.05) in wall thickness was observed in (SSCLS) group on day 30 following surgery (Table 3.8.2).

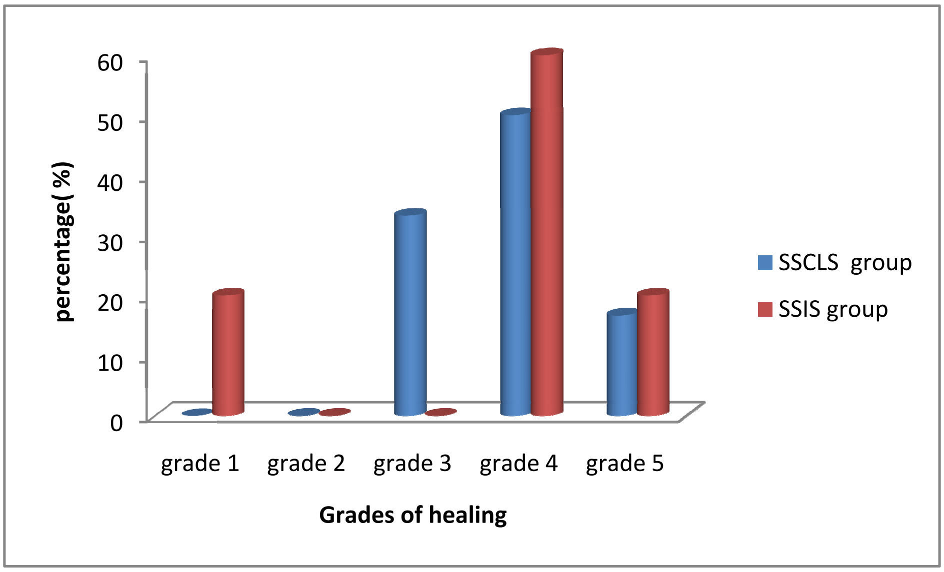

Figure (3.7.1): Healing grades (%) for jejunal anastomosis using two rows sero-submucosal continuous lembert sutures (SSCLS) and one row sero-submucosal interrupted suture (SSIS) in donkeys.

SSCLS: Two row sero-submucosal continuous lembert sutures.

SSIS: One row sero-submucosal interrupted suture.

Table (3.8.1): Effect of two different suture patterns (SSCLS and SSIS) used for jejunal anastomosis on lumen diameter (cm), M±SD at intervals 0, 24, 48 and 72 hours in donkeys.

Techniques	Lumen diameter (cm)		
	0 day	15 days	30 days
SSCLS	27.97±3.91	29.75±6.30	23.30±1.84^{a}
SSIS	27.40±1.87	27.25±5.44	29.65±5.73^{b}
Sig	N.S	N.S	*

Table (3.8.2): Effect of two different suture patterns (SSCLS and SSIS) used for jejunal anastomosis on Jejunal wall thickness (cm), M±SD at intervals 0, 24, 48 and 72 hours in donkeys.

Techniques	Jejunal wall thickness (cm)		
	0 day	15 days	30 days
SSCLS	4.97±0. 80	7.25±1.78^{a}	2.90±0.00^{a}
SSIS	4.77±1.55	4.95±0.21^{b}	3.45±0.07^{b}
Sig	N.S	*	*

n = 12
(SSCLS): Two row sero-submucosal continuous lembert sutures.
(SSIS): One row sero-submucosal interrupted suture.
0 day: Base line values
Sig: Significance
*= Significant at (P ≤ 0.05)
N.S: Non significant
Different letters in the same column indicate significant difference (P ≤ 0.05).

3.9. Bursting Pressure (mm/Hg) Following Jejunal Anastomosis Using SSCLS and SSIS Suture Patterns:

As shown in Table (3.9) the bursting pressure test (mm/Hg) was done on the anastomatic jejunal portions on day 15 and day 30 after anastomosis surgery. Non-significant difference in bursting pressure in both groups were detected at day 15 post surgery, however, the bursting pressure values started to retain closely near to normal values by the end of 30^{th} days following jejunal anastomosis in both groups.

Table (3.9): Effect of two different suture patterns (SSCLS and SSIS) used for jejunal anastomosis on bursting pressure (mm/Hg), M±SD at intervals 0, 24, 48 and 72 hours in donkeys.

Groups/POD	bursting pressure (mm/Hg)		
	0 day	15 days	30 days
SSCLS group	203.33±13.33	255±14.49	210±12.43
SSIS group	181.67±13.64	250.00±12.28	200±12.28
sig	N.S	N.S	N.S

n = 12
(SSCLS): Two rows sero-submucosal continuous lembert sutures.
(SSIS): One row sero-submucosal interrupted suture.
0 day: Base line values
Sig: Significance
*= Significant at (P ≤ 0.05)
N.S= Non significant

CHAPTER FOUR

DISCUSSION

Study of available literature and databases resulted limited information on jejunal anastomosis in donkey. Through this study efforts were attempted to keep all experimental conditions as stable as possible. Such precautions were important for the standardization and interpretation of the results.

Copious literature were available describing intestinal anastomosis in a variety of animals, but very little information was given to donkeys, for example some reports were carried out on intestinal surgery in horses (Baxter *et al.*,1992), jejunal surgery in goats (Al-Timmemi, *et al.*, 2010) and jejunal anastomosis in dogs (Al-Qadhi and Al-Hasan, 2013).

Numerous anastomatic techniques have been described for small intestinal anastomosis in horses (Hanson *et al.*, 1998a; and Edwards, 1986). Optimal intestinal healing is dependent on a good blood supply, accurate mucosal apposition, and minimal surgical trauma. Severeal investigations have shown that, the method of apposition influences the repair process of the epithelium. In this regard, satisfactory apposition of submucosal row is most important (Joyce *et al.*, 2002).

The aim of the intestinal anastomosis is to remove an irreversible injury, cancer, or abnormal segment of the intestine, and reconnection of the opened bowel ends in a manner that will optimize healing and restore luminal and mural integrity.

Manual intestinal anastomosis had been practiced, and it is still considered an option of intestinal anastomosis, the anastomatic leakage, stenosis degree, diverticular formation and ultimately faecal fistula with serious septic complication leading to death after anastomosis were common consequences. However the utility of any method of intestinal anastomosis depends upon safety, as well as anastomatic leakage at anastomatic site and luminal narrowing (Al-Timmemi *et al*., 2010).

Many researchers preferred double row method as being the method of choice, however many reports had advocated the use of single row anastomosis because of lower rate of leakage, time and cost effectiveness (Askarpour *et al*., 2010). Accordingly, this study was experimentally conducted to compare between two suture patterns for end to end jejunum anastomosis in donkeys.

The respiratory rate values which recorded in this study showed no significant changes between two anastomatic patterns in donkeys; however, slight increase was occurred in SSIS group at the third day following surgery, these results are strongley suported by findings of other workers Tavakoli *et al*. (2007), who reported that there were no significant differences in respiratory rate, also agree with Shahzad *et al*. (2016) who reported that the respiration rate in dogs, underwent single layer of simple interrupted suturing pattern and circular mechanical stapler, was started to increased few days following surgery. Also Ghazy *et al*. (2016) reported that mean of respiratory rate were 24±6/minutes, after surgical correction of left abomasal displacement on filed condition.

Heart rate value during this study showed no significant difference between two suture patterns, while slight increase in SSIS group three days post surgery, this finding is consistent with the finding of Tavakoli *et al*. (2007), reported that there were no significant differences in heart rate, also Shahzad *et al*. (2016) reported that pulse rate was increased, for the first two days, post anastomosis surgery. Ghazy *et al*. (2016) reported that mean of pulse rates within the physiological reference range before and after surgery of correction of left abomasal displacement on filed condition, while Jansson (2016) reported that heart rate was significantly higher in non-survivors when compared to survivors in the study of retrospective study on clinical findings in horses with peritonitis.

Rectal temperature showed slight increase in SSCLS group at three days following surgery this result agrees with Shahzad *et al*. (2016) who reported that body temperature of all the dogs was slightly increased, for the first two days, post-operatively; then afterwards, the temperature returned to normal on the third to fourth post-operative day, while disagrees with Jansson (2016) reported that statistically significant higher rectal temperature was seen in non-survivors when compared with survivors in the study of retrospective study on clinical findings in horses with peritonitis. On the other hand Tavakoli *et al*. (2007) reported that there were no significant differences between body temperatures, heart rate, and respiratory rate in animals underwent bowel anastomosis. Ghazy *et al*. (2016) reported that mean of rectal temperature within normal range before and after surgery of correction of left abomasal displacement on filed condition.

Red blood cells count revealed that insignificant minimal decrease after surgery in SSIS group compared with SSCLS group; findings are similar to the results reported by Holmer *et al*. (2014), who reported that there were any relevant changes in red blood cell count in rats on days 2 to 6 following surgery in rats, however, Hanson *et al*. (1992) who found that blood values were significantly higher than normal on the first postoperative day following small colon resection and anastomosis in horses. Hanson *et al*. (1992) reported that the resection and anastomosis had a significantly higher mean total RBC count over the entire 7-day postoperative evaluation in horses that underwent celiotomy surgery; Ghazy *et al*. (2016) reported that cattle with left abomasal displacement before and after different time of surgery had a significant decrease in the RBCs count.

White blood cells count (WBCs) showed a significant rise at 48 hours post jejunal anastomosis in SSIS group compared with SSCLS group, This may be due to reactive leucocytosis and stress associated with the surgery(Mohammad etal.,2008), these results are strongley suported by findings of Dilawer *et al*. (2009), reported increasing in white blood cells count after intra abdominal surgery, Salciccia *et al*. (2013), who reported that kinetics of blood leukocytes in survivors is higher than in non-survivors horses after colic surgery, however, Holmer *et al*. (2014), who reported that leukocyte counts were decreased with a marked left shift in the differential counts following surgery in rats.

Blood serum glucose concentrations were significant increase in both groups at 24, 48 and 72 hours following jejunal surgery. Findings agreed with Nazifi *et al*. (2000), reported that the concentration of glucose decreased significantly in Iranian crossbred male goats underwent enterectomy surgery. Geehan (2014) reported that hyper glycemia which observed during recovery time in all anaesthetics regimes in dromedary camels. Singh *et al*. (2006), suggested that increase might be attributed to the stress induced gluconeogensis as a result of anaesthesia and increased production of glucose in liver, in addition many investigations into the hyper glycemic effects of xylazine were studied in various species (Brikas *et al*., 1987; Eigle *et al*., 1979; Hsu and Hummel., 1981), explained that hyper glyceamia might be due to inhibition of insulin release by stimulation of alpha-2 adrenoceptors in pancreatic beta- cells (Angel and Langer.,1988).

Blood biochemical analysis showed no significant changes in total protein and serum albumin in both suture pattern groups, however, blood urea nitrogen appeared significantly decreased at 72 hours post surgery in SSCLS group compare with the other group, these results agree with Jansson (2016), reported that no significant difference in total protein of the abdominal fluid between survivors and non-survivors animals in the study of retrospective study on clinical findings in horses with peritonitis. And Durham *et al*. (2010), who reported significantly, lower serum concentrations of albumin and urea in study of nutritional and clinicopathological effects of post operative parenteral nutrition following small intestinal resection and anastomosis in the mature hors. Ghazy *et al*. (2016) reported that cattle with left abomasal displacement showed no significant changes in serum total protein, while serum albumin was significantly decrease at the first day following surgery then started to return near to it by the end of the experiment.

The mean of consumption time which required to complete anastomosis was shorter in SSIS group than SSCLS group, These results are strongley suported by finding of other workers such as Lee *et al*. (2012), who reported that Mean construct completion times were shorter for single layer than double layers and Burch *et al*. (2000) who reported shorter time was required to construct a single layer anastomosis than the two-layer technique in duodenum anastomosis in man. Auletta *et al*. (2011) reported that anastomoses using a continuous lembert single layer pattern were faster to perform comperad with gambee pattern in equine. Garude *et al*. (2013) reported that mean time required for single-layered anastomosis was significantly shorter than for double-layered, and

Mehmoud *et al*. (2012) also reported that mean time taken for anastomosis was shorter in single layer interrupted extra-mucosal anastomosis group than double layer anastomosis group in man (Rahul *et al*., 2015; Pathak *et al*., 2014).

Some reports revealed that surgical anastomatic time using new hand-sewn continuous suture without inversion anastomosis was relatively short compared with the using stapled anastomosis in man (Yao *et al*., 2016). Kar *et al*. (2017) reported that mean time taken for anastomosis was shorter in single layered extra-mucosal anastomosis than that time required in double layered intestinal anastomosis.

During this study anastomatic leakage at the anastomatic site was observed after post-mortem, and that no anastomosis leakage were occurred in SSCLS group (0%), however, SSIS group showed significant leakage at the anastomatic site (16.7%), Stenosis at the anastomosis can cause postoperative complications by restricting the passage of feces, resulting in abdominal pain, ileus, and an increase in intraluminal pressure leading to leakage and dehiscence (Hanson *et al*,1998a), this results are in line with the results of Rahul *et al*. (2015), who reported insignificant leakage at anastomatic site as a result of the single row compare with double rows intestinal anastomosis in human beings. Also it is supported by the findings of others researchers such as (Burch *et al*., 2000, Pathak *et al*., 2014) who reported that leakage occurred in the single row group higher than in two rows group in man, some results reported that the anastomatic leakage occurred in patients of single row interrupted extra-mucosal anastomosis more than patients underwent double row anastomosis group in human beings, however, the observed results were disagree with that reported a clinical anastomatic leakage in 7.7% patients in man. (Ayub *et al*., 2009; Mehmoud *et al*., 2012).

The percentage of wound infection in SSCLS group and SSIS group were 50 and 80 % respectively. Other authors confirmed that the incidence of wound infection was occurred on the anastomatic site in man (Shah *et al*., 2015., Pathak *et al*., 2014) reported that wound infection at the anastomatic site was more observed in a single row compared with that reconnected using double row patterns, though wound infection is more common complication in SSIS group, on the other hand the results were consistent with the finding of Loesch *et al*. (2002), reported that the some horses developed incisional infections and soft fluctuant swelling at the incision site following jejunoileal anastomosis with double layers simple continuous technique, while Rahul *et al*. (2015) reported similar results of wound infection in single row compared with double row intestinal anastomosis in human beings. However, there were no wound infections in oesophagus anastomosis compared with large bowel anastomosis (De Almeida *et al*., 1983).

The present study revealed that the mortality rate reported only in one animal (16.7%) in SSCLS group and two animals (33.3%) in SSIS group. This finding agree with Pathak *et al*. (2014) reported that uncontrolled sepsis caused animal death that observed occurred in one patient underwent single row anastomosis techniques in human beings, although Rahul *et al*. (2015) found similar results of mortality rate in both single row and double rows intestinal anastomosis in human beings.

Adhesion formations were severely observed in SSIS group compared with SSCLS group. Degree of adhesion was influenced by the anastomosis technique and the time after surgery. Previous studies have shown that adhesions at an anastomosis can be caused by the contamination of the peritoneal area, sutures (foreign material), and ischemic changes of the intestine in the anastomotic region (DeCherney and DiZerega 1997; Ellis 1997 and Holmdahl *et al*., 1997). Normal intestinal motility, combined with elaboration of collagenase during the maturation phase of wound healing, may be responsible for remodeling of the fibrous adhesions (Sullins *et al*., 1985). Those results are in the same line with that obtained by other researchers, in horses, Al-Qadhi and Al-Hasan (2013) observed severe adhesions at anastomosis site with omentum when used apposition End-To-End jejunal anastomosis using simple interrupted suture pattern, Hanson *et al*. (1998b), revealed on post mortem examination, extensive adhesion formations from the mesocolon to the stapled anastomatic site compared with the a simple interrupted suture pattern, although. Hanson *et al*. (1998a), reported that the adhesions formation were detected in horses when resection line was closed with the appositional one row suture pattern, Reinertson (1976), found that double rows inverting technique predisposed to intestinal obstruction was resulted in minimal adhesions in horses and ponies. Dean *et al*. (1985) reported that continuous inverting-suture pattern in the serosubmucosal layer resulted in significantly fewer adhesions than those underwent interrupted pattern.

Reinertson (1976) reported that, the modified Gambee technique for intestinal anastomosis resulted in minimal adhesions, and adequate strength, Alonso *et al*. (2014), observed that the incidence of postoperative adhesions with clinical manifestation in horses, in goats, it was found that one row of sero-submoucosal interrupted sutures were better in healing compared with one row of horizontal mattress interrupted sutures patterns (Al-Timmemi *et al*., 2010).

In dogs minimal intra-abdominal adhesions were seen macroscopically in end-to-end appositional intestinal anastomosis using simple interrupted stitches with their knots tied intra luminal compared with end-to-end appositional by simple interrupted stitches tied extra luminal (Ali, 2011). Hamza (2009) reported that biopsy examination revealed simple adhesions in the single layer by cross mattress interrupted suture patterns and single layer by cross mattress interrupted suture pattern covered by free omentum, however, no adhesions were observed in single layer by cross mattress interrupted suture patterns covered by pedicle omentum. On the others hand Azevedo *et al*. (2008) reported that sero-submucosal stitches tied exterior over the serosa, had excellent realignment and regeneration of the layers.

Histopathological findings of the intestinal specimens from euthanized animals on the 15 and 30 days post operative in the SSCLS group was characterized by hyperaemia, haemorrhage, granulation tissue, and infiltration with inflammatory cells (predominately neutrophils and lymphocytes) in the anastomatic line.

Granulation tissue had developed in the serosa and submucosa with new blood vessels as a grade 3, granulation tissue had developed in the serosa and submucosa with new blood vessels or intestinal epithelial cells from intact intestinal glands and short villi as a grade 4, and granulation tissue had developed in the serosa and submucosa with intestinal epithelial cells from intact intestinal glands and short villi and microvilli as a grade 5.

The histopathology slides of the SSIS group on the15 and 30 post operation days showed congestions, haemorrhage, plenty of fibroblasts, infiltration of neutrophils, monocytes and lymphocytes in the anastomatic line.
fibrinopurulent exudates, in the serosa and submucosa with new blood vessels as a grade 1, granulation tissue had developed in the serosa and submucosa with new blood vessels or intestinal epithelial cells from intact intestinal glands and short villi as a grade 4, and granulation tissue had developed in the serosa and

submucosa with intestinal epithelial cells from intact intestinal glands and short villi and microvilli as a grade 5.

The present histopathological findings are consistent with the finding of Al-Timmemi *et al*. (2010) who found that histopathological changes, such as presence of necrosis, poly morphonuclear infiltration, edema, epithelial recovery, and repair of submucosal-muscular row have shown that the technique in one row of sero-submoucosal interrupted sutures was closer to “ideal healing” than one row of horizontal mattress interrupted sutures technique in goats.

Also in dogs Hamza (2009) reported that histopathological examination revealed that healing in single layer by cross mattress interrupted suture pattern covered by pedicle omentum occurred by the first intention healing, Ali (2011) found higher rates of healing process microscopically in end-to-end appositional by simple interrupted stitches compared with the same appositional method, but the stitches were tied extra-luminally.

Examination of the jejunal lumen diameter after two rows suture patterns of anastomosis resulted significant increase were seen in lumen diameter in SSCLS group at 30th day post surgery. Results are in the same line with Reinertson (1976), reported in equidae, the modified Gambee technique for intestinal anastomosis results in near normal lumen diameter. Lee *et al*. (2012), reported that relative lumen diameters were larger for single layer than that for two layers. Dean *et al*. (1985) reported that there was no significant difference in the percentage of reduction of lumen diameter between the variations of the two layer techniques in horses.

The minimal luminal stenosis degree at 30th days post surgery in SSCLS group observed in this study is in agreement with previous results obtained by Hanson *et al*. (1998a), who reported that there was no difference in lumen diameter between the inverting two row suture patterns and appositional two rows suture pattern, while Hamilton (1967) who reported that the standard two-layer inverted technique narrowed the intestinal lumen an average of 54%, the single layer inverted technique decreased it 39%, the approximating Gambee technique narrowed it only 4%, and the everting Navy technique decreased it just 3% immediately postoperatively. Hanson *et al*. (1998b), reported that suture pattern resulted in greater luminal diameters with good apposition of the tissue layers compared with a triangulated double row pattern of stainless steel staples, Reinertson (1976) reported that the modified Gambee technique for intestinal anastomosis results in near normal lumen diameter in horses and ponies. Al-Qadhi and Al-Hasan (2013) reported that the degree of stenosis rates were lower in simple interrupted suture techniques, while the degree of stenosis rates were higher in continuous Lembert suture pattern following intestinal anastomosis in dogs. Al-Timmemi *et al*. (2010) reported stenosis degree was lower in serosubmucosal interrupted suture than horizontal mattress interrupted sutures in goats.

Bursting pressure test showed no significant differences between two groups, although SSIS group showed slight decrease in bursting pressure test compare to the SSCLS group on day 15 and 30 post surgery, these findings are consistent with the findings of Hanson *et al*. (1998a), who reported that the differences in bursting pressure were not evident between the inverting two row suture patterns compared with the appositional single row suture pattern techniques in horses, Lee *et al*. (2012), reported that there were no significant difference in bursting pressures following jejunal anastomosis in horses, Gandini and Chiado'Cutin (2007) reported that the bursting pressure resulted in lower values for double layer technique, however, Al-Qadhi and Al-Hasan (2013) who reported that the anastomatic bursting pressure was significantly lower in jejunal anastomosis in dogs. Hamza (2009) who reported that there were no significant differences of bursting pressure between single row by cross mattress interrupted and similar fashion with site of anastomosis was covered by free omentum and pedicle omentum suture technique at 15 and 30 days following surgery in dogs.

In goats Al-Timmemi *et al*. (2010) reported that bursting pressure was higher in one row of sero-submoucosal interrupted sutures than one row of horizontal mattress interrupted sutures, Krasniqi *et al*. (2009), also reported the average bursting pressure and tensile strength were higher on both the 4th and 7th postoperative days with the Gambee technique in rats.

CONCLUSION

The study was carried out to compare the efficacy of SSIS and SSCLS for jejunum anastomosis in donkeys. It can be concluded that SSCLS group showed that:

1- Lower percentage of wound infections and mortality rate.

2- Does not show any anastomatic leakage.

3- Healed in grade 3, 4 and 5 in all animals.

4-Does not showed any increased risk of postoperative complications.

The present study concluded that the both method are safe, effective and can be reliably performed as technique for small intestinal anastomosis in donkey for gastrointestinal problems in field conditions.

RECOMMENDATIONS

1- The two suture patterns for anastomosis in donkeys assessed in this study must be tested for use in other species of animals

2- Further studies must be carried out to investigate the effects of sexes and ages in both suture patterns.

3- The two suture patterns assessed in this study are strongly recommended to be used in donkeys.

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Appendixes

Appendix.1: **Adhesions degree (%) for jejunal anastomosis using two rows sero-submucosal continuous lembert sutures (SSCLS) and one row sero-submucosal interrupted suture (SSIS) in donkeys.**

Adhesion degrees (%)	SSIS group	SSCLS group
adhesion Slight	20	60
adhesion Mild	40	40
adhesion Sever	40	0
Total	100(%)	100(%)

Appendix.2. Healing grades (%) for jejunal anastomosis using two rows sero-submucosal continuous lembert sutures (SSCLS) and one row sero-submucosal interrupted suture (SSIS) in donkeys.

healing degrees	SSIS group	SSLS group
Grade1	20	0
Grade 2	0	0
Grade3	0	33.3
Grade4	60	50
Grade5	20	16.7
Total	100(%)	100(%)

Appendix.3. Mortality rates, Wound infection and Anastomatic leakage for jejunal anastomosis using two rows sero-submucosal continuous lembert sutures (SSCLS) and one row sero-submucosal interrupted suture (SSIS) in donkeys.

Post operative complications	SSIS group	SSLS group
Mortality rate	1	2
Wound infection	4	3
Anastomatic leakage	1	0
Total	6	5

Appendix.4. Tube with EDTA in plastic containers for haematological indices and tube with fluoride oxalate for plasma separation, for blood biochemical parameters measurements.