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EXPERIMENTAL STUDY

Hartmann colostomy with ligasure

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Abstract: *Purpose:* While LigaSure is commonly used for blood vessel closure, our aim was to research the effectiveness of using the latter tool for the purpose of closing intestines in rats.
Methods: Twenty Wistar albino rats were divided into two groups per 10 each. In Group 1, the sigmoid colon was cut from its middle and its distal was closed with 4/0 silk. In Group 2, on the other hand, the sigmoid colon was divided from the middle with LigaSure LS1200 probe and its distal was closed with LigaSure. In both groups, the proximal sigmoid colon was entered by means of colostomy with 4/0 silk to the left part of the abdomen. Operation durations, adhesion levels and explosion pressures were recorded. Tissue samples were taken for tissue hydroxyproline level.
Results: While the average duration of the operation was 25.7 minutes in Group 1, it was 18.8 minutes in Group 2 and the difference between them was significant in favour of LigaSure. ($p<0.001$). Stump explosion pressure was 181.4 (160–190) mmHg in average in the suture group (Group 1), and 173.3 (150–190) mmHg in the LigaSure group (Group 2) and the difference between them was not statistically significant. Tissue hydroxyproline level was 123.6 (13–232) in Group 1, and 123.3 (32–216) in Group 2 and no significant difference was determined between the groups. Adhesion level between the groups was also similar.
Conclusions: This study experimentally shows that the duration of effective stump closure as part of Hartman colonostomy can be shortened with LigaSure *(Tab. 1, Fig. 4, Ref. 12)*. Full Text in PDF *www.elis.sk.*
Key words: LigaSure, experimental study, hartmann colostomy, intestinal closure.

LigaSure vessel closure technology is a system providing permanent blood vessel wall fusion by denaturing the collagen and elastin in the blood vessel wall and transforming it into a haemostatic plug (1). It allows fast closure of tissues without performing dissection. It has been shown in studies that vessels which are closed with LigaSure are not opened at a pressure up to three times the normal systolic blood pressure at minimum (2).

It has been shown in the studies that closure with LigaSure is as effective as clipping and ligation. The closure process is permanent and continuous. In case of intestinal closure, it has been considered to use LigaSure as well because similarly as blood vessel wall the intestinal wall also contains a matrix of elastin and collagen. It was aimed to research the effectiveness of the use of LigaSure in intestine closure in rats as a step to clinical studies and new technological improvements.

Methods

The study was performed by taking the permit of the ethical committee under resolution No. 2011–47 at Selcuk University Experimental Medicine Research and Application Centre.

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Twenty Wistar albino rats of 250–350 gr of weight, 4–6 months of age were divided into two groups per 10 each. Food was administered *ad libitum*. The operation was carried out under general anaesthesia by giving intraperitoneal ketamine hydrochloride (80 mg/kg) and xylazin (10 mg/kg). The area was cleaned with povidon iodine after shaving the hair. In all rats, laparatomy was performed with an incision of 3 cm from the midline (Fig. 1).

The sigmoid colon was found in the rats. In Group 1, the sigmoid colon was cut from its middle and its distal was closed by 4/0 silk (Dogsan, Trabzon, Türkiye) (Fig. 2). In the second group, the sigmoid colon was divided in the middle with LigaSure (ForceTriad Energy Platform, Covidien, USA) LS1200 probe, and its distal was closed with LigaSure (Fig. 3). In both groups, the proximal sigmoid colon was entered by means of colostomy with 4/0 silk to the left part of the abdomen (Fig. 4). Operation time was recorded.

Postoperative rats were put into single cages and they were given standard food. Food was administered *ad libitum*

On the seventh day, the rats were given general anaesthesia in the same manner and the abdomen was opened in form of inverted U. Adhesives around abdomen and colostomy were photographed and recorded. A 0–4 scale was used in adhesive evaluation as follows (3):

0 = No adhesion available
1 = Thin or narrow, easily separable adhesion
2 = Thick adhesion limited to one area
3 = Adhesion spread over a thick and large area
4 = Thick and large adhesions, organs being adhesive to the front and/or abdominal wall

Fig. 1. Three centimetres linear incision.

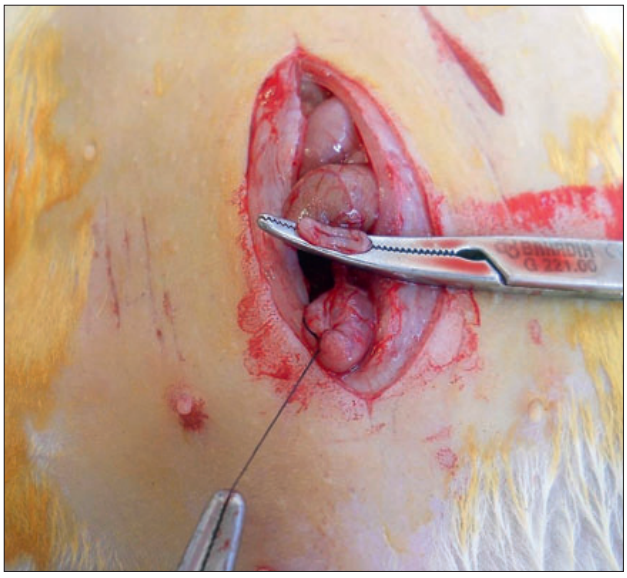

Fig. 2. Hartmann Colostomy with 4/0 Silk.

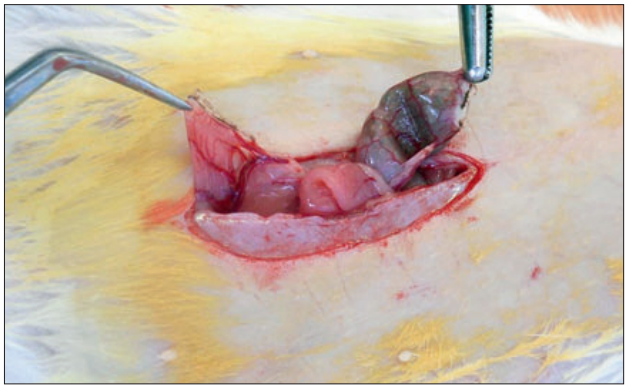

Fig. 3. Hartmann Colostomy with LigaSure.

Fig. 4. Appearance of Hartmann Colostomy.

Normal saline was put into abdomen and *in vivo* stump explosion pressures created with Gama G-5 Heine (Germany) tension tool were measured

After measuring the explosion pressure, hydroxyproline level of the closed intestinal stump was excised for measurement. It was kept in a deep freezer (VestFrost) at 50 degrees. Samples were transported to the laboratory with special storage boxes. Tissues taken were washed and cleaned with distilled water and then weighed 1 g with microbalances and hydrolized at 121 degrees in 1 ml of acidic buffer for five hours. Then, they were centrifuged at 5,000 rpm for 20 minutes. The prepared sample was evaluated by colorimetry (photometric) (Shimadzu UV 1800 Spectrophotometer) and tissue hydroxyproline level was calculated as mg/L/gr/tissue. All biochemical measurements of samples were performed blinded to their origin.

SPSS 15.0 Windows program was used for the analysis of data. Kruskal-Wallis and Mann-Whitney U test were used to compare the intergroup data. P value being smaller than 0.05 was considered significant.

Results

In both groups, one rat was lost due to anaesthesia in postoperative early period. In Group 1 (suture group), meconium ileus developed in two rats and they were left out of the study. The study was completed with 7 rats in Group 1 and 9 rats in Group 2.

While in Group 1, the average duration of the operation was 25.7 minutes, it was 18.8 minutes in Group 2, and the difference between them was significant in favour of LigaSure ($p<0.001$).

In both groups, no further adhesion was observed after first-degree adhesion and there was no difference in terms of adhesion between the groups.

Stump explosion pressure was 181.4 (160–190) mmHg in average in the suture group (Group 1), and 173.3 (150–190) mmHg

Tab. 1. Comparison of Groups.

	Adhesive Rate	Surgery Time (min)	BP (mmHg)	LH
Group 1	0.1	25.7	181.4	123.6
Group 2	0.2	18.8*	173.3	123.3

*p<0.001, BP – Bursting Pressure (mmHg), LH – Level of Hydroxyproline (mg/ /L/g/tissue)

in the LigaSure group (Group 2), and the difference between them was not statistically significant.

Tissue hydroxyproline level was 123.6 (13–232) in Group 1, and 123.3 (32–216) in Group 2, and no significant intragroup difference was determined (Tab. 1).

Discussion

LigaSure vessel closure system creates pressure with bipolar thermal energy and provides a safe and permanent closure of the vessels up to 7 mm (4, 5). This energy destroys and unites elastin and collagen in vessel walls and creates a new closing barrier. The closure process is permanent; moreover, it was shown with experimental studies that it is as safe as clipping and ligation (2).

Vessel closure is widely used in all surgical areas mainly in general surgery. The reliability of vessel closure system with LigaSure has been proven in many clinical studies and it was shown that the duration of the operation is shortened and it provides advantage in laparoscopic surgery (6).

LigaSure system's effectiveness in other tissues apart from vessel closure was researched. Experimental studies show its effectiveness in ureter closure but low effectiveness in cystic canal closure (7, 8, 9). Experimental studies show that the stump can be safely closed (up to 1 cm) in appendectomy (10).

In LigaSure closure system, the closure is provided by destroying collagen and elastin in the vessel wall. There is plenty of collagen in the intestinal wall, too. From this point of view, a similar closure was considered to be possible also in the intestine. In their anastomosis study on four pigs, Smulders et al (11) created eight anastomoses with the prototype tool they had developed themselves by using LigaSure only (11). It was seen that the pigs were healthy for seven days. On the seventh day, they were sacrificed, opened and examined macroscopically. In the histopathological examination, on the other hand, it was shown that epithelisation and new submucosal collagen synthesis developed in the edges of anastomoses.

In their experimental study on rabbits, Sorgato et al (12) used LigaSure for intestinal closure and showed that it was effective. However, none of these studies include the measurement of anastomoses or stump explosion pressure and there are no control groups.

Unlike other studies, our study compares the closure carried out with LigaSure to that closed with suture. No leak was determined in any of the animals in distal intestinal stump. Stump explosion pressure was found to be a little low in the stump closed with LigaSure but no statistical significance was observed. On the other hand, tissue hydroxyproline level was found to be similar. The duration of the process, on the other hand, was significantly shorter in the LigaSure group. With this study, it has been shown that in experimental Hartmann type of colostomy, the stump can be closed with LigaSure as effectively as with silk.

It is considered that new horizons can be opened in laparoscopy and open surgery with the prototypes to be newly developed for the use of LigaSure closure system in anastomoses and intestinal closures. In particular, it can contribute to intestinal anastomosis creation or intestinal closure in laparoscopic surgery. If this is achieved, savings can be made as a result of shortened duration of operation and lowered expenditure on materials such as staplers.

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