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Macroscopic and microscopic evaluation of different sutures and suturing techniques in peritoneum and muscles repair after performing laparotomy in goats

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Abstract

The present study was conducted on twenty seven clinically healthy female goats aging about 1-2 years and weighing in between 16-20 kg. The experimental animals were randomly divided into three groups; A, B and C (n=9x3). In all the animals laparotomy was made on the middle of the left flank under xylazine hydrochloride anesthesia intramuscularly and linear infiltration of 2% xylocaine hydrochloride locally. Peritoneum and muscles were repaired with 2/0 chromic catgut, 2/0 black braided silk and 2/0 mercerized cotton threads in animals of group A, B and C respectively. The observation was made on the basis of macroscopic and microscopic studies of the tissue from the repaired area on 10th, 20th and 30th post-operative days. The healing was marked normal grossly and histologically with all these sutures, a few nodules and mild adhesions were detected with peritoneum in few animals (goat No. 4, 6 and 8) of group A (repairing with 2/0 chromic catgut). This type of pathological lesions could not be detected grossly and historically after the use of 2/0 black braided silk and 2/0 mercerized cotton threads in group B and C respectively. There was lack of mortality after the surgery in any group. Though, all these three suturing materials are worthy for internal use in goats but the superiority may be graded as 2/0 black braided silk, 2/0 mercerized cotton thread and 2/0 chromic catgut respectively. Thus, these last two suturing materials may be used clinically in caprine internally wherever needed in goats for the poor persons of the society.

Keywords: Goat, sutures, cotton, catgut, silk, laparotomy, abdominal wall

1. Introduction

Laparotomy in goat is an invasive surgical procedure into the abdominal cavity that allows visual examination of abdominal organs and documentation and correction of certain pathologic abnormalities observed (Ames, 2007; Hendrickson, 2007) [1,2]. Generally, it constitutes the single largest group of surgical operations carried out in ruminants (Freeman, 2003; Haskell, 2004) [3,4]. Laparotomy is commonly indicated either for exploratory purposes when clinical diagnosis is uncertain or for therapeutic surgical intervention when specific diagnosis has been made (Hendrickson, 2007) [2]. Laparotomy is indicated for exploration of abdominal and pelvic cavities and other surgical procedures involving abdominal and pelvic organs; other specific indications are caesarean section, embryo transfer to produce transgenic goats, ovariectomy, rumenotomy, abomasotomy, ventral abdominal herniorrhaphy, intestinal resection, anastomosis, and cystotomy (Dehghani and Ghadrani, 1995) [5].

Varieties of suturing material both absorbable and non-absorbable like, chromic catgut, P.G.A. Vicryl, Dacron Maxon, Silk, Cotton, Nylon, horse hair etc. had been used as internal suture for repairing the injuries of abdominal wall, loops of intestine, urinary bladder and other visceral organs since last decades (Eilert *et al.* 1971; Mbiucki, 1983; Lastedt and Debur, 1990) [6-8]. Although, available literatures revealed maximum information regarding the use of chromic catgut for internal use in human beings and animals but there is scanty information regarding the use of non-absorbable suturing materials for internal use in animals as well as in human being. Thus, the present research work was undertaken to know the efficacy of 2/0 black braided silk and 2/0 mercerized cotton threads (both non-absorbable) as compared to chromic catgut 2/0 (absorbable) for suturing the peritoneum and muscles of abdominal wall in goats.

2. Materials and Methods

The present study was conducted on twenty seven clinically healthy female goats aging about 1-2 years and weighing in between 16- 20 kg. All animals were kept under similar environmental condition and close observation for a period of one week during which a

preliminary examination was done to check up their health. Selected animals were dewormed with Albendazole @ 5mg per kg body weight, a fortnight earlier to the start of experiment.

2.1 Design of experiment:

The selected animals were randomly divided into three groups consisting of nine animals in each group. Group A: In this group of animals, the peritoneum and muscles were repaired with 2/0 chromic catgut after performing laparotomy. Group B: In this group of animals, the peritoneum and muscles were repaired with 2/0 black braided silk after performing laparotomy. Group C: In this group of animals, the peritoneum and muscles were repaired with 2/0 mercerized cotton after performing laparotomy.

2.2 Preparation of Animals Prior to Surgery

The experimental animals were fasted 24 hrs. prior to surgery. The left flank area was prepared for aseptic surgery. It was saved and scrubbed with soap and water. It was mopped with 70% alcohol and painted with Povidone Iodine solution (Betadine®, Medicare Pvt. Ltd. 1400, Hemkut Tower, 98, Nehru Place, New Delhi-110019, India), a day earlier to surgery. Sterilization of instruments, drape, gauge and other necessary appliances including suturing material like 2/0 black braided silk, 2/0 mercerized cotton threads were sterilized in autoclave as a routine manner.

2.3 Anaesthesia

Xylazine hydrochloride (sarabhai Zydus, Animal Health Limited, Goa) @ of 0.5 mg/kg body weight was injected intramuscularly 10 minutes prior to surgery. The prepared animal was kept on right lateral recumbency on the operation table and 10 ml of 2% xylocaine (Asrazeneca pharma India Ltd., 12th mile, Bellary road, Bangalore) was injected locally in linear manner on the middle of the left flank.

2.4 Operative Technique

A mid-vertical incision about 12 cm in length was made on the left flank below the lumbar transverse process. Skin and subcutaneous tissues were reflected with the help of Allis tissue forceps. Then abdominal muscles and peritoneum were incised in the same direction. Bleeding vessels were caught with the help of artery forceps and ligated. The operative field was mopped with sterile gauge and Neosporin (Burroughs Wellcome (India) Limited, 91, LBS Marg, Mumbai-400080) powder was sprinkled on operative site. Two tier systems for closure of laparotomy incision were adopted. Peritoneum and muscles were sutured with 2/0 chromic catgut, 2/0 black braided silk and 2/0 mercerize cotton threads using the simple continuous technique in group A, group B and group C respectively. In each group skin and subcutaneous tissue were sutured with 2/0 black braided silk in horizontal Halsted fashion. Then, a protective piece of bandage applied and sutured on the incisional wound which was moistened with Tincture benzoin Co. (Sonu chemical India 24, Srinath Colony, Indore) to prevent secondary bacterial infection.

2.5 Post-operative Management

The animals were kept in clean, dry and well ventilated place. 250 ml of 5% Dextrose solution was injected I/V daily for 3 consecutive days. The operated animals were medicated with Cilclox (Excell Formulations Pvt. Ltd. 202, Silverline, opp. Holy Cross High School, old Mumbai- Pune Road, Thane-

400601) @ 20 mg/kg body weight B.I.D. daily and Nutriliv (Vetcare Div., Tetragon White Pvt. Ltd. 1840, KHB Industrial Area, Yelahanka, New Town, Bangalore-500054) @ 2.5 ml I/M on alternate day up to 7th day of surgery. The animals were maintained mainly on rice gruel for the first two days after the surgery and other feeds were completely withheld. They were allowed water ad lib and maintained on green grasses from the 3rd post-operative day. They were also allowed to graze green grasses from the third post-operative day. The surgical wound was examined daily for any post-operative complication and cleaned mopped with Tincture iodine (Sonu Chemical Ind., 24, Srinath Colony, Indore), Himax (Indian Herbs, Research & Supply Co. Ltd., Darra Shivpuri, Saharanpur, India), ointment was applied locally to prevent secondary bacterial infection, as well as for its having fly repellent action. Skin suture were removed on 8th post-operative day, while antiseptic treatment was continued further on line of suture. The animals were observed carefully for any complication during whole of the observation period. The operated animals were examined grossly for proper healing or untoward pathological lesions during the period of observation and at the time of collection of tissues for histopathological examinations. Tissues were collected after injecting xylazine as anaesthetic on 10th, 20th, and 30th, postoperative days. Then laparotomy incision was closed in routine manner as mentioned earlier. Tissues were preserved in 10 percent formalin solution. Tissue section was made and stained with Haemotoxyline & Eosin stain and Van Giesson's stain.

3. Results

In the present experiment three types of suturing materials viz. 2/0 chromic catgut (absorbable), 2/0 black braided silk and 2/0 mercerized cotton threads (both non absorbable) were used for closure of laparotomy incisions in a total number of twenty seven healthy female goats.

3.1 Macroscopic observation

In group-A, on 10th day there was complete healing of the incisional wound from outside. However, a few nodules were marked on the serosa of rumen in some operated animals (goat No. 4, 6 and 8) when expose for removal of tissues for microscopic studies. On 20th day, mild adhesion with peritoneum was detected in two animals (Goat No. 6 and 9) during this stage. Complete healing was marked. Nodule formation or any other gross lesions could not be detected grossly on the visceral organs. On 30th post-operative day, healing was complete but mild hemorrhage on the muscular tissue could be detected showing the moderate tissue reaction with chromic catgut. In group-B, on 10th post-operative day, healing was complete. Gross lesions could not be detected. There was lack of peritoneal adhesion. However, pieces of non-absorbable silk thread were also visible grossly. On 20th post-operative day, healing was complete. No gross lesion could be detected. Peritoneal adhesion was also negligible. However, pieces of non-absorbable silk thread were observed like 10th day grossly. On 30th post-operative day, complete healing was observed macroscopically without peritoneal adhesion or any un-towards pathological lesion. The tissue reaction was observed minimal in this group. In group-C, on 10th post-operative day, mild inflammation and induration in the subcutaneous tissue were detected in the periphery of incised wound showing moderate tissue reaction. Peritoneal adhesion or nodule formation on the visceral organs could not

be detected in this group. On 20th post-operative day, zone of inflammation was minimal and induration in the tissue could not be detected. No. other gross pathological lesions could be observed. On 30th post-operative day, the healing was complete with inflammatory zone showing moderate tissue reaction. Peritoneal adhesion or there pathological lesions could not be detected grossly.

3.2 Microscopic observation

In group A, on 10th post-operative day, laparotomy duly repaired by chromic catgut revealed unabsorbed suturing material. Additionally the side of suture was evident by the presence of inflammatory tissue reaction formation of the collagen fibers and hemorrhage (Fig-1). The site appeared to be interwoven by widely spaced collagen fiber network. The repaired site also showed the distribution of numerous inflammatory cells. The collagen fibers network, thus formed was comparatively weaker line of repair between the muscles (Fig-2). On 20th post-operative day, the catgut suture was almost absorbed with a few residual suturing materials at the site. The vacant area thus formed by absorption of catgut suturing material was filled with inflammatory cells along with quite a good number of fibroblasts, engaging themselves in the production of fine collagen fibers (Fig-3). On 30th post-operative day, the site of catgut suture was completely filled with collagen fibers along with the appearance of isolated striated muscles from the surrounding areas (Fig-4). Microscopically no inflammatory condition was recorded at the site of incision. In group-B, on 10th Post-operative day, the histological studies revealed a thick connective tissue ring around the suturing material and moderate degree of tissue reaction due to of inflammatory cell (Fig-5). On 20th post-operative day, the inflammatory cells distribution were marked lowered at the junctional area around the suturing material (Fig-6). On 30th post-operative day, the histology examinations revealed appreciable degree of repair at the site of incision. The area was filled with abundance of collagen fibers with interlocking arrangement of regenerating skeletal fibers. The vascularity was appreciably marked with some vacant areas denoting the site of suturing materials (Fig-7). In Group- C, on 10th post-operative day, the site of repair revealed intense inflammatory reaction around the line of suture. The inflammatory reaction was marked by the present of numerous polymorphic leukocytic infiltrations at the region. Occasionally several small capillary networks were also seen to appear within the area duly infiltrated by the inflammatory cells. Near the non-sutured area proliferation of collagen fibers were also recorded exhibiting the healing process (Fig-8). On 20th post-operative day, the site of incision did not revealed intense inflammatory tissue reaction. However, in some of the experimental animals two of peritoneum adhered with each other at several points. The parietal peritoneum appeared to have adhered with the muscle fibers of inner most layers of obliquus abdominis internus muscles (Fig-9). The suturing site usually showed ring like encapsulation of collagen fibers around the mercerized cotton suturing materials (Fig-10). On 30th post-operative day in most of the animals, the site of repaired area in the vicinity of suture appeared to be thicker due to fibrosis, supported by the presence of greater number of capillaries and a few fibroblast cells. The outer margin of this fibrosed area continued to show the distribution of inflammatory cells near the site of the repair (Fig-11).

4. Discussions

In group A, complete healing was observed at the time of removal of external stitches on the 8th post-operative day. Similar result was observed by Vig and Tyagi (1970)^[9] and Shastry and Rao (1981)^[10] after the use of chromic catgut as suturing material during cystorrhaphy in bovine. Few nodules were observed on the serosa of rumen in some goat, which might be due to local reaction or inflammatory changes. Anyhow actual reason for the nodule formation could not be assessed. Mild hemorrhage on muscular tissue in the vicinity of incisional wound could be detected grossly in few operated animals, was also similar with the findings of Kumar *et al.* (1968)^[11] during repair of incisional wound at the hip region and Ravikumar *et al.* (1992)^[12], at the time of cystorrhaphy in bovine. The peritoneal adhesion which was observed at the time of tissue removal for histopathology was similar with the result of Tyagi and Lumb (1961)^[13], after hysterotomy in a she goat. Kumar and Singh (1970)^[14], use chromic catgut and cotton threads as suturing material during rumenotomy in buffalo calves and observed higher incidence of peritoneal adhesion with catgut than cotton. Microscopically, presence of inflammatory tissue reaction was observed during the present study. Similar observation was marked by Gage and Lyons (1949)^[15], in their opinion persistent inflammatory reaction was observed after the use of catgut. Formation of collagen fiber and hemorrhage in muscular tissues on 10th post-operative day was marked histologically in this group which was also agreeable with the result of Singh (1993)^[16] and Ojha (1965)^[17], after oesophageal repairing with chromic catgut in bovine experimentally. The incisional vacant area formed by absorption of catgut had been filled with the good number of fibroblast cells and thus, it confirmed the result of Kudalk and Hattangady (1971)^[18], who had performed cystoplasty using the chromic catgut No. 4/0. Severe tissue reaction in the form of excessive cellular zone consisting abundant polymorph, macrophages and fibroblast cells were also visible microscopically by Kulkarni and Bhokre (1985)^[19]. On 30th day, the vacated area of catgut suture was completely filled with collagen fiber and thus, result coincide with the result of Sharma and Khan (1978)^[20] after performing cystoplasty using 3/0 chromic catgut in bovine with good result.

In group B, any type of complication on the day on the surgery and after the surgery could not be detected. The healing was also complete. Thus the result of present research work is in agreement with the result of Gupta *et al.* (1985)^[21], after performing intestinal anastomosis with silk ligature in buffalo calves, Gopal *et al.* (1995)^[22] and Pandey *et al.* (1995)^[23] who had used silk threads respectively during rumenotomy and cystotomy in bovine. However, the result of present research work did not coincide with the result of Schultz *et al.* (1962)^[24] who had used two layer techniques during intestinal anastomosis using silk thread in puppies. During their study, there was development of stricture at the site of anastomosis. Anyhow, moderate tissue reaction was observed by them. In this group, peritoneal adhesion was negligible. Thus, the result corroborated with result of Kanade *et al.* (1984)^[25] after repairing of umbilical hernia using silk ligature in bovine. Similar result were marked by Ojha (1965)^[17], after urethroplasty in bovine. The tissue reaction was minimal in this group as compared to Group B which coincided with the result of others (Ojha, 1965; Sharma, 1973; Kumar, 2000 and Ansari 2002)^[17, 26, 27, 28] after the use of silk ligature in bovine experimentally. In the present

research work silk thread was visible till the last day of observation and thus, it was agreement with the result of Sharma and Khan (1978) [20], Kumar (2000) [27], Ansari, (2002) [28] after the use of silk threads in urological surgery experimentally in bovine. Microscopically, on 10th day of laparotomy, a thick connective tissue ring was marked around the suturing material while on 20th day, moderate degree of tissue reaction was noticed which was similar to the result of Sharma and Agrawal (1997) [29] who observed highly vascularized connective tissue after cystectomy and prosthetic bladder replacement in bovine. Similar results were also observed by other workers (Gopal *et al.* 1995) [22] in canine experimentally. The operated area was filled with abundance of collagen fibres histologically which was in agreement with the result of Sharma and Khan (1978) [20] after bladder surgery in bovine. Singh (1993) [16] conducted comparative studies on Vicryl, chromic catgut and black braided silk as suture material in oesophagotomy and preferred black braided silk on economic point of view.

In group C, microscopically, on 10th post-operative day, intense inflammatory reaction was marked which was denoted by numerous polymorphic leukocytic cell infiltration at the operate site. Proliferations of collagen fibers were also recorded. Thus, the present result agreed with the result of Kumar and Singh (1970) [14] who had observed the tissue reaction microscopically by infiltration of mononuclear and polynuclear leukocytes around the suture. Vig and Tyagi (1970) [9] also reported similar finding after urethrotomy in bovine. On 20th day, histopathological study revealed peritoneal adhesion with the inner most layer of oblique abdominis internus muscle which was similar with the result of Kumar and Singh (1970) [14] who observed mild adhesion between peritoneal and muscles after rumenotomy in bovine and caprine. The histological study on 20th and 30th day, revealed ring like encapsulation of collagen fibers around the mercerized cotton thread which was in agreement with the result of Kumar and Singh (1970) [14] who observed macrophages and fibroblasts cells encapsulating the cotton thread microscopically. Kleinsassar *et al.* (1950) [30] used peritoneal grafts during intestinal anastomosis in eighteen dogs experimentally in which No. 7/0 cotton threads were used with unsatisfactory result. Similar result was also obtained by Shultz *et al.* (1962) [24] when he used two layer technique for oesophageal repair with cotton in bovine. He had marked development of stricture and fistula formation at the site of operation. Thus, the result of present study was somewhat different in caprine as compared to these workers. On 30th post-operative day, histologically sutured area appeared to be thicker in the present group which might be due to fibrosis which was also in agreement with the result of Ojha (1965) [17] who had observed same type of thickening after repairing of oesophageal incision.

5. Authors' Contributions: All authors have contributed, read and approved the final version of the manuscript.

6. Competing Interests: The authors declare that they have no competing interests.

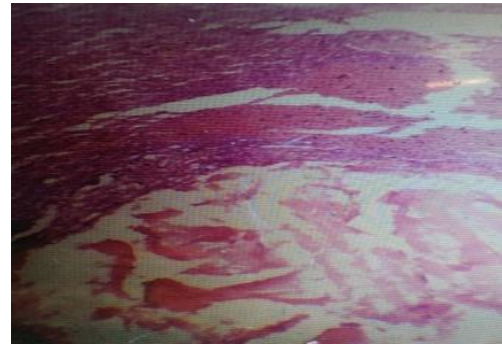


Fig 1: Photomicrograph showing unabsorbed chromic catgut suturing material surrounded by inflammatory cells and connective tissue fibers on 10th post-operative day of laparotomy (H & E, 150X).

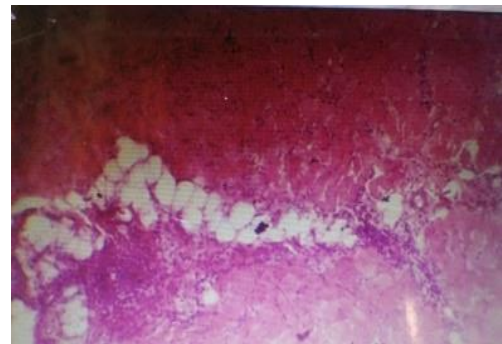


Fig 2: Photomicrograph showing line of repair with the help of weak collagen network between two margin of cut abdominal muscle repaired with chromic catgut on 10th post-operative day of laparotomy (H & E, 150X).



Fig 3: Photomicrograph showing regeneration of collagen fibres along with inflammatory cells at the site repaired with chromic catgut on 20th post-operative day of laparotomy (VG, 150X).

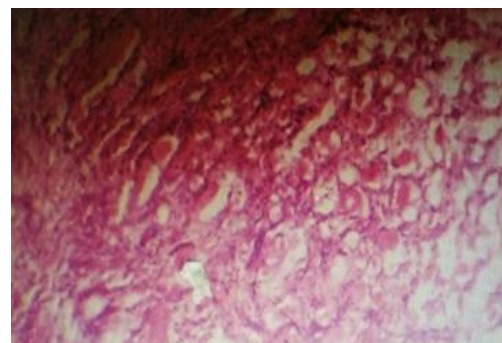


Fig 4: Photomicrograph showing replacement of chromic catgut by collagen tissue on 30th post-operative day of laparotomy (H & E, 150X).

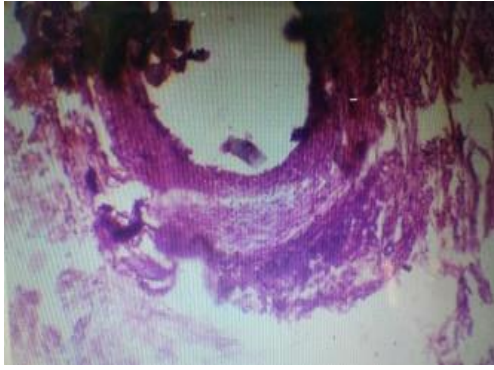


Fig 5: Photomicrograph showing distribution of inflammatory cells surrounded by ring like fibrotic tissue around the silk suturing material on 10th post-operative day of laparotomy (H & E, 150X).

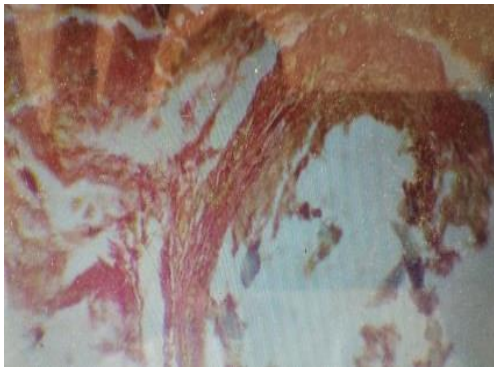


Fig 6: Photomicrograph showing the distribution of inflammatory cells surrounded by ring like fibrous tissue around the silk suturing materials on 20th post-operative day of laparotomy (H & E, 150X).



Fig 7: Photomicrograph showing the collagen fibres around the silk thread on 30th post-operative day of laparotomy (VG, 150X).

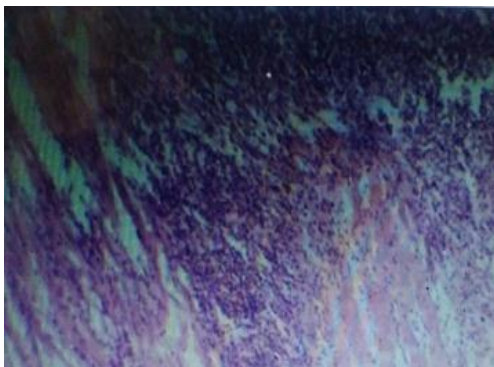


Fig 8: Photomicrograph showing inflammatory cells at the site of repaired with cotton sutures, on 10th post-operative day of laparotomy (VG, 150X).

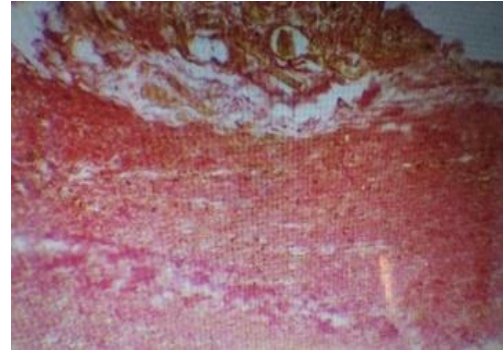


Fig 9: Photomicrograph showing the site of adhesion between peritoneum and abdominal muscle repair with cotton sutures on 20th post-operative day of laparotomy (VG, 150X).

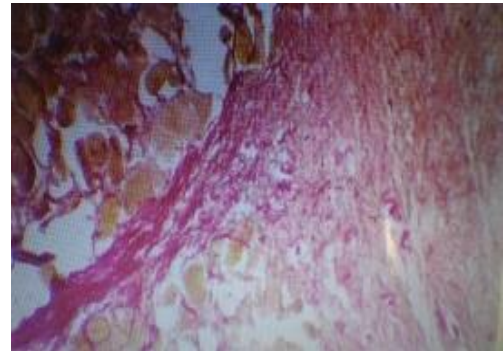


Fig 10: Photomicrograph showing unabsorbed cotton suturing material separated by a ring like arrangement of collagen fibers, on 20th post-operative day of laparotomy (VG, 150X).

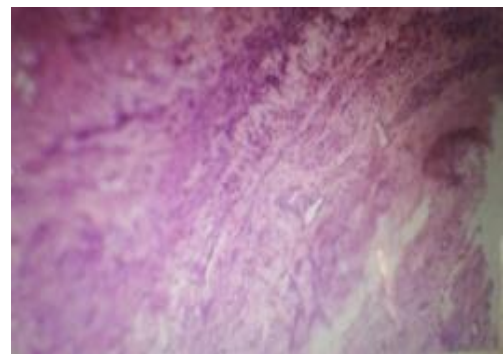


Fig 11: Photomicrograph showing the distribution of inflammatory cells surrounded at the site of repair by cotton suturing on 30th post-operative day of laparotomy (H & E, 150X).

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