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# Rumino-cecal anastomosis for treatment of recurrent tympany: Experimental study in goats.

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**Abstract**

The present study is an experimental study performed on seven mature healthy goats, from which two goats were used for description of the topographical anatomy of the area through which the cecum passed and anastomosed with the dorsal ruminal sac. The remaining five goats were used for induction of rumino-cecal anastomosis that was followed by induction of a state of frothy tympany for 3 months to simulate recurrent tympany associating diaphragmatic hernia. Results revealed that the technique is a simple technique required no complicated equipments and had minimal complications. All operated goats survived the period of experiment after which they were sacrificed and the rumen, the cecum, and seat of anastomosis were examined histopatholo-gically. Histopathology revealed complete epithelization and fusion at seat of anastomosis, mild submucosal histopatho-logical changes of the cecal wall close to seat of anastomosis, and absence of severe histopathological changes at the rumen and cecum. It is concluded that the technique can be considered for treatment of selected cases of pregnant large ruminants suffered from diaphragmatic hernia and recurrent tympany, and further study in clinical cases is required to prove the suitability of this experimental technique in large ruminants.

**Key words: anastomosis, cecum, experim-ental, goats rumen, tympany**

**Introduction**

Recurrent tympany is a serious digestive disorder that appears after diaphragmatic hernia **(Sahu, et *al.*, 2003; Singh, et *al.*, 2006** and **Saini, et *al.*, 2007)** as a result of interference of rumen peristalsis owing to reticular adhesions **(Mally** and **Jayadevappa, 1974)**. The most common clinical signs of diaphragmatic hernia are anorexia, suspended rumination, recurrent tympany and scanty feces **(Singh, et *al.*, 2006)**.

Moreover, diaphragmatic hernia itself is a chronic wasting and inflammatory thoraco-abdominal disorder in adult large ruminants **(Sobti, et *al.*, 1989; Steiner, et *al.*, 1992; Fazili, et *al.*, 2001; Bisla, et *al.*, 2002; Sahu, et *al.*, 2003** and **Saini, et *al.*, 2007)** that is usually observed either in recently calved adult large ruminants or when they are at late gestation **(Divers and Smith, 1979** and **Smith, 2002)**.

The main causes of diaphragmatic hernia has been reported to be trauma, foreign body syndrome, progressive weakening of the diaphragm adjacent to reticulo-peritonitis and increased intra-abdominal pressure like ruminal tympany, violent fall, advanced pregnancy, parturition, chronic cough and straining **(Singh, et *al.*, 2006** and **Divers and Peek, 2008)**.

The higher prevalence of diaphragmatic hernia in buffaloes than cows may be attributed to the lesser collagen content, elasticity, and vascularity of buffalo diaphragm, and the habit of wallowing in buffaloes that may act as an exciting factor for diaphragmatic rupture **(Singh, et *al.*, 2006** and **Athar, et al., 2010)**.

Conservative treatment in cases of chronic bloat is usually directed towards fistulation and cannulation of the rumen **(Anderson, *et al.,* 1976)**, however these conventional methods have many complications like leakage of ruminal juice with subsequent peritonitis, accordingly many modifications of the techniques have been recorded to minimize such complications **(Schnautz, 1957; Binns and James, 1959; Komarek, *et al.,* 1961; El-Monzaly, 1975; Corley, *et al.,* 1999; Nocek, *et al.,* 2002** and **Abdel-Fattah et *al.*, 2007)**.

The other treatment options of cases of diaphragmatic hernia with recurrent tympany are either euthanasia or herniorrhaphy under general anesthesia with keeping the animal on assisted ventilation **(Anne, et *al.*, 2010)**. Unfortunately this surgical procedure is too risky, requires complicated equipments and high skills, associated with high intra or post-surgical mortality, and has higher success rates in younger ruminants **(Kelmer, et *al.*, 2008** and **Anne, et *al.*, 2010)**.

Regarding anatomy of the cecum and rumen in small ruminants, it was found that the ventral sac of the rumen is relatively larger and extends more to the right side of the median plane than in the ox, further caudally (6-8cm) than that of the dorsal sac and the cecum has an average length of 30cm and a diameter of 8cm **(Getty, 1975)** meanwhile **El-Hagri (1967)** mentioned that the length and width of the cecum are 25-42cm and 5cm respectively. The cecum is only marked off from the colon by the point of termination of the ileum and near the ventral end of the last rib, the cecum extends caudodorsally along the right flank from which it is separated by the greater omentum. Its rounded blind end lies at the right side of the pelvic inlet **(El-Hagri, 1967, Getty, 1975, Hofmann, 1988** and **Konig and Liebich, 2009)**. Moreover, **El-Hagri (1967)** observed that only 5cm of the cecum are free.

As a result of difficulty of herniorrhaphy in mature large ruminants and the high probability of peritonitis after fistulation of the rumen, we are led to construct the present study, which aimed at establishment of experimental rumino-cecal anastomosis technique in goats. At the same time a state of recurrent tympany was induced for evaluation of the technique and at the end of the study, animals were humanly sacrificed for determination of histopathological changes of the rumen and cecum after anastomosis.

**Materials and Method**

Two adult female goats were euthanized and used in fresh state to investigate the anatomical considerations of the cecum and the rumen to determine the best site for induction of anastomosis **(Fig. 1)**. Subject of the study were five mature apparently-healthy goats of native breed that were prepared for aseptic surgery through the left flank then they were secured on the right side and anesthetized by intravenous diazepam (0.5 mg/ kg), intramuscular xylazine HCl (0.05 mg/ kg), and inverted L block local analgesia by lidocaine HCl 2%. Following celiotomy, the rumen was pushed cranially and the cecum was grasped gently from the right side without induction of torsion **(Fig. 2)**, partially evacuated from ingesta by gentle massage from the apex to the base, and a loose ligation was made around the cecum to preserve a cecal apex free from ingesta **(Fig. 3)**. The apex of the cecum was sutured to the dorsal sac of rumen **(Fig. 4)**, a hole of about 2.5cm diameter was created in the rumen close to the line of suturing, and then another hole of the same diameter was created in the cecum **(Fig. 5)**. Both holes were sutured to each other to induce rumeno-cecal anastomosis after which the loose cecal ligation was removed to permit escape of ruminal gasses to the cecum **(Fig. 6)**. Finally the abdominal wound was closed

in layers and after care included intramuscular injection of oxytetracycline LA 20% (1 ml/ 10 kg), AD3E, and daily dressing of the wound till removal of silk after 10 days.

After surgery the animals were permitted to ingest lush legumes such as clover or alfalfa either in green feeds or as new hay with feeding finely-ground concentrates to induce a state of frothy tympany for three months **(Radostits, *et al.*, 2000** and **Mary and David, 2011)**. This persistent tympany induction was made to simulate the state of recurrent tympany associating diaphragmatic hernia.

At the end of the experiment, animals were humanly sacrificed and the seat of anastomosis, the dorsal ruminal sac and the cecum **(Fig. 7)** were harvested and fixed in 10% neutral formalin, and processed for routine histologic examination, then Five- to seven-micrometer sections were stained by hematoxylin and eosin stain **(Bancroft and Stevens, 1996)**.

**Results**

The cecum in goat **(Fig. 1)** appeared as a large cylindrical blind tube at the beginning of the large intestine and demarcated from the colon by the entrance of the ileum, it was found on the right flank region and directed oblique caudo-ventrally. It has right and left surfaces, a dorsal border attached to the proximal loop by the colon by the cecocolic ligament and a ventral border attached to the ileum by the ileocecal ligament and an apex which is rounded, directed caudally to the right of the pelvic inlet. The length of the cecum was about 18-20cm and 3-4cm width. Its apex was found caudal to the ascending colon about five fingers (10cm) and just cranial and right to the uterine horns. It was noticed that the two surfaces, the dorsal border as well as the apex are free from large blood vessel. The distance between the apex of the cecum and the caudodorsal blind sac of the rumen on the left side was about nine fingers (18-20cm) and it was occupied by the spiral loop of the ascending colon. It was noticed that the folding of the cecum from its apex toward the craniodorsal blind sac of the rumen resulted in bending of the cecum over the spiral loop of the ascending colon. Regarding to the dorsal ruminal sac, it was observed that the more safe area for surgical interference is the most caudodorsal part about four fingers above the caudal transverse groove of the rumen. This area was free from large blood vessels.

With respect to surgery, induction of the technique was simple and easy with minimal complications, and it was similar to rumenotomy procedure. The complications observed with rumenostomy or ruminal cannulation couldn’t be observed with this technique. Immediate

complications included wound infection in two goats that could be managed conservatively, and no long-term complication could be observed in the operated animals.

Sudden change in feed permitted a state of slight frothy bloat similar to that of diaphragmatic hernia, and at the same time, the feces acquired pasty nature.

Histopathological examination **(Figs. 8 and 9)** revealed complete epithelization and fusion between anastomosed ruminal and cecal walls, histopathological changes within the anastomosed cecal wall, near seat of anastomosis, in the form of mild submucosal leucocytic infiltration, congestion, edema and hemorrhage. Moreover, small amount of granulation tissue was present within musculosa and serosa at the junction of anastomosis. However, the cecum and the rumen preserved their histologic appearance and mild pathologic changes could be detected in both of them.

**Discussion**

Treatment of diaphragmatic hernia and its associating recurrent tympany in pregnant large ruminants constitutes great challenge for veterinarians in our location. Slaughtering of such animals predisposes to high economic loss for both the owner and the government, moreover this meat is sold as low quality meat due to high water contents. On the other hand, treatment of the condition by herniorrhaphy under general anesthesia **(Sahu, et *al.*, 2003** and **Anne, et *al.*, 2010)** is not an alternative option for our veterinarians under field condition as a result of lake of skills, experience and suitable equipments. At the same time, ruminal fistulation and cannulation associated with many complications, usually unacceptable option by the owners and requires modulation to avoid its complications (**Abdel-Fattah et *al.*, 2007)**. The present experimental study resolved obstacles of diaphragmatic herniorrhaphy as it can be performed on standing animals like rumenotomy, required no complicated equipments or high skills, and had no mortality as that reported with herniorrhaphy **(Kelmer, et *al.*, 2008** and **Anne, et *al.*, 2010)**. At the same time it avoided complications of ruminal fistulation and cannulation (**El-Monzaly, 1975** and **Abdel-Fattah et *al.*, 2007)** as it neither caused leakage of ingesta into peritoneal cavity with subsequent peritonitis nor blemishing of the abdominal wall.

Sudden change of the food into finely-grounded grains and alfalfa or clover, legumes that rapidly digested in the rumen, resulted in a high concentration of fine particles that trap gas bubbles. Additionally, some of the soluble proteins from such plants may serve as foaming

agents **(Mary and David, 2011)**. This procedure facilitated induction of a state of frothy bloat similar to that observed with diaphragmatic hernia.

From histopathological point of view, no life threatening lesion of the rumen or cecum could be detected, and complete healing ensued at seat of anastomosis with complete epithelization.

As a result of absence of life-threatening complications of the technique, absence of important pathological changes of the rumen and cecum, simplicity of the technique that can be performed on standing position without the need of complicated equipments, we are led to concluded that this technique can be used as an alternative technique for treatment of recurrent tympany in pregnant large ruminants affected with diaphragmatic hernia, and further studies are required to evaluate it in clinical cases.

**Figure legend**

Figure 1: Left side of female goat showing the topographical anatomy of the abdominal viscera. ACP: Proximal loop of ascending colon, ACS: Spiral loop of ascending colon, C: Cecum, DC: Descending colon, DR: Dorsal ruminal sac (caudodorsal blind sac), J: jejunum, LK: Left kidney, O: Omentum, and U. Uterus. The square indicates the proper area for surgical interference

Figure 2: Left flank incision. R: Rumen and C: Cecum

Figure 3: Black arrow shows ligation of the cecum. R: Rumen and C: Cecum

Figure 4: White arrow shows suturing of the cecum to the rumen, black arrow shows ligation of the cecum, R: Rumen and C: Cecum

Figure 5: Creation of two holes of both of the rumen and cecum for anastomosis

Figure 6: Directly after connection of the rumen and cecum with removal of ligation, R: Rumen and C: Cecum

Figure 7: Seat of anastomosis 3 months post surgery, white arrow shows cecum and black arrow shows rumen

Figure 8 and 9: Complete epithelization and fusion between anastomosed ruminal and cecal walls, mild submucosal leucocytic infiltration, congestion, edema and hemorrhage. The cecum and the rumen preserved their histologic appearance (HE stain × 400)

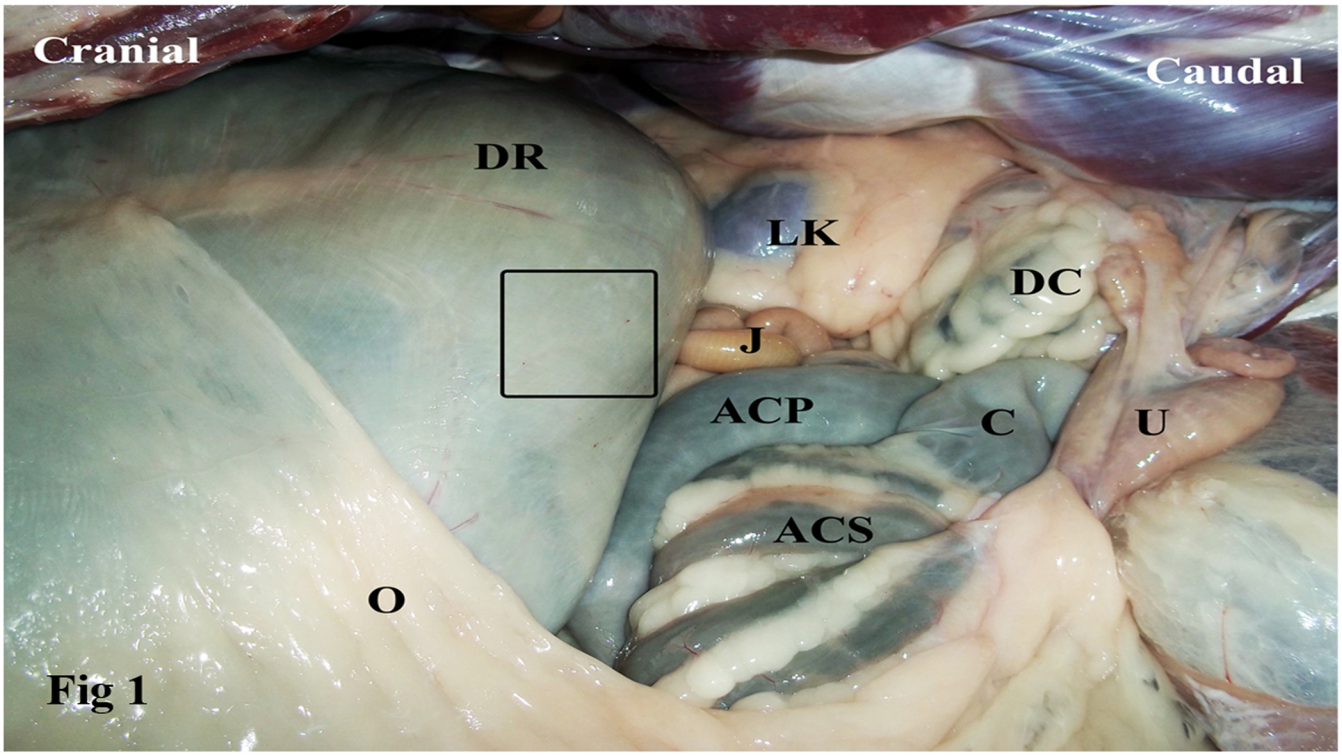

Fig 1

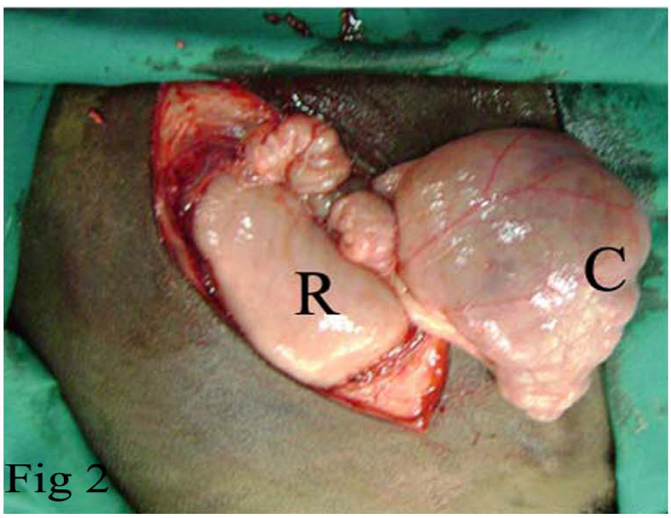

Fig 2

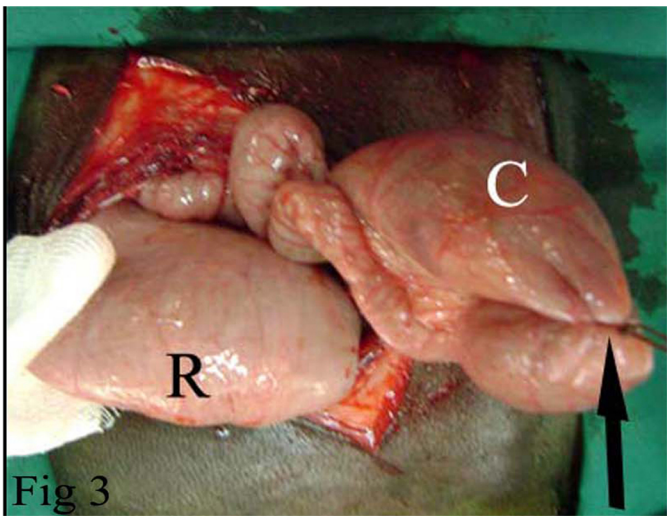

Fig 3

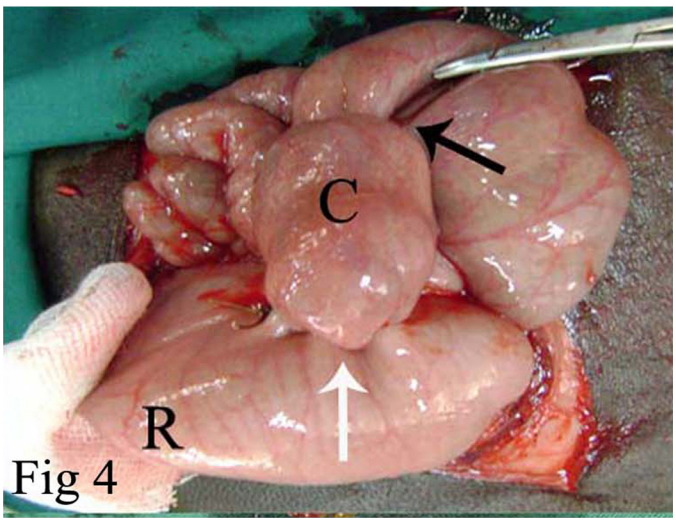

Fig 4

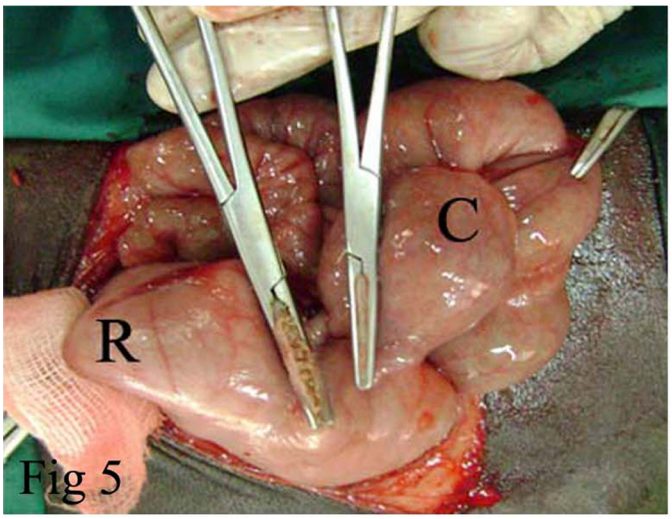

Fig 5

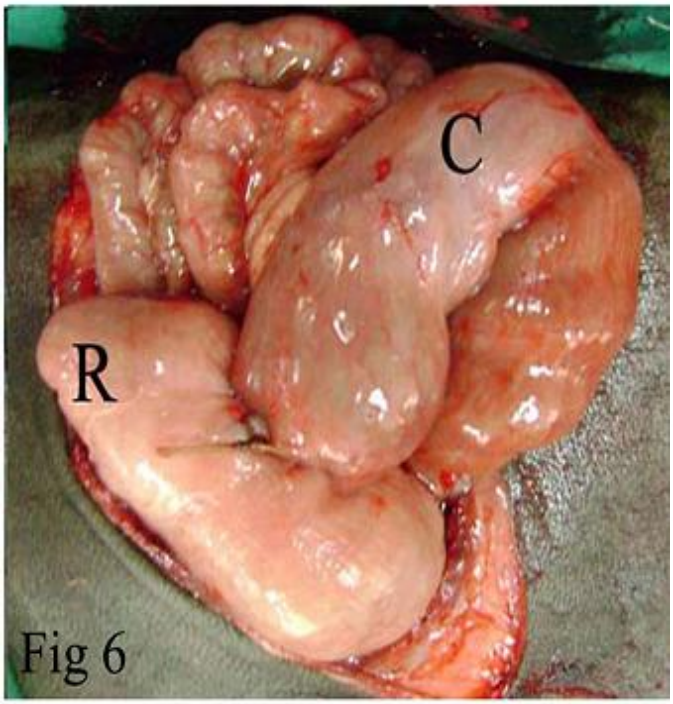

Fig 6

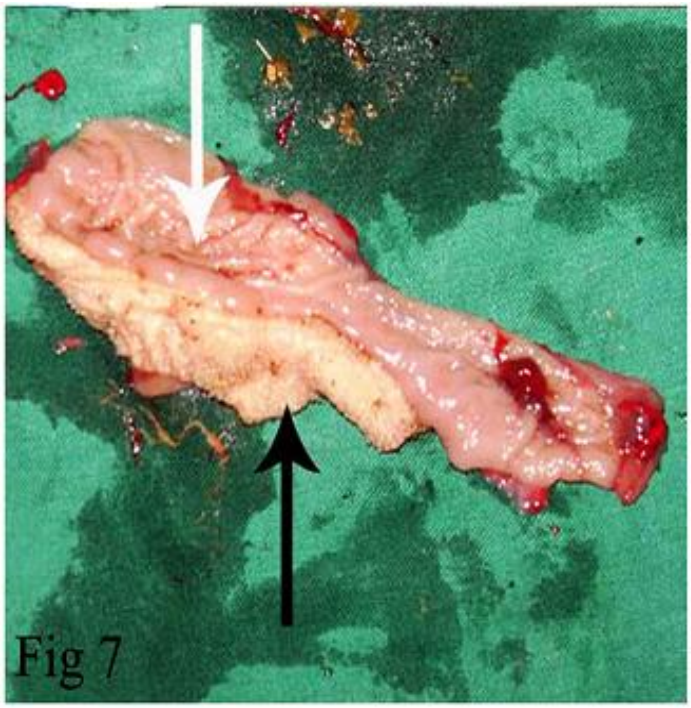
Fig 7

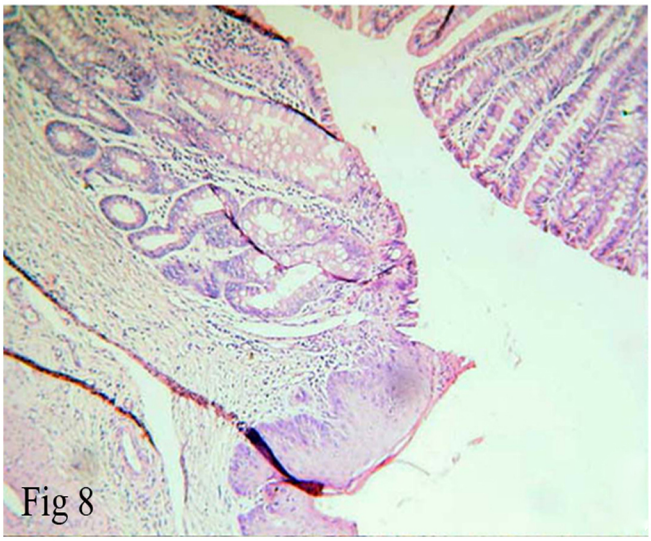
Fig 8

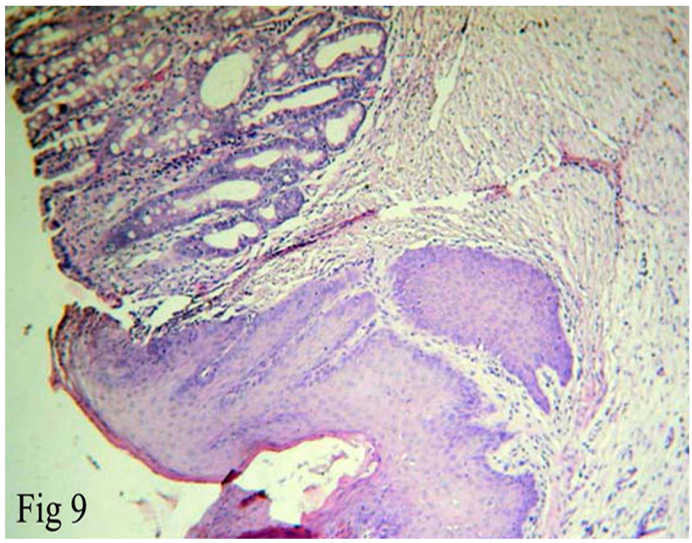
Fig 9

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**الملخص العربى**

**توصيل المصران الاعور بالكرش لعلاج النفاخ الدائم: دراسة تجريبية فى الماعز**

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تم اجراء هذه الدراسة على عدد ٧ من الماعز حيث تم استخدام ٢ منهم لعمل توصيف تشريحى لمسار المصران الاعور وتحديد افضل الطرق لتوصيله بالكرش اما باقى الحيوانات فقد استخدمت بغرض توصيل المصران الاعور الى الغرفة العليا من الكرش. بعد عملية التوصيل الجراحى للاعور بالكرش تم استحداث حالة من النفاخ الرغوى شبيهة بالنفاخ الرغوى المصاحب لحالات فتق الحجاب الحاجز وذلك لمدة ٣ أشهر. اوضحت النتائج ان التقنية الجراحية المستخدمة فى هذا البحث سهلة وبسيطة ولا تحتاج الى اجهزة معقدة بالاضافة الى عدم وجود مضاعفات جراحية خطيرة او نفوق فى الحيوانات التى تعرضت للجراحة. بعد انتهاء فترة التجربة تم جمع عينات من مكان التوصيل والاعور والكرش لفحصها هستوباثولوجيا حيث اوضحت النتائج حدوث التأم تام للجرح بعد مرور ٣ شهور على العملية مع وجود تغيرات باثولوجية بسيطة فى مكان العملية فى صورة ارتشاحات وانزفة بسيطة مع غياب للتغيرات الباثولوجية الشديدة فى باقى الكرش والمصران الاعور. لذلك يوصى باستخدام هذه التقنية لعلاج حالات النفاخ الدائم المصاحب لفتق الحجاب الحاجز فى المجترات الكبيرة بعد تقييم هذه الطريقة فى حالات اكلينيكية.