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## Research Article

# Evaluation of Experimental Gastric Endoscopic Mucosal Resection (EMR) in Dogs

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### Abstract

**Background:** Experimental Endoscopic Mucosal Resection (EMR) is a relatively new therapeutic method for resection of certain neoplastic lesions throughout the gastrointestinal (GI) tract in the veterinary practice. **Materials and Methods:** This experimental study was applied on five mongrel dogs to evaluate the technical efficacy and possible complications of such technique as well as using canine model for educational training of EMR technique. The range of resected mucosal size was 10-25 × 5-20 mm with surgical time range 32-61 min. **Results:** In the first three cases (with smaller resected mucosal sizes 15 × 10, 10 × 5 and 10 × 10 mm, respectively), there were no recorded complications. The fourth and fifth cases (with larger resected mucosal sizes 25 × 20 and 20 × 15 mm, respectively) showed postoperative vomiting. **Conclusion:** The present results were without complications such as bleeding or perforation as recorded in previous studies for human. The obtained results might be due to the application of suction followed by banding ligation.

**Key words:** Endoscopic, resection gastric, banding ligation, polyps, neoplasms, polypectomy, canine model

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**Competing Interest:** The authors have declared that no competing interest exists.

**Data Availability:** All relevant data are within the paper and its supporting information files.

## INTRODUCTION

In general, if a gastrointestinal lesion must be resected, open surgical operation, laparoscopy or endoscopic means may be used. Endoscopic methods can be grouped into two main technical categories: Ablative techniques and Endoscopic Mucosal Resection (EMR). There are several ablative techniques, among which electrocoagulation, argon plasma coagulation, laser photocoagulation, photodynamic therapy, ethanol injection therapy and cryotherapy are the most widely used<sup>1</sup>.

The EMR procedure was initially introduced by Japanese endoscopists as an alternative to traditional surgery and has lately gained favor in the West as a less invasive and equally effective method for removing certain neoplastic lesions in the GI tract<sup>2</sup>.

The EMR emerges as an important new addition to the therapeutic interventions as it plays an important role in establishing a diagnosis and treating early GI cancer benign lesions (elevated, flat and depressed lesions) with an extremely low risk of lymphatic metastasis and absence of lymphovascular invasion (e.g., adenomas) as well as sessile villous tumors ranged between 1-1.5 cm diameter<sup>3-13</sup>.

Many different types of naturally occurring cancer may affect dogs and canine malignancies have been established as strong comparative models for the human disease due to their spontaneous development and frequency dogs live in our environment and eat similar food and are thus exposed to similar risk factors, so the etiology and pathogenesis of canine tumors is likely to be similar to that of human tumors<sup>14-16</sup>.

The aim of the present study was detecting the safest and the most applicable technique for excision of gastric pedunculated or sessile polyps (sized 0.5-1.5 cm) without

complications such as bleeding or perforation as recorded in previous studies for human. Dog is considered a good model for educational training on EMR application.

## MATERIALS AND METHODS

**Animals:** The present study was performed on five male mongrel adult dogs (age ranged between 1-3 years) in accordance with the guidelines of the Animal Ethics Committee of Faculty of Veterinary Medicine, Cairo University, Giza, Egypt.

**Endoscopic imaging and animal's preparation:** The endoscopic images were captured for GIT of the inquired dogs using Eickemeyer video-endoscope unit supplied (8.5 mm diameter, 1.5 m length and 2 mm working channel) and Olympus (Tokyo, Japan insertion tube 9 mm diameter, 1 m length and 2 mm working channel video-endoscope unit. Each dog was anaesthetized by general injectable anaesthesia<sup>17,18</sup>.

**Endoscopic Mucosal Resection (EMR) materials:** Endoscopic Mucosal Resection (EMR) was employed for experimental gastric polypectomy according to Akiyama *et al.*<sup>3</sup> and Wang *et al.*<sup>12</sup>. The sclera-therapy needle (Fig. 1a) was used through the working channel and endoscopic band ligator device (cap) (Fig. 1b) was applied. There was haemostatic band (Fig. 1b) application combined with injection of hypertonic saline solution with epinephrine for hemostasis. Standard polypectomy snare (Fig. 1c) with a combination of cutting and coagulation current in a single fragment was used.

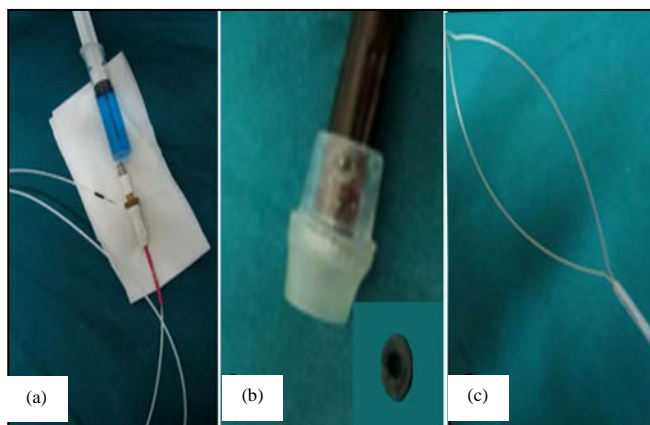


Fig. 1(a-c): Materials of EMR, (a) Mixture for injection, (b) Band ligator device (cap and haemostatic band) and (c) Polypectomy snare

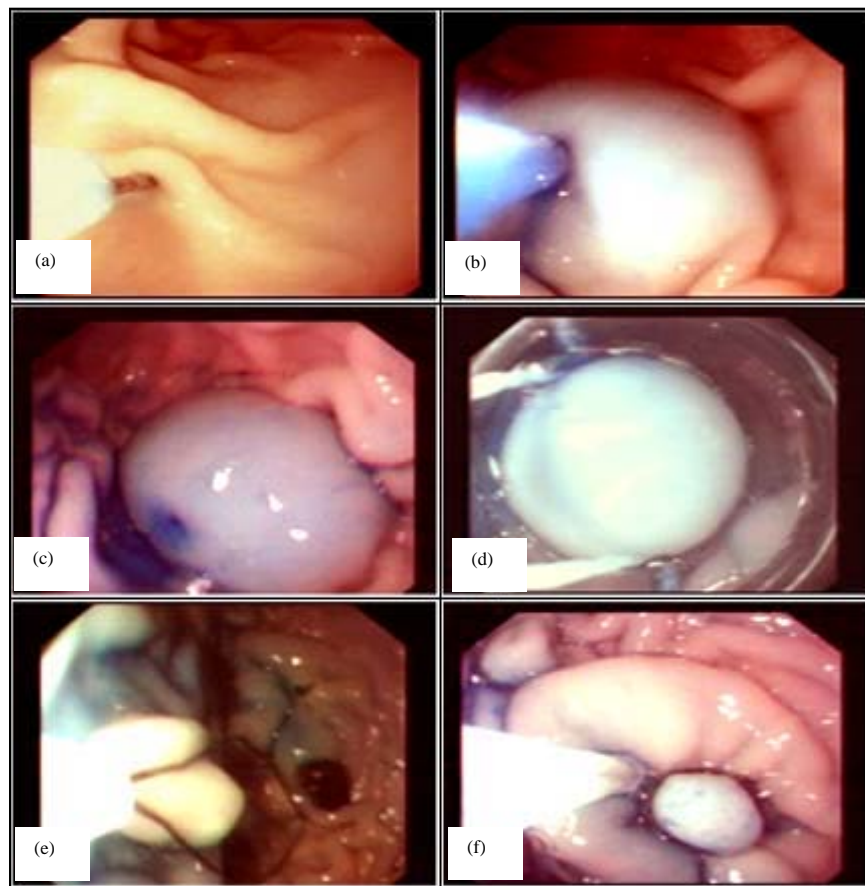


Fig. 2(a-f): Endoscopic Mucosal Resection (EMR) procedure, (a) Insertion of the needle in the mucosal fold, (b) Injection of the EMR mixture in the base of mucoal fold, (c) Formation of polyp during the injection, (d) Ligation the polyp from the base by ligation system with hemostatic band, (e) Snare tip in front of the polyp after the ligation and (f) Snaring with thermo cauterization

**Injectable solutions:** The injected mixture was normal saline (18.5 mL), epinephrine 1:100,000 (1 mL) and methylene blue (0.5 mL) for elevation the area of lesion about the healthy part, the epinephrine as haemostatic agent and methylene blue as coloring agent.

**EMR procedure:** A variceal band ligator was used to form a "Pseudo-polyp" at the fundus. Firstly, the mixture was injected in the sub-mucosa by the needle slowly at the base of the lesion (1 mL by 1 mL till the elevation was occurred) (Fig. 2a, b). Once a lesion was identified (injected amount from 5-20 mL) then out by the endoscope to apply the band ligator device with suitable band then enter to ligate at the neck of the marked area (Fig. 2c, d), following that the lesion was removed by standard polypectomy snare (Fig. 2e, f) with a combination of cutting and coagulation current in a single fragment.

**Postoperative follow up:** All cases were kept under observation for 2 weeks and were put on brief dietary rest with intravenous fluid therapy for 3 days after EMR. They got a highly digestible, bland "Hypoallergenic" diet. Also, they received proton pump inhibitors drugs (Omez®, omeprazol 20 mg b.i.d.) and systemic antibiotic ceftriaxone® (500 mg ceftriaxone sodium 50 mg kg<sup>-1</sup> IM, Novartis Pharma S.A.E. Egypt) as daily dose<sup>17</sup>.

Postoperative endoscopic follow up was performed to evaluate the EMR site in the five cases at 0, 3, 7, 14 and 21 days.

## RESULTS

The endoscopic examination of the EMR applied cases (1, 2 and 3) revealed that the site of polypectomy as circumscribed mucosal defect at the 0 day (Fig. 3a), reduced



Fig. 3(a-e): Follow up of (EMR), (a) Site of polypectomy at zero day, (b) Site of polypectomy at 1st week postoperative, (c) Site of polypectomy at 2nd week postoperative, (d) Mucous plug covered the site of EMR at 3rd day postoperative in case four and (e) Healed part striated with bile secretions after 21 days postoperative in case four

Table 1: Different size of specimens, procedural durations and recorded complications of EMR in the fundal part of canine stomach

Case No.	Size of specimen (mm)	Procedural durations (min)	Complications
1	15×10	39	None
2	10×5	32	None
3	10×10	35	None
4	25×20	61	Post operative vomiting
5	20×15	49	Post operative vomiting

Table 2: Descriptive statistics of the endoscopic mucosal resection (EMR)

Values	Procedural durations (min)	Specimen length (mm)	Specimen width (mm)
<b>n = 5</b>			
Mean	43.2	16	12
SD	11.84	6.52	5.70
SE	5.30	2.92	2.55
Range	(32-61)	(10-25)	(5-20)

size mucosal ulceration at 1st week (Fig. 3b) and complete mucosal healing with absence of the gastric rugae at the site of EMR 2nd week postoperative (Fig. 3c).

In the fourth and fifth cases, the endoscopic examination of the EMR site showed mucosal plug masking the site of EMR at 3rd day (Fig. 3d) and healed part striated with bile secretions 21 days postoperative.

There were different specimen's dimensions of the resected part of the gastric mucosa (Fig. 4a-e).

The EMR procedure was performed without recorded complications in three cases and with postoperative vomiting for two to three days was recorded in two cases (Table 1). The procedural durations of the EMR were ranged from 32-61 min in the five dogs with average  $43.2 \pm 5.3$  min (Mean  $\pm$  SE) (Table 2). The Specimen lengths and widths were ranged from 10×5-25×20 mm in the five dogs with average  $16 \pm 2.92 \times 12 \pm 2.55$  mm (Mean  $\pm$  SE) (Table 2).

## DISCUSSION

In the ESD, there is complete removal of the mucosa and submucosa so the risk of perforation has increased especially

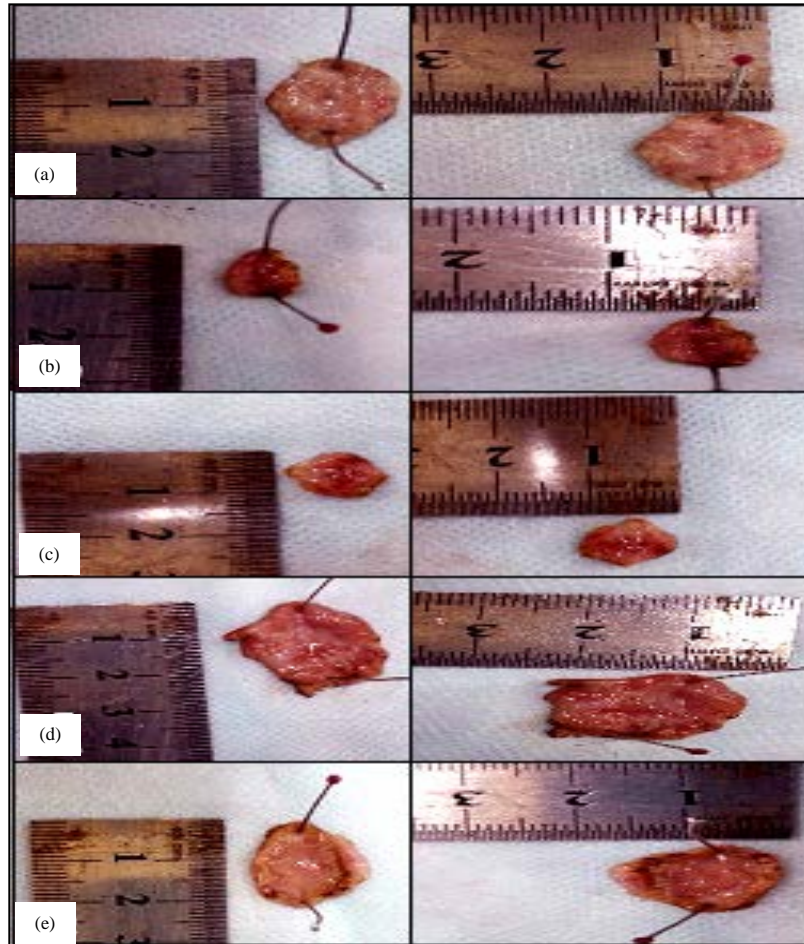


Fig. 4(a-e): EMR specimens with different dimensions, Resected specimen (a) In case (1) with 15×10 mm dimensions, (b) In case (2) with 10×5 mm dimensions, (c) In case (3) with 10×10 mm dimensions, (d) In case (4) with 25×20 mm dimensions and (e) In case (5) with 20×15 mm dimension

in thin mucosa organs. The limitations of the ESD have been considered technically difficult, hazardous and this procedure takes considerably longer than the EMR method and the dissection must be performed very carefully in order to prevent dissection deep through the muscularis propria<sup>12,19</sup>. These technical difficulties and expected complications of ESD had not been recorded in the present study using EMR. The EMR was without complications such as bleeding or perforation.

In the present study, EMR was completed without complications (hemorrhage and perforation) using the snare in five mongrel dogs. Clinically, there was no any disturbance in the general physical parameters (body temperature, mucous membrane, heart rate and the respiratory rate) which indicated that EMR did not affect the general health conditions under optimum postoperative care. The range of resected mucosal size was 10-25×5-20 mm (Table 1). In the

first three cases (with smaller resected mucosal sizes 15×10, 10×5 and 10×10 mm, respectively), there were no recorded complications. The results are in agreement with Wang *et al.*<sup>12</sup> who reported that the size of the resected lesions by EMR (pedunculated or sessile polyps) ranged between 1-1.5 cm diameter. Ell *et al.*<sup>20</sup> who mentioned that the appropriate lesions for EMR are those that are usually flat or slightly elevated, less than 20-25 mm in diameter and are limited to the mucosa. With larger resected mucosal sizes 25×20 and 20×15 mm in the fourth and fifth cases showed postoperative vomiting and it might be due to the larger resected mucosal size as Shiba *et al.*<sup>8</sup>, Oda *et al.*<sup>9</sup> and Yamaguchi *et al.*<sup>21</sup>, said that lesions ≥2 cm that are not amenable for EMR so that, the Endoscopic Submucosal Dissection (ESD) has been developed for such conditions.

The present results were without complications such as bleeding or perforation and that might due to this

experimental work carried by suction followed by banding ligation and that considers controversies to Akiyama *et al.*<sup>3</sup> Ahmad *et al.*<sup>5</sup> and Sigounas *et al.*<sup>7</sup> who said that complications associated with EMR in the stomach were bleeding in 1.2-22% of the cases (depending on the definition of bleeding) and perforation in 0-5% of the procedures in human been. These controversies may be due to the most used EMR technique in the previous researches were without suction and band application which reduce bleeding. Whereas, in the current EMR technique, the hemostasis had been carried by application of hemostatic band at base of the resected part while in the previous studies, the hemostasis was obtained in ESD by hemostatic forceps as the submucosal dissection progresses for all the visible vessels below the lesion, to prevent bleeding obstructing vision of the cutting direction and post-ESD bleeding<sup>12,19,22,23</sup>.

From the obtained data, EMR techniques enable specimens evaluation and help determine whether additional therapeutic intervention should take place depending on the depth of invasion and completeness of the resection. In contrast, the ablative techniques do not allow a specimen to be obtained for further histopathologic evaluation. These findings were in agreement with Fleischer<sup>1</sup> and Tanimoto *et al.*<sup>19</sup>.

In the present study, EMR technique showed no complications compared to the radical excisions of gastric tumors recorded by Nielsen and Anderson<sup>24</sup>. The complications recorded were temporary bleeding at the surgical site, infection, stomach ulcers, dehiscence (stomach incision opens) recurrence of vomiting and death. In addition to that, tumor recurrence or spread of the cancer was a common sequel following surgery.

The serials of the first three cases endoscopic examination showed regular stages of mucosal defect healing while in the last two cases with larger resected mucosal size showed retardation of healing, these results suggested that gastritis represented by mucosal plug masking the site of EMR at 3rd day and ended by healing with scar tissue formation.

## CONCLUSION

The EMR is more safe and applicable than the radical excision of gastric pedunculated or sessile polyps and it avoids complications of the surgery. The EMR technique was applied for the lesions sized 0.5-1.5 cm with time range 32-61 min. Dog is considered a good model for educational training on EMR application.

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