

# FEASIBILITY EXPERIMENT OF A NOVEL DEFORMABLE SELF-ASSEMBLED MAGNETIC ANASTOMOSIS RING (DSAMAR) FOR GASTROINTESTINAL ANASTOMOSIS THROUGH NATURAL ORIFICE

Miaomiao Zhang, Jia Ma, Jianqi Mao, Aihua Shi, Yi Lyu, **Xiaopeng Yan\***

E-mail: yanxiaopeng99@163.com

Department of Hepatobiliary Surgery, The First Affiliated Hospital of Xi'an Jiaotong University

## Introduction

Magnetic compression anastomosis (MCA) is a simple and safe non-suture anastomosis method associated with superior early histologic healing metrics. MCA, along with endoscopy, can be employed as a novel minimally invasive treatment model for gastrointestinal stenosis. However, the existing cylindrical or circular magnetic anastomosis devices are incapable of meeting the clinical needs of patients with digestive tract stenosis without an ostomy channel.

Inspired by previous studies, a deformable self-assembling magnetic anastomosis ring (DSAMAR) which can be deformed into magnetic ring after passing through the narrow segment of digestive tract was designed, and its feasibility was confirmed by performing animal experiments in this study.

## Materials and methods

The DSAMAR comprises 10 magnetic units, and each unit is a trapezoidal magnet with a hexahedral structure. The center of the magnetic unit has a hole along the long axis and is located on the central axis of the left and right sides, which allows the guide wire to pass through it (Fig. 1).

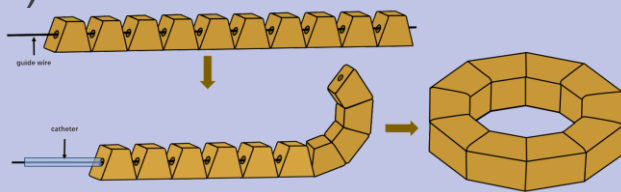


Fig. 1 Design and deformation diagram of DSAMAR.

Twelve beagles were used as animal models, and DSAMARs were inserted into the stomach and colon through the mouth and anus, respectively, via endoscopy to achieve gastrocolic magnamosis (Fig. 2). Surgical time, number of failed deformations, survival rate of the animals, and the time of magnet discharge were documented. Specimens of the anastomosis were obtained and observed with the naked eye as well as microscopically after one month.

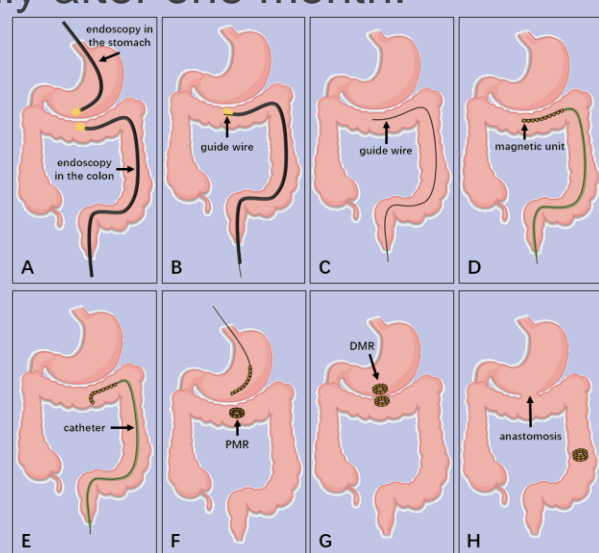


Fig. 2 Schematic diagram displaying the gastrocolic anastomosis using DSAMAR. A. Two endoscopes were placed through the mouth and anus, respectively, to determine the location for anastomosis. B. The guide wire was inserted through the biopsy hole of the endoscope in the colon. C. The guide wire was fixed and the endoscope was withdrawn. D. The catheter pushed the magnetic units to the guide wire head end. E. As the guide wire exits, the magnetic units gradually deform. F. After the successful deformation of the PMR in the colon, the magnetic units were inserted into the stomach in the same way. G. DMR and PMR attracted together. H. After the magnetic rings fell of, an anastomosis was formed. (PMR: Parent magnetic ring; DMR: Daughter magnetic ring.)

## Results

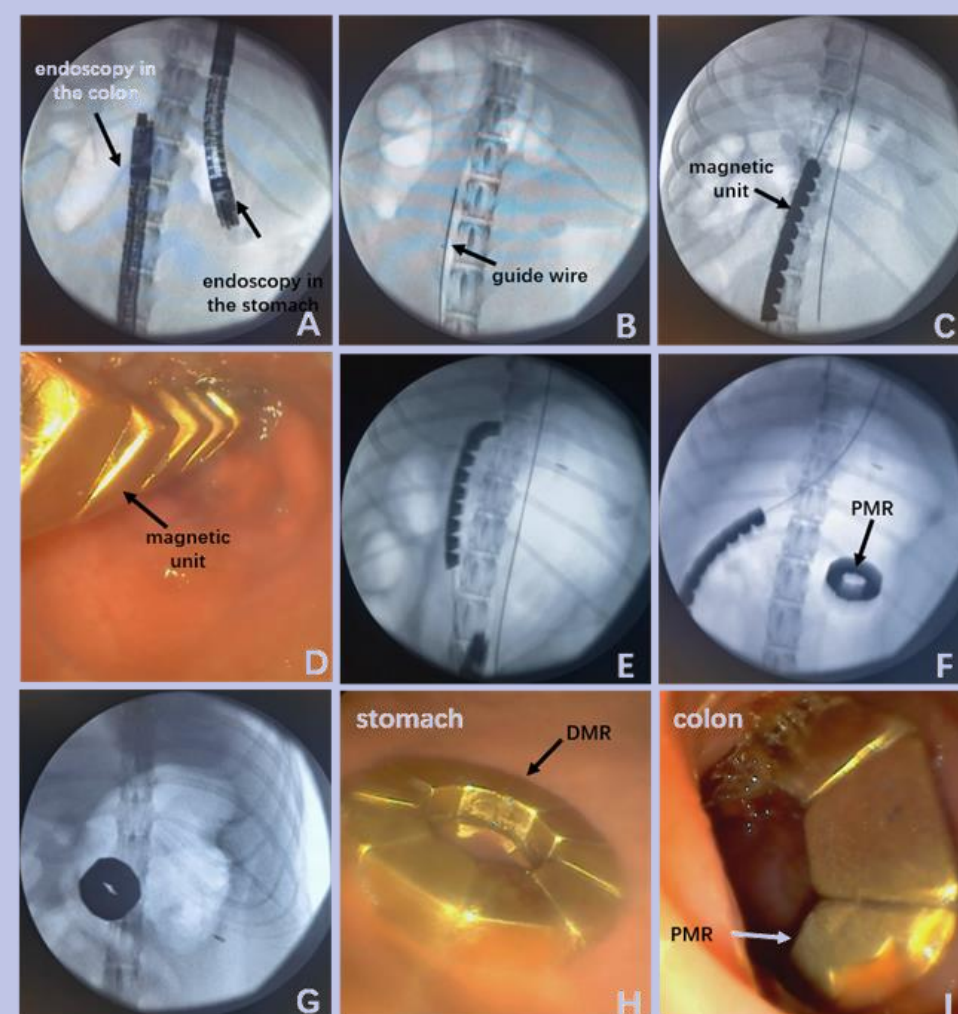


Fig. 3 The process of intraoperative operation for a representative dog. A. The specific location to be anastomosed was determined under X-ray monitoring. B. The guide wire in the colon was placed in a suitable position. C. The linear magnetic units in the colon were pushed to the head of the guide wire. D. Magnetic units in the colon were observed through endoscopy. E. The magnetic units in the colon were deforming. F, G. After the DSAMAR was placed in the stomach in the same way, the two magnetic rings attracted each other. H. DMR in the stomach was observed by endoscopy. I. PMR in the colon was shown by endoscopy.

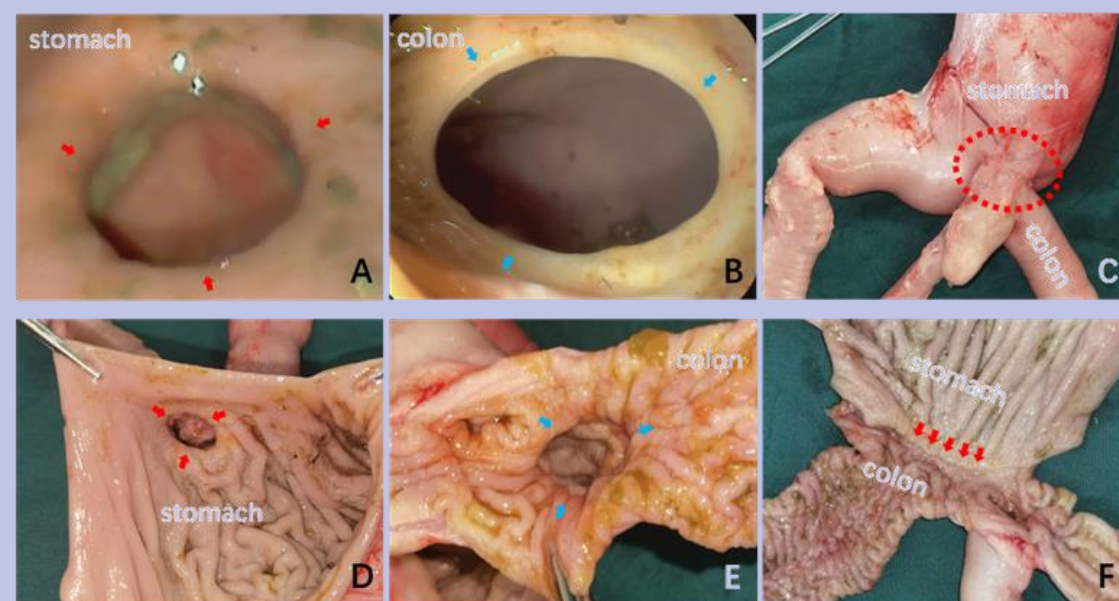


Fig.4 A gross specimen of the anastomotic of a representative dog. A. The anastomosis on the gastric side displayed by an endoscope. B. The anastomosis on the colon was observed by the endoscope. C. The serosal layer of the anastomosis. D. The mucosal layer of the anastomosis was observed from the gastric side. E. The mucosal layer of the anastomosis was observed from the colonic side. F. The mucosal layer of the anastomosis was observed after a longitudinal dissection.

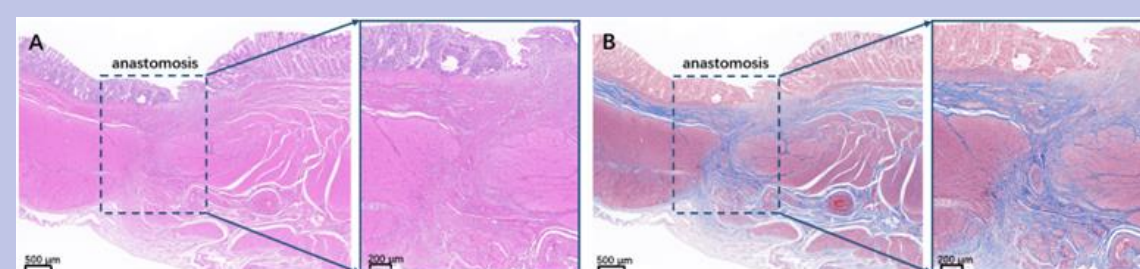


Fig. 5 Histological specimen of the anastomosis. A. HE staining (2.0x). B. Masson's staining (2.0x).

## Conclusion

DSAMAR is an ingeniously designed and easy-to-operate magnamosis device, and this study demonstrated the feasibility of performing gastrocolic magnamosis completely via endoscopy.