Magnetic Compression Anastomosis
An Emerging Technology for Gastrointestinal Surgery

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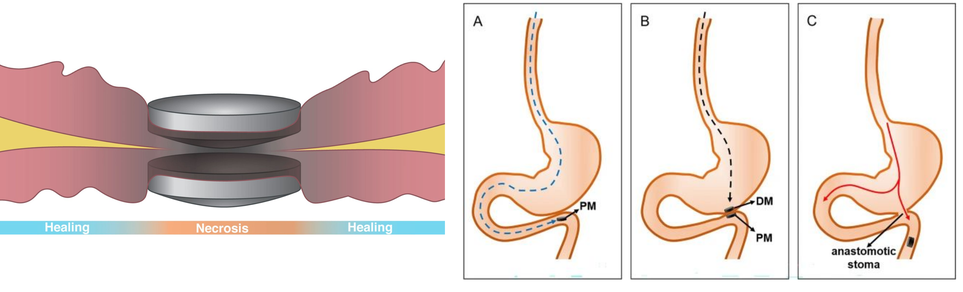
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Introduction

Magnetic compression anastomosis (MCAs) is a developing approach to gastrointestinal anastomosis creation. The technology employs use of intraluminal magnets that impose force against the wall of the GI tract, leading to development of a fistula over the course of days. Early studies suggest that MCA has comparable outcomes to traditional surgical techniques (i.e, suture, staples) with the theoretical benefit of no retained foreign body. There must be further investigation regarding appropriate patients & procedures for MCA to demonstrate its efficacy.

Methods

A comprehensive literature review was performed in PubMed for articles published in English pertaining to MCA use in human patients. 48 articles resulted. 3 were removed as they only discussed animal trials. 1 was removed as only the article abstract was in English.



Results

Techniques

- The types of magnets typically utilized are either circular or flat in shape and are either have hollow rings or solid throughout. Magnetic compression induces central necrosis while the peripheral tissue forms into a fistulous tract. The magnets then are free to pass through the gastrointestinal tract.
- Techniques for delivery and coupling of magnets varied highly depending on the anatomic site of each planned anastomosis
- A combination of endoscopy & fluoroscopy was commonly used throughout many procedures. Laparoscopy can be used to assist in pulling the magnet to its target site.
- For biliary anastomoses, magnets were most often delivered fluoroscopically through an IR biliary tube with the distal magnet placed endoscopically
- In some cases, magnets were placed manually or laparoscopically through enterotomy

Clinical Applications

Subspecialty	Procedures/Surgeries
Bariatrics	● Duodenal ileal anastomosis with or without concurrent sleeve gastrectomy
Biliopancreatic	● Whipple hepaticojejunostomy and pancreaticojejunostomy ● Strictures associated with surgery, transplant, or cholangiocarcinomas with: ○ Creation of an anastomosis directly through stricture OR ○ via bypass of obstruction with hepatico-/choledocho-jejunostomies.
Colorectal	● Bowel obstructions caused by: ○ Hostile abdomens ○ Diverticular strictures ○ Anastomotic strictures
Foregut	● Esophageal diverticulum ● SMA syndrome ● Malignant obstructions ● Anastomotic strictures.
Pediatric	● Esophageal or rectal atresia ● Hirschsprung's disease ● Ileostomy reversal

Safety and Adverse Events

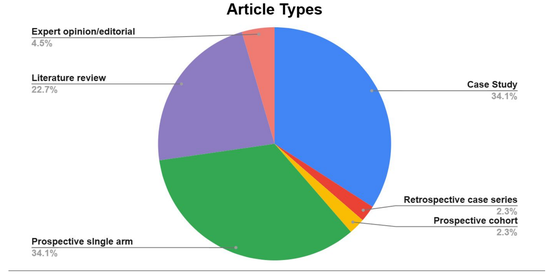
- Theoretical risks included heavy metal toxicity, compression of large blood vessel resulting in hemorrhage, or leak.
- Metal toxicity was not reported. One study reported bleeding secondary to ischemic bowel not caused by the device. Only one study reported a leak at a biliary MCA site. Other reported leaks were secondary to gastrectomy staple line leaks or serosal injuries suspected to have occurred during magnet positioning.
- Most common reported adverse events were GI distress, diarrhea or abdominal discomfort. Other reported adverse events included bowel obstructions, perforation secondary to dilation of anastomotic stricture, cholangitis & device failure.
- Deaths typically occurred in patients with malignancy and were attributed to their malignant disease process.

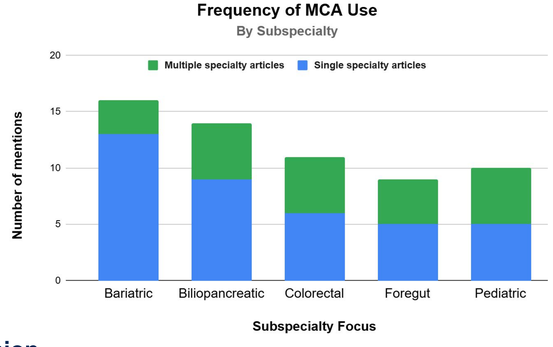
Efficacy and Feasibility

- Efficacy was measured by patency of anastomosis (assessed with endoscopy or fluoroscopy), degree of stricturing, hospital length of stay & readmission rate.
- In bariatrics, efficacy was measured by reductions in Hgb A1c, fasting blood glucose, use of antihyperglycemics, weigh & BMI. Additionally measured quality of life improvement, & with a technetium study to assess percentage of food passing through anastomosis.
- All studies reported the procedures as efficacious.
- Feasibility measures included time to perform the procedure, serial decrease in procedure time over the study periods, and successful positioning of the magnets.. All studies that discussed feasibility concluded the MCA was feasible.

Strength of Evidence

- Most studies reported lack of strength due to low sample size. The largest study reviewed contained 43 patients. There is a need for larger volume studies in the future
- Most articles were case studies. The vast majority of trials were single center trials. No randomized trials were reviewed. Of the cohort studies, almost all were single arm studies without a control group. Editorial comments and review articles were also included in this review.
- Bariatric studies attempted prospective studies, however had stringent inclusion criteria, which limited the volume of patient in these studies
- The overall low statistical power raise concerns about the generalizability of the conclusions drawn in these studies in regards to safety, feasibility and efficacy. Larger scale, randomized studies are needed in order to compare MCA against the current standard of care.





Conclusion

MCAs are an emerging technology in the world of gastrointestinal surgery. It seems unlikely for them to fully replace stapling or hand sewn techniques, however they will likely continue to be more commonly utilized and tested in a multitude of areas within the gastrointestinal surgical world with their niche becoming more apparent as studies continue and gain statistical power.