NEW METHODS

Impact of magnetic steering on gastric transit time of a capsule endoscopy (with video)

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Backgrounds and Aims: Delayed gastric transit of the capsule may lead to incomplete small bowel examination, reducing the diagnostic yield. Thus, this study was designed to determine if magnetic steering could enhance capsule gastric emptying and mucosal visualization within the duodenum.

Methods: The intervention group comprised 100 patients undergoing magnetic-controlled capsule endoscopy between May to September 2017 in whom magnetic control was used to assist transpyloric passage of the capsule and duodenal inspection. A cohort of 100 patients who had undergone the procedure before May 2017 was randomly selected from the database as an historic control group in whom transpyloric movement of the capsule occurred spontaneously (without magnetic assistance). The difference in the pyloric transit time (PTT) and duodenal papilla detection rate (DPDR) between the 2 groups were compared, and related factors were also investigated.

Results: Transpyloric passage of the capsule under magnetic control was successfully performed in 59 patients (59%). Median PTT was greatly reduced in the intervention group from 58.38 minutes (range, 13.45-87.47) to 4.69 minutes (range, 1.56-55.00; $P < .001$), and DPDR was also greatly improved with magnetic steering (30.5% vs 9%, $P < .001$). Magnetic steering, male gender, and higher body mass index were independently associated with reduced gastric transit time and magnetic steering with an enhanced DPDR.

Conclusions: Magnetic steering of the capsule can enhance gastric emptying of the capsule and may prove useful in nonobese and female patients who appeared to have longer gastric transit time and achieved a better DPDR than that under the action of peristalsis alone. (Clinical trial registration number: NCT03441945.)

Capsule endoscopy (CE) is noninvasive, painless, and safe and is a valuable diagnostic tool for small bowel diseases, including inflammatory bowel disease, suspected polyposis syndromes, unexplained abdominal pain, celiac disease, and obscure GI bleeding.[1] However, incomplete examination of the small bowel may reduce the diagnostic sensitivity. According to previous reports, the noncompletion rate of small-bowel examination can be up to 13%,[2-5] in part because of slow gastric transit, limited battery life, and poor bowel preparation. Delayed gastric emptying is believed to account for 30% of the incomplete small-bowel CE procedures.[4]

Furthermore, there is concern about the diagnostic sensitivity of CE in the duodenum. The major duodenal papilla,

Abbreviations: BMI, body mass index; CE, capsule endoscopy; DPDR, duodenal papilla detection rate; GTT, gastric transit time; MCE, magnetic-controlled capsule endoscopy; PTT, pyloric transit time.

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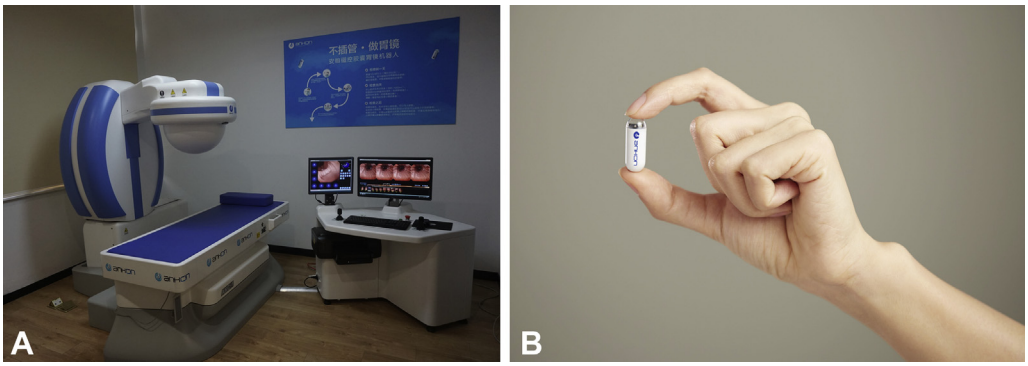

Figure 1. The Navicam magnetic control system (Ankon). It contains an endoscopic capsule, a data recorder, a guidance magnet robot, and a computer workstation. **A,** Guidance magnet robot and workstation. The magnetic field generated can be adjusted and can reach a maximum of 200 mT. The capsule can be controlled with the synchronized rotation of the external magnetic robot and the variable magnetic field. The computer workstation is designed for real-time viewing and controlling. The capsule can be controlled either manually by a magnet robot through a joystick or automatically by default mode on the control panel. **B,** The capsule endoscope. The capsule has a size of 26.8 × 11.6 mm, with a weight of 4.8 g. It has a battery life of more than 8 hours, offering a viewing field of 151 degrees. Images are captured at a rate of 2 frames per second with a resolution of 480 × 480 pixels. It contains a CMOS image sensor; with that the LED light exposure time are adjusted automatically to optimize the brightness and contrast of the images. *CMOS*, Complementary metal oxide semiconductor; *LED* to light emitting diode.

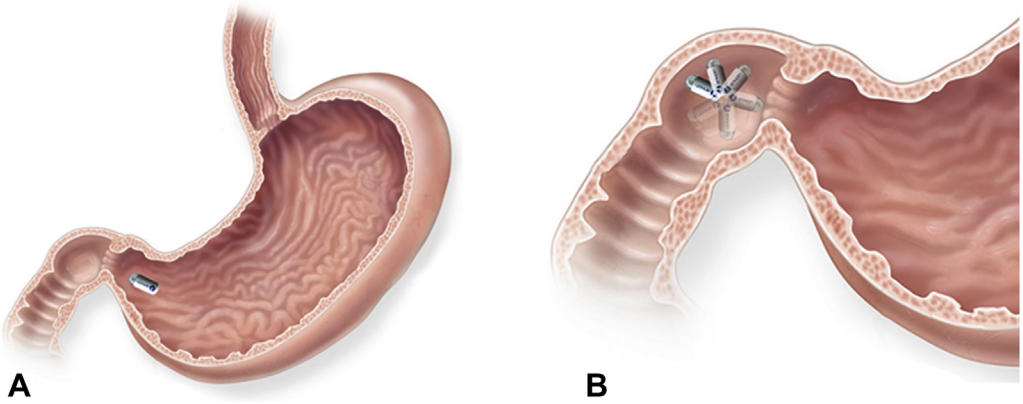

Figure 2. Schematic diagram showing magnetic control of the capsule. **A,** The endoscopist rotated the capsule until the camera end faced the pylorus. **B,** In the duodenal bulb, the "360-degree automatic scanning" model was used during the procedure.

7 to 10 cm from the pylorus on the posteromedial wall of the descending part of duodenum, is a landmark in the duodenum, and the detection of the duodenal papilla has been regarded as a surrogate indicator of diagnostic yield in the proximal small bowel. However, it was infrequently identified by CE.[6-8] Furthermore, the detection of the duodenal papilla played a significant role in the detection of adenomatous polyposis[9] and intestinal type intraductal papillary mucinous neoplasm of the pancreas.[10] Thus, enhancing capsule gastric emptying and duodenal papilla detection may improve visualization and completion of small-bowel examination. Approaches aimed at achieving these goals to date include the development of a wider angle of view,[9] faster adaptable frame rate,[7,8] longer battery life,[11] positional change,[12] prokinetics,[13,14] chromoendoscopy,[15] and a 3-dimensional localization method.[16]

Magnetic-controlled CE (MCE) has been used in clinical practice since 2010. With external magnetic fields to guide and orientate the capsule in a fluid-distended stomach, it is noninvasive, requires no sedation, incurs no risk of cross-infection, is easy to perform, and has comparable diagnostic accuracy with EGD in gastric examination.[17,18] Therefore, this study was performed to determine whether magnetic steering could improve small-bowel examination by enhancing gastric emptying and detection of the major duodenal papilla, which may help to improve the completion and mucosal visualization during small-bowel examination.

METHODS

Study design

Consecutive patients undergoing MCE were compared with the same number of historical control subjects. The study was approved by the ethics committees at Changhai Hospital, Shanghai, China, according to the Helsinki Declaration. Written informed consent was obtained from all patients.