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Is Endoscopic Mucosal Clipping Useful for Preventing Colonic Probe Displacement?

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Abstract

Goal—To examine whether endoscopic mucosal clipping prevents probe migration.

Background—Ambulatory colonic manometry can provide useful pathophysiologic information regarding colonic motor function. However, probe displacement during prolonged recording can be problematic.

Methods—Thirty healthy volunteers, underwent 24-hr ambulatory colonic manometry with colonoscopic-assisted probe placement, and fluoroscopic confirmation of the location of most proximal sensor at hepatic flexure. Subjects were randomized to 2 groups; in 14 subjects (m/f= 8/6), the probe was anchored to the colonic mucosa using mucosal clips and in 16 subjects, (m/f= 9/7), the probe was left unattached in the colon. Magnitude of transducer displacement was assessed by fluoroscopic localization. The difference between the number of transducers in each segment at the beginning (x) and at the end (y) of each study was summed up and divided by 2, to calculate the 'displacement score' and this was taken as the main outcome measure.

Results—In subjects without clipping, the mean (s.d.) displacement score was 1.6 (0.9), implying displacement of transducers by 1.6 colonic segments relative to their initial location. In contrast, there was no displacement of transducers in those who received clipping. Clipping caused no adverse events.

Conclusions—Endoscopic mucosal clipping is safe and effective for prevention of probe displacement, and ensures more accurate temporospatial resolution of data for prolonged colonic manometry recording.

Keywords

Mucosal clipping; ambulatory colonic manometry; probe displacement

Introduction

The motor activity of the colon is complex, intermittent and varies between different colonic segments.[1-4] It also shows significant temporal and spatial variations.[5] Consequently, short-duration manometry studies from a limited region of the distal colon are less likely to provide pathophysiologically relevant information.[5] Prolonged ambulatory colonic manometry, with multiple recording sites from different colonic segments may provide a more comprehensive and useful pathophysiological information regarding colonic motor activity. Using this

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technique, we have described seven different motor patterns in the colon of normal healthy subjects, as well as diurnal variation and a characteristic increase in motor activity after awakening and food ingestion.[5] This technique has also been used for studying colonic motor activity in patients with idiopathic slow-transit constipation,[6] irritable bowel syndrome,[7] fecal incontinence [8] and inflammatory diarrhea.[9] Colonic manometry may provide a better understanding of physiology and pathophysiology of colonic motor function and defecation disorders.

Colonic manometry involves placement of intraluminal pressure sensing catheter into the colon, especially to evaluate the temporo-spatial relationships of colonic contractile activity. Three methods have been described for colonic manometry: nasal intubation with migration of probe into the colon,[1,10] guide wire-assisted water-perfused probe placement [8,11] and retrograde direct probe placement.[5,11-14] In the latter two techniques, a colonoscope is used to place a guide wire or to advance the probe under direct vision.

The drawback of prolonged ambulatory colonic manometry is intra-colonic probe migration, from one colonic segment to the other.[5,13,15] In order to overcome probe displacement, intraluminal probe fixation is desirable. Although anchoring the manometry catheter to the colonic mucosa with hemostatic clips has been described, there has been no systematic evaluation of the efficacy of this technique. [6,16]

Here, we assessed the utility of endoscopic mucosal clipping as a method of improving spatiotemporal resolution of transducers and maintaining sensor location in the colon, by a randomized case-control study in healthy subjects undergoing prolonged ambulatory colonic manometry.

Methods

Subjects

Thirty healthy volunteers (17 men, 13 women; mean age 29 yrs, range 21-39 yr) were recruited through a hospital advertisement. All subjects gave written informed consent, and the study protocol was approved by the Human Ethics Review Board and the Radiation Protection Committee. The volunteers had no previous history of gastrointestinal symptoms or surgery, were not taking any medications, and had normal physical examination. They all reported normal bowel function.

Manometry Assembly

We used a 6-mm-diameter flexible probe containing six strain-gauge pressure transducers (Gaeltec, Dunvegan, UK). For the purposes of manometric measurements, the colon was divided into six segments, namely, the proximal (1) and distal transverse colon (2), splenic flexure (3), descending colon (4), sigmoid colon (5) and rectum (6). These transducers were so placed that they lay in the middle of each colonic segment and at approximately 70, 55, 40, 25, 15, and 7cms, respectively, from the anus (Figure 1).

Experimental Design

Subjects were admitted to the Clinical Research Center after an overnight fast. At 7:00 AM, they received a tap water enema. Thereafter, with the use of the following technique, the manometry probe was placed in the colon. A silk thread was tied to the tip of the probe. The thread was grasped by a polypectomy snare that was introduced through the biopsy channel of a pediatric colonoscope (Olympus GIFC10). The snare was pulled back so that its tip lay 2-3 cm inside the distal end of the instrument. No sedation was used. The probe and the colonoscope were advanced under direct vision up to the hepatic flexure, with minimal air insuflation. Once the location of the probe was confirmed by fluoroscopy, the silk thread was released, freeing the probe and the snare was removed.

The subjects were then randomized to receive either endoscopic mucosal clipping where the probe was fixed to the mucosal or the probe was left in sites without any fixation. After placement of the tip of the probe at the hepatic flexure and confirmed fluoroscopically, a clip-fixing device was introduced through the biopsy channel and the silk sutures located at the tip and at three other sites on the probe were clipped to the colonic mucosa using mucosal clips (Olympus America Inc, Melville, NY) (Figure 2). Subsequently, the colonoscope was withdrawn, care being taken to remove as much air as possible. The probe was then taped securely to the gluteal region.

After probe placement, the patients were free to ambulate throughout the study. During the study, the subjects received three standard meals, a 400-kcal snack at 10 AM following probe placement and two standardized 1,000-kcal meals, one each at 6 PM on the same day and at 10 AM the next morning. The patients were allowed free access to water (maximum 1.5 l/24 h) but were prohibited from drinking alcohol. The probe was *in situ* from 9 AM till 2 PM on the next day. At the end of the study, the probe was pulled out easily by gentle tugging and without endoscopy in all cases.

Probe displacement and data analysis

At the end of 30 hrs, repeat fluoroscopy was performed to assess the presence and extent of probe/sensor migration in both groups (Figure 3). The total radiation exposure for each individual did not exceed 1,144 μrad. Fluoroscopic images were saved and sketches were drawn based on the fluoroscopic images, both at the time of probe placement and at repeat fluoroscopy the following day, just prior to probe withdrawal. The initial and final images and sketches were compared to determine the transducer location and displacement for each study. The differences between the number of transducers in each segment at the beginning (x) and at the end (y) of each study were summed up and divided by 2 to assess the number of transducers that were displaced [Σ(x-y)/2], and to calculate the ‘displacement score’. This method allowed detection of significant displacement from one functional colonic segment to the next but does not detect simple displacement of the transducer within the same segment.

Statistical analysis

The number of subjects in whom there was some displacement of transducers was compared in both groups. Difference between the two groups for qualitative variables was tested using chi-square statistics. All analyses were performed using Microsoft Excel 2007 software.

Results

Subjects

We recruited 30 subjects of whom 14 subjects (m/f = 8/6) received endoscopic mucosal clipping and 16 subjects (m/f = 9/7) had the probe left in the colon without fixation. In two subjects who did not receive probe fixation, the probe was extruded with a bowel movement, within 4-8 hours, during the course of the study and these subjects were excluded from the analysis. Thus, data from 14 subjects each, with or without probe fixation, were analyzed and compared.

Effect of mucosal clipping on probe location

Overall, there was no significant displacement of transducers in the 14 subjects in whom the probe was fixed to the colonic mucosa. The mean transducer displacement score was zero. In contrast, among the 14 subjects who did not receive mucosal clipping, there was significant

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probe displacement. The mean (s.d.) transducer displacement score was 1.6 (0.9). This suggests that between the placement and completion of the study, the probe migrated on average by at least 1.6 colonic segments (Figure 4).

There was some probe displacement, as assessed by comparison of the initial and final fluoroscopic images of probe, in 1 out of 14 subjects who received mucosal clipping as compared to 12 out of 14 subjects who did not receive probe fixation [Chi-square=17.4; $p<0.001$].

Adverse Events

The process of initial mucosal clipping during probe fixation was not associated with any adverse event in the 14 subjects who received clipping. The post-procedure removal of the probe was not associated with any significant adverse effects. One subject had mild anal trauma from an open clip during probe withdrawal, which resolved.

Discussion

The pathophysiology of colonic motor disorders is poorly understood. This is related in part to the relative inaccessibililty of the organ as well as regional differences in colonic structure and function. Patients with intractable symptoms will require further testing to elucidate an underlying cause for colonic dysfunction and to better direct therapies.[17] Colonic manometry is one such tool that has been underutilized in the assessment of colonic disorders. Prolonged ambulatory colonic manometry has been used to better understand colonic dysfunction in IBS,[7] fecal incontinence,[8] diverticular disease [18] and chronic constipation [6] and in pediatric colorectal disorders.[19]

One of the limitations of prolonged colonic manometry is intra-colonic probe migration from one segment to the other, or significant displacement during the course of recording.[5,13,15] The incidence of significant probe migration in studies using the transanal approach varies from 5-25%, resulting in several failed procedures.[5,8,20,21] Sometimes, this also results in probe extrusion as was observed in two subjects in our study who did not receive probe fixation. This is expected considering the continuous, propulsive as well retropulsive, intrinsic colonic motor activity. Given the significant efforts, costs and technical challenges involved in the placement of colonic manometry probe, either significant migration or probe extrusion carries a substantial impact on the ability to perform this test. Because of probe displacement, data obtained from such studies can be inconsistent and inaccurate for studying temporo-spatial relationships of colonic motor activity. Furthermore, probe expulsion renders the colonic study useless resulting in loss of subject- and physician-time and wasted resources.

We found that clipping of the manometry probe to the colonic mucosa prevented displacement of the probe in virtually all subjects, and thereby improved the quality of manometry recording. In contrast, there was significant migration of the transducers from one functionally relevant colonic segment to the next in subjects who did not receive probe fixation. This resulted in a less accurate manometric recording, and required post-hoc adjustment of data from different transducers, in order to more accurately quantify pressure activity.

Mucosal clipping in the colon has been used for various purposes: to mark out clinically significant areas during colonoscopy,[22] treatment of colonic diverticular bleeding[23,24] and treatment of small colonic perforations.[25] Endoclips have also been used to secure feeding tubes and esophageal prosthesis.[26,27] Here, we describe a novel use for endoscopic mucosal clipping for prevention of probe migration during prolonged ambulatory colonic manometry. Endoscopic mucosal clipping ensured that there was no probe displacement even over a 30-hr period in ambulatory patients.

In the only other small published study on endoclips in colonic manometry, six subjects underwent successful placement of mucosal clips, with no apparent migration of catheter assembly as demonstrated by repeated abdominal radiographs and recordings that were carried out over a mean period of 74 hrs.[16] Furthermore, similar to our finding, they reported that clipping was not associated with any complication. In another small study of colonic manometry, placement of hemostatic clips has been described using a technique similar to ours.[28] However, in both of these studies, there was no systematic assessment of the efficacy of clipping. Furthermore, unlike our technique, the method of probe placement, used by Fajardo *et al*, involved an elaborate procedure that utilized two colonoscopies, the first to remove residual liquid and stool, after bowel cleansing, with subsequent repeat colonoscopy for placement of manometric catheters.

In conclusion, we have demonstrated that endoscopic mucosal clipping is safe and an effective technique of preventing probe migration during prolonged ambulatory colonic manometry. Our method is simple and easy to perform and ensures accuracy and reliability of manometry recording from multiple colonic segments. Although clipping will add some extra procedural time, approximately 15-20 minutes, and costsits benefits far outweigh the time lost, especially if the probe were to be extruded or significantly displaced. We recommend that mucosal clipping be routinely used as an adjunct for probe placement during colonic manometry.

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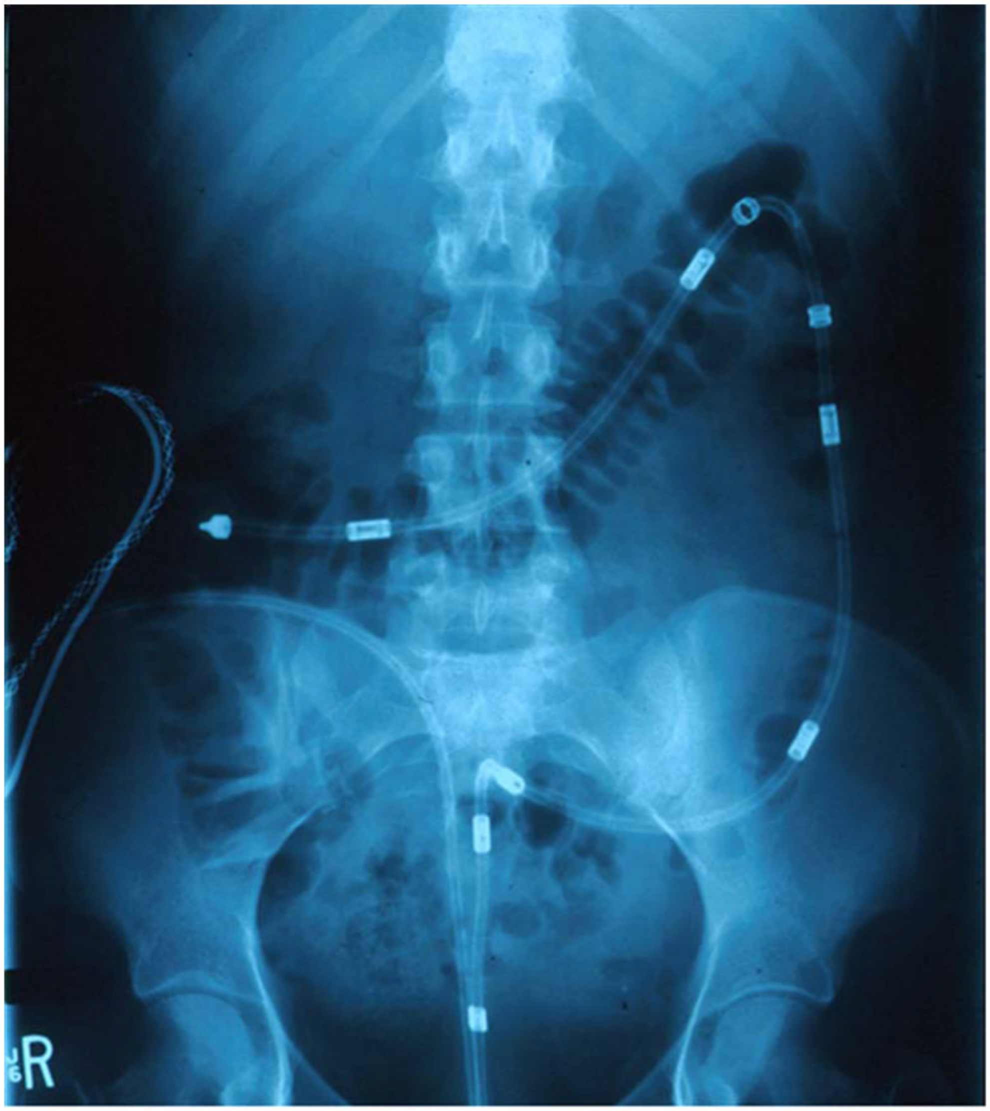

Figure 1.
Abdominal X-ray shows typical location of sensors after probe placement in the colon.

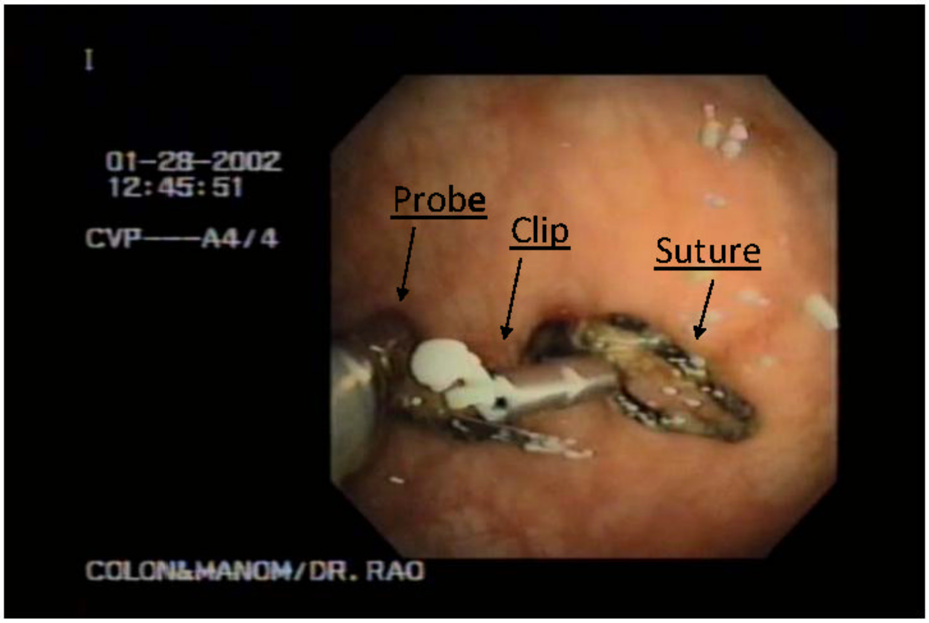

Figure 2.
This shows clipping of the silk suture located on the probe to the colonic mucosa.

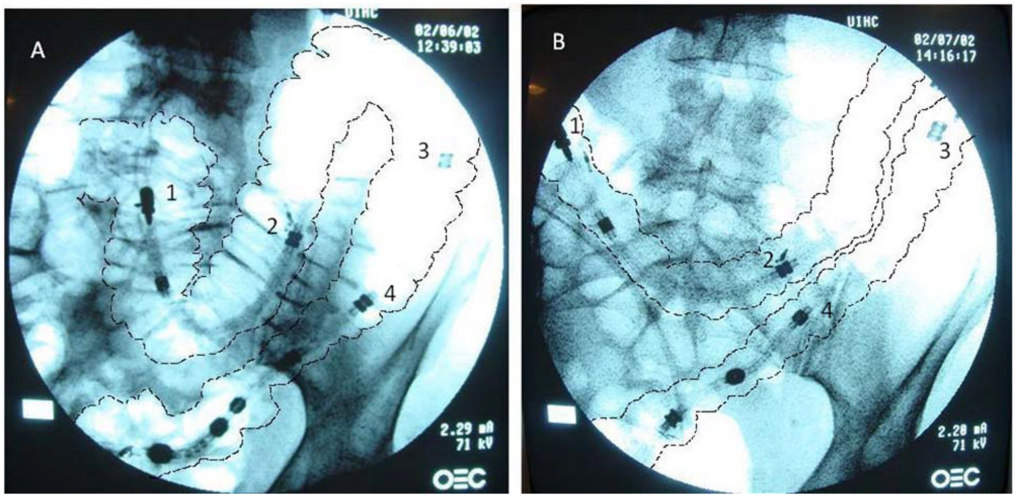

Figure 3.
Typical example of fluoroscopic images obtained during colonic manometry recording in a single subject after mucosal clipping, at the beginning (A) and at the end (B) of a 24 hour colonic manometry recording. The figure shows the colonic silhouette and the 4 sites where clips were placed: 1 – hepatic flexure, 2 – distal transverse colon, 3 – splenic flexure, 4 – descending colon. As can be seen, although the colonic configuration changed during the course of recording, the probe remained at the same location, at the end of the recording, without any displacement.

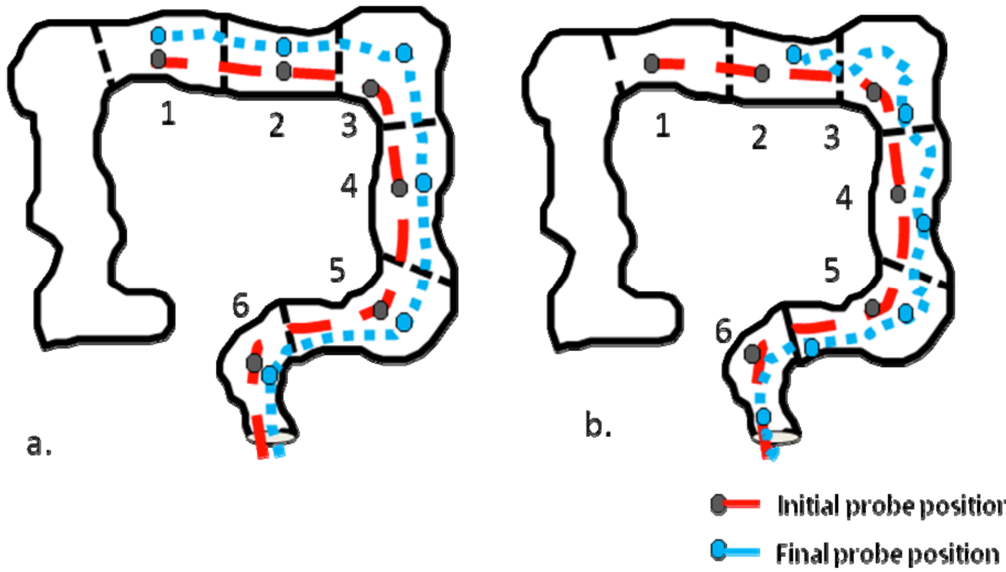

Figure 4.
Graphic reproduction of the mean sensor location, before and after 24 hr-colonic manometry in patients (a) with mucosal clipping, and (b) without mucosal clipping. Numbers 1 to 6 represent the six functional segments corresponding to the transducer location at study commencement: proximal (1) and distal (2) transverse colon, splenic flexure (3), descending colon (4), sigmoid colon (5), and rectum (6).