

Prolonged Intestinal Transit Time and Its Relation with Capsule Endoscopy Diagnostic Yield

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ABSTRACT

Background: Capsule endoscopy is a gold standard diagnostic method for small bowel lesions. There is scarce evidence regarding variables that may increase the odds of identifying small bowel lesions with this endoscopic method. The aim of this work is to describe variables associated with a higher probability of finding small bowel lesions on capsule endoscopy.

Methods: Cross-sectional study was performed using our Department's adult patients' capsule endoscopy database. The presence of any small bowel mucosal lesion was registered. Other variables were examined: age, gender, reason for referral, quality of bowel cleansing, and intestinal transit time. These variables were compared between those patients showing at least 1 lesion versus those without lesions. Univariate and multivariate analysis was performed to determine variables significantly associated with the presence of bowel lesions.

Results: In total, 140 studies were analyzed; 90% were performed due to occult gastrointestinal bleeding. Median age was 69 years (60-75); 54.29% were males. Bowel cleansing was adequate in 94.29%; 68.57% showed at least 1 lesion. Non-significant difference was observed in terms of age between groups of comparison (70 [61-76] vs 63 [59-74], $P = .07$). No difference was found comparing bowel cleansing, gender, or reason for referral. Intestinal transit time was significantly longer among those patients with a bowel lesion (359 minutes [257-427] vs 279 minutes [200-333], $P = .05$). On multivariate analysis, age and intestinal time were significantly associated with the presence of at least one small bowel lesion (odds ratio 1.02 [1-1.06] and 1.09 [1.03-1.12], respectively).

Conclusion: Age and intestinal transit time were significantly associated with the presence of abnormal findings on capsule endoscopy.

Keywords: Capsule endoscopy, intestinal transit time, small bowel lesions

INTRODUCTION

Small bowel capsule endoscopy (SBCE) has become the gold standard for the diagnosis of mucosal lesions of the small bowel (SB) because it allows non-invasive examination of the entire length of the SB.^{1,2} It has a higher diagnostic yield than other methods (i.e., push enteroscopy, conventional computed tomography, and angiography). This yield can range between 38% and 83% according to previously published studies.³ Usually SBCE has a battery life of 8-12 hours and captures images at a rate of 2-6 frames per second.³ For an optimal and complete evaluation of the SB, the capsule should reach the cecum while the battery is still recording. However, if SBCE passage was too fast, it would limit its ability to evaluate the SB mucosa.^{3,4} Small bowel capsule endoscopy passage times and images visualization often vary between individuals and even within the same individual on consecutive examinations and may be associated with the nature

of gut peristalsis.⁴ There is scarce evidence that identifies variables that may increase the odds of locating SB lesions with this endoscopic method. In addition, it is not well known if small bowel transit time (SBTT) may have an impact on the odds of finding an SB lesion on SBCE. Our aim was to describe variables associated with higher odds of finding SB lesions on SBCE. We hypothesized that longer SBTT would increase the odds of lesion identification in SBCE.

MATERIALS AND METHODS

Our study complied with the ethical statements expressed in the Declaration of Helsinki; this study was also evaluated and approved by our local ethics committee. Since it was a retrospective observational study and no crucial data on subject identity was used, no informed consent was needed.

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Design and Study Population

A cross-sectional study was performed using our Department's capsule endoscopy database from July 2015 to July 2020. Adult patients older than 18 years referred to our center for SBCE with suspected SB bleeding (overt and/or occult), suspected Crohn's disease, malabsorption diarrhea, abdominal pain, and/or polyp surveillance were included. Patients who underwent SBCE as outpatients as well as patients who were admitted to our hospital were included.

Small Bowel Capsule Endoscopy Procedure

Small bowel capsule endoscopy was performed using Pillcam SB2 and SB3 capsules (Given Imaging, Yoqneam, Israel). All patients underwent 12-hour fasting and received 2 L of polyethylene glycol 6 hours before capsule ingestion. Fluid and light meals were allowed 2 and 4 hours respectively after capsule swallowing.¹ Exclusion criteria were large quantity of residue precluding a reliable examination of the SB mucosa, capsule malfunction, and no visualization of the cecum at the end of the video recording. Patients with stenosing tumor lesions were also excluded. Digital information was downloaded for analysis using Pillcam software. All recordings were analyzed by 2 gastroenterologists proficient in SBCE performance, and reading speed was a maximum of 10 frames per second.⁵ Small bowel cleansing score was assessed with 2 visual parameters using a validated scale: proportion of visualized mucosa (4-step scale ranging from 0 to 3: score 3, >75%; score 2, 50-75%; score 1, 25-50%; score 0, <25%) and degree of obscuration (4-step scale ranging from 0 to 3: score 3, <5% obscuration; score 2, 5-25% obscuration; score 1, 25-50% obscuration; score 0, >50% obscuration). For this scoring, representative frames from SB images were serially selected and scored at 5-minute intervals.² Small bowel transit time was defined as the amount of time elapsed between the first duodenal image and the first cecal image. To study the location of endoscopic lesions, the SB was divided into 3 equal parts (first, second, and third segment).

Main Points

- Describe variables associated with higher odds of finding small bowel lesions on capsule endoscopy.
- Intestinal transit time was significantly longer among those patients with at least 1 small bowel lesion.
- Age and intestinal transit time were significantly associated with the presence of abnormal findings on capsule endoscopy.

Data Collection and Outcome Measurement

Adult patients referred for capsule endoscopy whose cleansing score was adequate and capsule arrival to cecum was documented were included for analysis. For each case, the presence of any SB mucosal lesion was registered: erosions, ulcers, vascular ectasia, red spots, polyps, tumors, or other findings. The following variables were also examined: age, gender, reason for referral, quality of SB cleansing, and SBTT. These variables were compared between those patients showing at least 1 lesion versus those without SB lesions to evaluate if there were significant differences associated.

Statistical Analysis

Stata software was used (version 11.1, Statacorp, College Station, TX, USA). Categorical variables were described as percentages. Numerical variables were described as mean with their standard deviation or range; in case of non-parametric numerical variables, they would be described as median with their interquartile range 25-75%. In order to establish if a numerical variable was parametric or not, Kolmogorov-Smirnov test was used.

For the comparison of categorical variables, a chi-square test was used. For the comparison of numerical variables, Student's *t*-test or Mann-Whitney test (for non-parametric variables) were used. Odds ratios (OR) with their corresponding 95% CI were estimated.

A univariate analysis with a subsequent multivariate analysis following a logistic regression model was performed to determine variables significantly associated with the presence of SB lesions. A *P* value of less than .05 was considered as statistically significant.

RESULTS

Figure 1 shows the process we undertook to include eligible patients. Overall, 140 studies were analyzed; 90% of them were performed in the context of obscure gastrointestinal bleeding. Median age of enrolled patients was 69 years (60-75) and 54.29% were males. Small bowel cleansing was adequate in 94.29% of patients. At least 1 SB lesion was observed in 68.57% of patients: the most common finding was vascular ectasia (42.86%) corresponding to P1 Saurin classification.⁷ Figure 2 shows the proportion of lesions identified in SBCE. A non-significant difference was observed in terms of age between groups of comparison (70 [61-76] vs 63 [59-74], *P* = .07). No difference was found when comparing SB cleansing, gender, or reason for referral (Table 1).

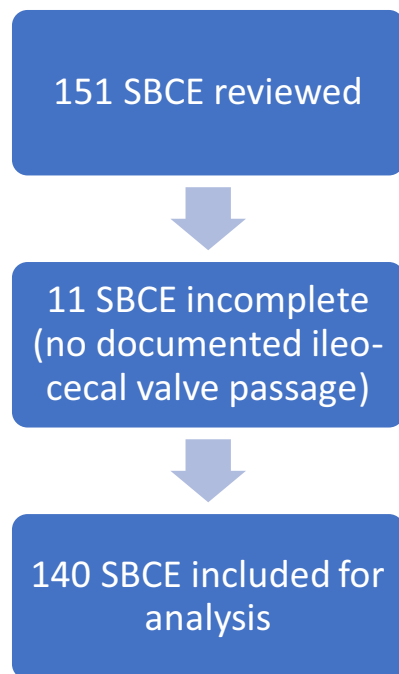


Figure 1. Flow chart showing the patient selection process. SBCE, small bowel capsule endoscopy.

Intestinal transit time was significantly longer among those patients with an SB lesion (359 minutes [257-427] vs 279 minutes [200-333], $P = .05$). Figure 3 shows the proportion of positive findings according to SBTT intervals: we found a significant difference in the proportion of positive findings when SBTT was higher than 300 minutes. On multivariate analysis, age (**OR 1.02**

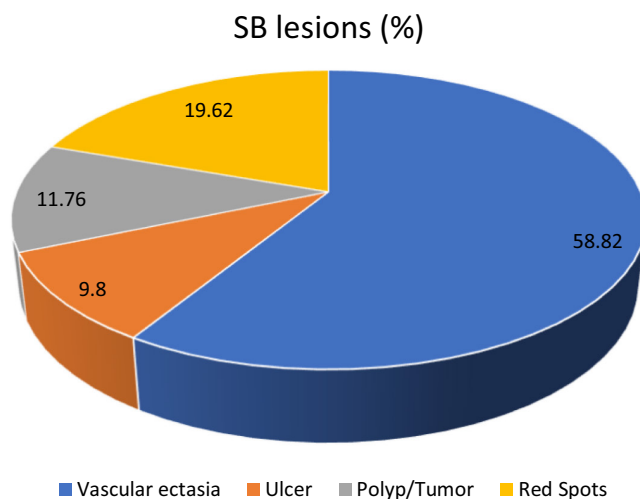


Figure 2. Proportion of small bowel lesions identified in small bowel capsule endoscopy. SB, small bowel.

Table 1. Comparison of Main Characteristics Between Patients With and Without Findings in SBCE

	Findings in SBCE (% n/N)	No findings in SBCE (% n/N)	OR (95% CI)	P
Age	70 (61-76)	63 (59-74)	1.01 (0.99-1.03)	.07
Gender (%F)	45.83 (44/96)	45.45 (20/44)	1.01 (0.49-2.08)	.88
OGIB as reason for referral	89.58 (86/96)	90.91 (40/44)	0.86 (0.25-2.91)	.90
Adequate bowel cleansing	91.66 (88/96)	95.45 (42/44)	0.52 (0.11-2.57)	.51
SBTT (minutes)	359 (257-427)	279 (200-333)	1.02 (1-1.03)	.05

OR, odds ratio; SBCE, small bowel capsule endoscopy; OGIB, obscure gastrointestinal bleeding; SBTT, small bowel transit time.

[1-1.06]) as well as intestinal time (**OR 1.09 [1.03-1.12]**) were significantly associated with the presence of at least 1 SB lesion on SBCE (OR 1.02 [1-1.06] and 1.09 [1.03-1.12], respectively).

DISCUSSION

We found that SBTT was significantly associated with the presence of abnormal findings on SBCE in the group of patients where the capsule had reached the cecum within SBCE recording period time. These findings are in concordance with other studies of SBCE which suggested that a longer SBTT was associated with the identification of SB lesions.^{3,8} In the SB, 2 types of contraction waves are present. There are non-propagated waves and peristaltic waves (characterized by the migrating motor complex).³ For these reasons, it is not unusual for an SBCE to move forward and backward before advancing due to a peristaltic wave. This

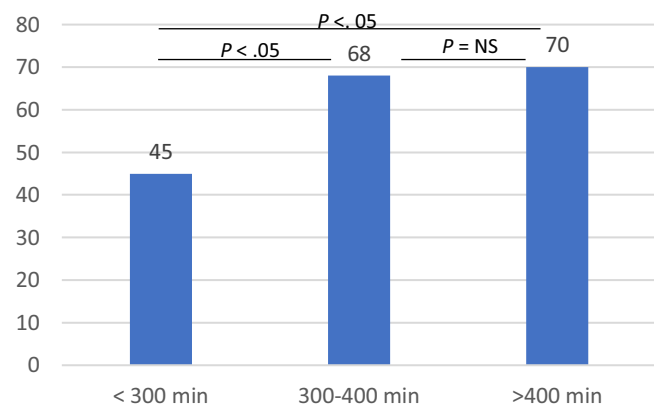


Figure 3. Proportion of small bowel lesions on small bowel capsular endoscopy according to small bowel transit times.

explains the variability of SB passage times even when SBCE performance is repeated in the same patient. This may also limit the ability of the SBCE to accurately distinguish the number of lesions present, whether vascular lesions or other mucosal alterations, especially when 2 or more apparently similar lesions are found in close proximity to each other.³ Other technologies are being evaluated to better localize the SBCE, including video-based estimation techniques using artificial intelligence⁹ or magnetic resonance coupling,¹⁰ but these kinds of technologies are currently in development stage. It would be interesting to identify a threshold for SBTT that ensures a minimum time to optimize diagnostic yield.

There is a relatively small amount of well-designed studies addressing the impact of SB cleaning preparation on SBCE diagnostic yield. In addition, there is a lack of consensus regarding the cleansing strategy to be adopted before these studies. We followed the American Gastroenterological Association recommendations of using 2 Ls of polyethylene glycol prior to each SBCE in our cohort.¹¹ The role of prokinetic agents in the SBCE performance could be helpful in equipment with a short battery lifetime. However, its use is controversial because there is not enough data on the contribution of prokinetics for the diagnostic yield of SBCE and actually their routine administration is not recommended.^{1,8,12,13}

We found an association between the diagnostic yield of SBCE and the age of patients. One cause of this could be due to a possible influence of aging and the number of total lesions expected in our cohort population.^{14,15}

Limitations should be mentioned. First of all, sample size is relatively small. More evidence is needed with the inclusion of a larger population to assess the reproducibility of our results. In addition, most patients were outpatients with a history of obscure gastrointestinal bleeding. It has been proven that active or recent bleeding may exert some influence in SBTT, so it could be confounding factor.^{3,16} Since a very small proportion of patients underwent SBCE for other reasons than bleeding, we were unable to perform a sensitivity analysis for this matter.

In conclusion, increasing age and prolonged intestinal transit time were significantly associated with the identification of abnormal findings on SBCE. However, larger prospective studies might be necessary to establish the nature of the association between SBTT and SBCE diagnostic yield.

Ethics Committee Approval: The study was approved by the medical ethics committee of CEMIC.

Informed Consent: N/A.

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