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Best Approach for Incomplete Colonoscopy: Colon Capsule Endoscopy or Repeat Conventional Colonoscopy?

Tiago Lima Capela[a, b, c] Tiago Cúrdia Gonçalves[a, b, c] Bruno Rosa[a, b, c] José Cotter[a, b, c]

[a]Gastroenterology Department, Unidade Local de Saúde do Alto Ave, Guimaraes, Portugal; [b]Life and Health Sciences Research Institute (ICVS), School of Medicine, University of Minho, Braga, Portugal; [c]ICVS/3B's, PT Government Associate Laboratory, Guimaraes/Braga, Portugal

Keywords
Incomplete colonoscopy · Colon capsule · Capsule endoscopy

Abstract

Background: The most appropriate strategy for completing a previous incomplete colonoscopy (IC) is not standardized. We aimed to compare the efficacy and safety of two strategies for completing a previous IC: colon capsule endoscopy (CCE) versus repeat conventional colonoscopy. ***Methods:*** A retrospective cohort study that included consecutive adult patients referred to our center after IC under sedation due to irreducible loop formation or colonic fixed angulation was performed. Patients underwent CCE (PillCam COLON2 Medtronic®) or repetition of conventional colonoscopy under sedation. In this setting, an appropriate CCE progression was defined as the capsule reaching the segment achieved during the previous IC. Repeated conventional colonoscopy was considered complete when cecal intubation was accomplished. We compared the rate of appropriate CCE colon progression with the cecal intubation rate from repeated conventional colonoscopy. Quality of colon preparation, diagnostic yield, and rate of adverse events for CCE and colonoscopy was also analyzed. ***Results:*** A total of 192 CCE and 181 colonoscopies were performed for IC, primarily due to fixed angulation of the left colon (69.2%, n = 258). There were no significant differences between the two groups (CCE vs. colonoscopy) concerning age, sex, overweight/obesity status, previous abdominal surgery, and reasons for IC. The rate of appropriate colon progression with CCE was not significantly different from the cecal intubation rate of repeated colonoscopy (95.3% vs. 90.1%, p = 0.073, respectively), even after adjusting for the quality of colon preparation (p = 0.122), which differed significantly between the groups (76.0% vs. 92.8%, p < 0.001, respectively). There were no significant differences in overall colorectal findings identified between the CCE and colonoscopy groups (55.2% vs. 62.4%, p = 0.172, respectively), and no adverse events were reported in either group. ***Conclusions:*** Our findings suggest that both CCE and repeat conventional colonoscopy are effective and safe options for completing a previous IC.

karger@karger.com
www.karger.com/pjg

Correspondence to:
Tiago Lima Capela, tiagolimacapela@gmail.com

Qual a melhor abordagem para a colonoscopia incompleta: cápsula do cólon ou repetição de colonoscopia convencional?

Palavras Chave
Colonoscopia incompleta · Cápsula de cólon · Cápsula endoscópica

Resumo
Introdução: A estratégia mais adequada a adotar após colonoscopia incompleta (CI) não está padronizada. Pretendeu-se comparar a eficácia e segurança de duas estratégias após CI: cápsula do cólon (CCE) versus repetição de colonoscopia convencional. ***Métodos:*** Estudo retrospectivo incluindo doentes adultos referenciados para o nosso centro após CI devido a ansa irredutível ou angulação cólica. Os doentes foram submetidos a CCE (PillCam COLON2 Medtronic®) ou repetição de colonoscopia convencional sob sedação entre 2019–2023. Foi extraída informação demográfica, clínica (cirurgia abdominal, excesso de peso/obesidade) e relacionada com a CI prévia, CCE e colonoscopia de repetição. Progressão cólica adequada foi definida como uma CCE que atingisse o limite proximal alcançado pela CI prévia. A colonoscopia convencional de repetição foi considerada completa se ocorresse intubação cecal. Foi comparada a taxa de progressão cólica adequada e de intubação cecal como a qualidade da preparação intestinal, acuidade diagnóstica e taxa de eventos adversos entre ambas as técnicas. ***Resultados:*** Um total de 192 CCE e 181 colonoscopias foram realizadas após CI, maioritariamente por angulação cólica (69,2%, n = 258). Não se verificaram diferenças significativas entre os grupos em relação à idade, sexo, excesso de peso/obesidade, cirurgia abdominal e motivo da CI. A taxa de progressão cólica adequada da CCE não foi significativamente diferente da taxa de intubação cecal após repetição da colonoscopia (95,3% vs. 90,1%, p = 0,073, respectivamente), mesmo após ajuste para a qualidade da preparação intestinal (p = 0,122), que diferiu significativamente entre os grupos (76,0% vs. 92,8%, p < 0,001, respectivamente). Não se observou uma diferença significativa relativamente à acuidade diagnóstica global entre ambas as estratégias (55,2% vs. 62,4%, p = 0,172, respectivamente). Nenhum evento adverso foi registado em ambos os grupos. ***Conclusões:*** A CCE como a repetição de colonoscopia convencional são ambas estratégias eficazes e seguras para completar uma CI.

Introduction

Optical colonoscopy remains the gold standard for diagnosing, preventing, and managing colorectal pathology, particularly as the primary method for colorectal cancer screening [1]. It is the only procedure that allows for both detection and removal of colorectal neoplastic lesions. The quality of a screening colonoscopy is determined by several indicators, including bowel preparation, withdrawal time, adenoma detection rate, and cecal intubation rate [2]. Cecal intubation involves advancing the colonoscope tip beyond the ileocecal valve to visualize the entire cecal caput, including the medial wall of the cecum. Achieving cecal intubation enhances the detection rate of advanced neoplasia and reduces the occurrence of interval proximal colon cancer, as 33–50% of advanced neoplasia are located in the proximal colon [3, 4]. Conversely, the risk of proximal colon cancer doubles if the colonoscopy is incomplete [5].

Despite recommendations for cecal intubation rates of at least 90% in routine practice and 95% in screening colonoscopies, actual rates in daily practice often fall short [6]. Incomplete colonoscopy (IC) rates range from 4% to 25%, and several factors can contribute for an incomplete procedure, including inadequate bowel cleansing, patient discomfort, and altered colon anatomy [5, 7–9]. Inadequate bowel preparation can typically be addressed by adjusting preparation protocols, while patient discomfort can be managed through modifications in anesthesia. However, altered colon anatomy such as a redundant (excessive looping) or tortuous (excessive angulation) colon often necessitates alternative endoscopic or imaging techniques. Various endoscopic methods have been developed, including repeating the optical colonoscopy with more experienced endoscopists, using different techniques, or employing different endoscopes such as thinner colonoscopes, gastroscopes, and device-assisted enteroscopes [10–16]. Colon capsule endoscopy (CCE), such as the PillCam COLON2® by Medtronic (Dublin, Ireland), is also a valid option for completing an IC [17–20]. Imaging methods, including double-contrast barium enema and computed tomography colonography, have also been described in this context [21–23]. Barium studies, in addition to exposing patients to radiation, are suboptimal for colon pathology assessment. Computed tomography colonography, while promising, also requires radiation exposure, may not adequately detect flat polyps, and is not widely available [24, 25].

Despite these advancements, there is no standardized approach for managing incomplete colonoscopies, with

practices varying based on local expertise [26]. Furthermore, there is a lack of data comparing the efficacy and safety of CCE with repeat conventional colonoscopy for managing incomplete procedures. Therefore, our study aims to compare the efficacy and safety of these two strategies for completing a previously IC: CCE versus repetition of conventional colonoscopy.

Patients and Methods

Study Design

We conducted a retrospective cohort study that included adult patients referred to our center between 2018 and 2023 after an IC under propofol sedation due to irreducible loop formation or colonic fixed angulation. Patients with IC due to inadequate colon preparation or colonic stricture were excluded. Each patient received a thorough explanation regarding the benefits and risks of the available approaches (repeating conventional colonoscopy, CCE, or computed tomography colonography) for completing the previous IC and were free to choose among them. For this study, we included only patients who performed either CCE or repeating conventional colonoscopy. This study was conducted in accordance with the principles of the Declaration of Helsinki, and ethical approval was waived by our center's Ethics Committee.

Data Collection

Data were collected from electronic medical records, and patients with incomplete medical information (at least one main variable missing) were excluded. We retrieved information regarding patients' age, sex and clinically significant comorbidities (overweight/obesity [body mass index ≥25] and history of abdominal surgery). Additionally, we gathered relevant information such as the indication, reason for incomplete procedure (irreducible loop formation or colonic fixed angulation), and limit of progression (distal or proximal to the splenic angle) of the previous IC.

For CCE, data retrieved included the quality of colon preparation (using Colon Capsule Cleansing Assessment and Report – CC-CLEAR), CCE completeness (if incomplete, the most distal segment reached), colorectal findings, adverse events, and subsequent investigations [27, 28]. Adequate colon preparation quality was defined as a CC-CLEAR score of ≥6 (with ≥2 per segment, independent of overall classification). Complete CCE was defined as capsule device egestion or, at least, visualization of the hemorrhoidal pedicles within battery time.

Colon Capsule Procedure

All procedures were performed with the PillCam COLON2 capsule (Medtronic®, Dublin, Ireland) according to our center's protocol [29, 30]. Patients were instructed to follow a low-fiber diet and drink at least 10 glasses of water 2 days before the procedure. On the day before the procedure, a clear liquid diet was prescribed, along with 1 L of polyethylene glycol solution plus ascorbate followed by 1 L of water between 7:00 and 9:00 p.m. On the morning of the procedure, another 1 L of this solution followed by 1 L of water was ingested (between 6:30 and 8:30 a.m.), and fasting was required afterward. Thirty minutes before capsule ingestion, patients were given 100 mg of simethicone. At 9:00 a.m., patients were instructed to ingest the capsule. One hour later, using the real-time viewing system, capsule progression to the small bowel was confirmed, and 10 mg of domperidone were administered if the capsule was still in the stomach, according to a previously published protocol from our institution [31]. Thirty minutes later, capsule progression was reassessed, and if it remained in the stomach, it was endoscopically placed in the small bowel. When the small bowel was reached, a booster of 30 mL of sodium phosphate solution was administered, followed by ingestion of 1 L of water. Three hours later, the second booster of sodium phosphate (15 mL) was administered, plus 500 mL of water. After another 3 h, if the capsule was not excreted, a bisacodyl suppository was given.

Repeated Conventional Colonoscopy

All repeated colonoscopies were performed in our center by an experienced endoscopist (B.R.) under propofol sedation administered by an anesthesiologist. Colon preparation used was MoviPrep®. The endoscopist could choose different types of endoscopes to perform the colonoscopy, including "standard" endoscopes defined as an adult colonoscope (CF-Q165, CF-H180AL, and CF-H190L), pediatric colonoscope (PCF-Q180AL), or a gastroscope (GIF-Q165, GIF-H180, and GIF-H190). An enteroscope (SIF Q180, Olympus, Center Valley, PA) with or without single-balloon overtube was also used. Adult and pediatric colonoscopes had variable stiffness capability, allowing for adjustment of insertion tube flexibility. The selection of the initial scope used in the repeat colonoscopy was primarily determined based on the reason for the IC (fixed angulation or irreducible loop). Patients referred for IC due to an irreducible loop were initially scoped using a standard adult colonoscope. If cecal intubation was not achieved, another type of scope could be used, primarily the enteroscope with a single-balloon overtube. Conversely, patients referred for IC due to fixed angulation were preferentially scoped

using a pediatric colonoscope, with a switch to a gastroscope or enteroscope without the overtube if the fixed angulation still could not be passed. The quality of colon preparation (using Boston Bowel Preparation Scale score – BBPS), cecal intubation rate, limit of progression (distal or proximal to the splenic angle), colorectal findings, adverse events, and subsequent investigations were also evaluated. Adequate colon preparation quality was defined as an overall BBPS score of ≥6 (with ≥2 per segment, independent of overall classification) [32].

Outcomes

Regarding efficacy, the cecal intubation rate of repeated conventional colonoscopy was compared to the appropriate colon progression rate by CCE. Appropriate colon progression was defined as a CCE that could reach the most proximal segment achieved during the previous IC, therefore visualizing the segments that were not previously reached. This was ascertained by reviewing the previous IC report and CCE video by two experienced endoscopists. Regarding safety, the rate of colonoscopy-related adverse events (including bleeding, perforation, and cardiorespiratory complications) was compared to CCE-related adverse events (including CCE retention and preparation-related symptoms such as nausea, vomiting, and headache).

Statistical Analysis

Statistical analyses were conducted using the Statistical Package for Social Sciences program version 29 (IBM Corporation, Armonk, NY, USA). Categorical variables were described using absolute frequencies and percentages. Depending on the normality tests, continuous variables were expressed as mean and standard deviation or median and interquartile range (IQR). The χ^2 test was used to compare categorical variables, and depending on the normality tests, continuous variables were compared using independent samples *t* test or nonparametric tests (Mann-Whitney or Kruskal-Wallis). A binary logistic regression model, adjusted for the quality of colon preparation, was used to compare the difference between the cecal intubation rate of repeated conventional colonoscopy and the appropriate colon progression rate by CCE. All reported *p* values are two-tailed, with a *p* value less than 0.05 indicating statistical significance.

Results

A total of 192 CCE and 181 colonoscopies from 373 patients were included (Fig. 1). Most patients were female (n = 273, 73.2%) with a mean age of 66 (IQR 10) years old (Table 1). A minority were overweight/obese (n = 53, 14.2%) and the majority had undergone abdominal surgery (n = 210, 56.3%).

The most frequent indication for colonoscopy was colorectal cancer screening (n = 345, 92.5%), followed by chronic diarrhea (n = 18, 4.8%) and iron-deficiency anemia (n = 10, 2.7%). Incomplete colonoscopies were mainly due to colonic fixed angulation (n = 258, 69.2%) and were limited to segments distal to splenic flexure in most patients (n = 280, 75.1%).

None of the baseline variables evaluated were significantly different between the CCE and repeated colonoscopy groups (Table 1).

Although CCE examinations were complete in only 71.4% (n = 137) of the cases, most CCE allowed appropriate colon progression, with 95.3% (n = 183) of CCE reaching the most proximal segment achieved during the previous IC, allowing the visualization of the segments that were not previously reached by colonoscopy (Table 2). All patients (n = 9, 4.7%) with inappropriate colon progression had a history of IC due to colonic fixed angulation. Forty-five patients (23.4%) who underwent CCE were referred for a subsequent colonoscopy, the majority due to inadequate colon preparation (n = 44, 97.8%) or abnormal findings (n = 36, 80.0%). The subsequent colonoscopy achieved a cecal intubation rate of 91.1% (n = 41).

A cecal intubation rate of 90.1% (n = 163) was achieved by repeating colonoscopy, in most cases using a pediatric colonoscope (n = 80, 49.1%), but also using an adult colonoscope (n = 65, 39.9%), an enteroscope (n = 12, 7.4%), or a gastroscope (n = 6, 3.7%). The use of enteroscopes was not associated with a higher cecal intubation rate compared to standard endoscopes (100% vs. 89.3%, p = 0.612, respectively). All patients (n = 48, 26.5%) referred for IC due to an irreducible loop and submitted to a repeat colonoscopy were managed with an adult colonoscope, achieving a 100% cecal intubation rate. Among patients referred for IC due to fixed angulation (n = 133, 73.5%), a cecal intubation rate of 86.4% was achieved, either using a single endoscope (pediatric colonoscope [n = 80] or adult colonoscope [n = 17]) or requiring a switch to another endoscope (enteroscope without overtube [n = 12] or gastroscope [n = 6]). In 18 patients (13.5%), cecal intubation could not be achieved, even after switching from a pediatric colonoscope to a gastroscope. Of these patients, eight (44.4%) subsequently underwent CCE, with successful colon progression achieved in 87.5% (n = 7). The percentage of adequate colon preparation was significantly lower in the CCE group compared to the repeat colonoscopy group (76.0% vs. 92.8%, p < 0.001, respectively).

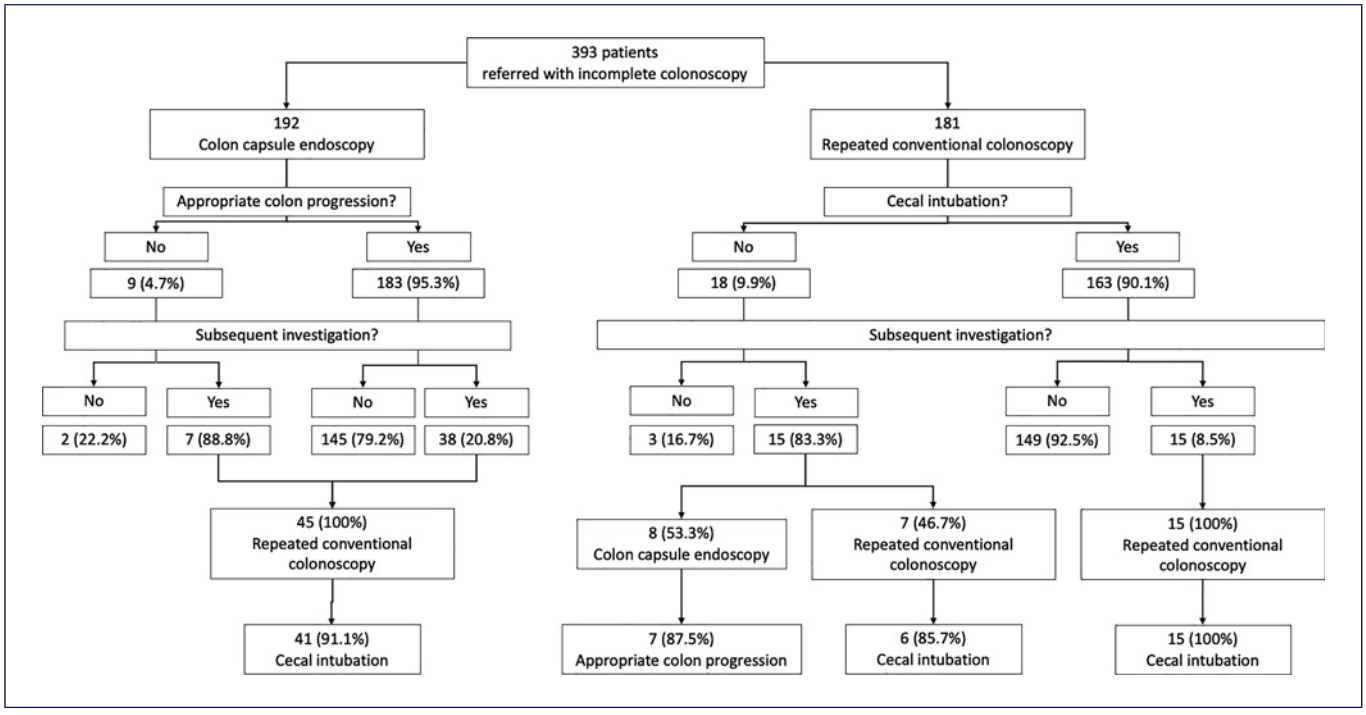

Fig. 1. Flowchart of the main outcomes for patients who underwent CCE or repeated colonoscopy after an IC.

Table 1. Baseline characteristics of patients who had CCE or repeated colonoscopy after IC

	CCE group (*n* = 192)	Colonoscopy group (*n* = 181)	*p* value
Female sex, *n* (%)	141 (73.4)	132 (72.9)	1.000
Median age (IQR), years old	68 (15)	65 (14)	0.052
Overweight/Obesity, *n* (%)	31 (16.1)	22 (12.2)	0.301
Previous abdominal surgery, *n* (%)	105 (54.7)	105 (58.0)	0.532
First colonoscopy indication, *n* (%)			0.710
Colorectal cancer screening	179 (93.2)	166 (91.7)	
Chronic diarrhea	8 (4.2)	10 (5.5)	
Iron-deficiency anemia	5 (2.6)	5 (2.8)	
Reason for IC, *n* (%)			0.093
Colonic fixed angulation	125 (65.1)	133 (73.5)	
Irreducible loop formation	67 (34.9)	48 (26.5)	
Segment reached by colonoscopy, *n* (%)			0.580
Distal to splenic flexure	140 (72.9)	140 (77.3)	
Proximal to splenic flexure	52 (27.1)	41 (22.7)	

CCE, colon capsule endoscopy; IC, incomplete colonoscopy; IQR, interquartile range.

The appropriate colon progression rate with CCE was not significantly different when compared to the cecal intubation rate of repeated colonoscopy (95.3% vs. 90.1%, p = 0.073, respectively), even after adjusting for quality of colon preparation (p = 0.122). Moreover, the percentage of patients who required a subsequent investigation did not

Table 2. Characteristics and main findings of CCE and repeated colonoscopy after IC

	CCE group (n = 192)	Colonoscopy group (n = 181)	p value
Adequate colon preparation[1], n (%)	146 (76.0)	168 (92.8)	<0.001
CCE completeness[2], n (%)	137 (71.4)	–	–
Adequate progression[3], n (%)	183 (95.3)	163 (90.1)	0.073
Overall findings, n (%)	106 (55.2)	113 (62.4)	0.172
Polyps	99 (51.6)	85 (47.0)	0.408
Angioectasias	15 (7.8)	7 (3.9)	0.126
Diverticula	15 (7.8)	7 (3.9)	0.820
Erosions/ulcers	0 (0)	0 (0)	1.000
Neoplasia	1 (0.5)	0 (0)	1.000
Subepithelial lesions	2 (1.0)	2 (1.1)	1.000
Adverse events, n (%)	0 (0)	0 (0)	1.000
Need for subsequent investigation, n (%)	45 (23.4)	30 (16.6)	0.121
Inadequate colon preparation	44 (97.8)	13 (43.3)	
Inadequate progression	7 (15.5)	15 (50.0)	
Findings needing a therapeutic procedure[4]	32 (71.1)	2 (6.7)	

CCE, colon capsule endoscopy; IC, incomplete colonoscopy; IQR, interquartile range. [1]Overall Boston Bowel Preparation Scale score or Colon Capsule Cleansing Assessment and Report of ≥6 (with ≥2 per segment, independent of overall classification) for colonoscopy and CCE, respectively [27, 32]. [2]Completeness was defined as capsule device egestion or, at least, visualization of the hemorrhoidal pedicles within battery time. [3]For CCE, defined as an appropriate CCE progression, when capsule reached the segment achieved during the previous IC; for repeated conventional colonoscopy, defined as when cecal intubation was accomplished. [4]In CCE group: 29 had at least one neoplastic lesion to remove, 2 had angioectasia to treat and 1 had suspected colorectal neoplasia to biopsy; in colonoscopy group: 2 colonic lesions referred to piecemeal endoscopic mucosal resection.

differ significantly between those who underwent CCE and those who underwent a repeat colonoscopy (23.4% vs. 16.6%, p = 0.121, respectively) (Table 2).

There were no significant differences in overall colorectal findings identified between the CCE and colonoscopy groups (55.2% vs. 62.4%, p = 0.172, respectively), including identification of polyps (51.6% vs. 47.0%, p = 0.408), angioectasias (7.8% vs. 3.9%, p = 0.126), diverticula (7.8% vs. 3.9%, p = 0.820), erosions/ulcers (0% vs. 0%, p = 1.000), neoplasia (0.5% vs. 0%, p = 1.000), and subepithelial lesions (1.0% vs. 1.1%, p = 1.000). No adverse events were reported in either group.

Discussion

To the best of our knowledge, this head-to-head study includes the largest patient cohort comparing the efficacy and safety of two approaches for completing an IC due to anatomical factors. Our findings confirm that both CCE and repeating a conventional colonoscopy are very effective and safe procedures for properly visualizing the colonic segments proximal to the site where the first colonoscopy failed to reach.

CCE is a minimally invasive, painless endoscopic technique that can explore the colorectal mucosa without requiring sedation, gas insufflation, or radiation exposure. Since the release of the second-generation CCE (PillCam COLON2, Medtronic, Dublin, Ireland), which provides a higher frame rate and a larger angle lens, various research has shown improved accuracy in detecting both neoplastic and nonneoplastic disease in different settings, including after IC [17, 29, 33]. In fact, recent international guidelines consider CCE a possible and feasible screening method for colorectal cancer in moderate-risk groups when conventional endoscopy is incomplete, in centers with expertise in and availability of CCE, preferably the same or the next day [17, 34]. The efficacy of CCE in this context is demonstrated by the high appropriate colon progression rate observed in our study, which aligns with previous data [18, 20, 21]. A recent meta-analysis showed a pooled appropriate colon progression rate ranging from 75% to 98% [35]. The suboptimal completeness rate observed in our research is comparable with findings of similar analyses, with pooled completeness rates ranging from 65% to 93% [35]. Although the percentage of adequate colon preparation for CCE was suboptimal, it is also comparable with similar

reports [18, 20, 21]. These drawbacks of CCE are likely to improve over time with the development of new bowel preparation protocols or adaptations of the existing colon preparation regimens [36]. The diagnostic yield for colorectal polyps was high (51.6%), which is consistent with other data [18, 20, 21]. Although rare CCE-related adverse events are described, including CCE retention and preparation-related symptoms, none were identified in our study [37].

Our results also show that repeating conventional colonoscopy is also a very effective and a safe method for complete a previous IC. Numerous publications have reported successful repetition of colonoscopy with experienced endoscopists, using different techniques, or employing different endoscopes such as thinner colonoscopes, gastroscopes, and device-assisted enteroscopes [10–16]. As emphasized in other reports, most of our cases were managed using standard endoscopes with a high success rate and safety, with pediatric colonoscopes being the most frequently used, followed by standard colonoscopes. Although in our study the difference in cecal intubation rate did not reach statistical significance, the use of enteroscopes may be employed, in centers with availability and expertise, for cases that were not successful using standard endoscopes [13, 16]. As in other reports, the diagnostic yield was high, and no adverse events were recorded [10–16].

To the best of our knowledge, there is no data supporting the use of a specific approach (e.g., colon capsule vs. repeat colonoscopy) based on variables from the previous IC (e.g., reason for IC [fixed angulation vs. irreducible loop], the experience of the endoscopist or center, or the type of scopes used). Although all the procedures with inadequate progression (27/393 [n = 9 after CCE and n = 18 after repeat colonoscopy]) were performed in patients whose reason for IC was fixed angulation, this only suggests that fixed angulation might be a risk factor for failure, independently of the approach used (colon capsule vs. repeat colonoscopy). On the other hand, our data suggest that the reason for IC (fixed angulation vs. irreducible loop) should influence the choice of scope when a repeat conventional colonoscopy is performed. As addressed in the following question, our approach has demonstrated high efficacy (high cecal intubation rates) and safety (no adverse events). Comparing both approaches, we found no significant differences in their capacity to complete a previous IC or in their adverse event rates. Although both groups were homogenous for some variables traditionally associated with incomplete procedures, even after adjusting for the quality of colon preparation, the outcomes did not differ [38]. Moreover, the percentage of patients requiring subsequent investigation among those who underwent CCE and those who underwent a repeat colonoscopy appears to be similar. As far as we know, head-to-head comparisons between these two approaches are lacking, with most studies comparing CCE with CTC or different types of endoscopes in this context [11, 14, 21, 35, 39].

This study presents some limitations. It was a single-center study with a retrospective design, which has inherent biases. However, as far as we know, it includes the largest sample of patients with IC due only to anatomical factors and who were submitted to CCE or repetition of a conventional colonoscopy. Additionally, both groups were similar regarding known risk factors for incomplete procedures, and the quality of colon preparation, which differed between groups, was adjusted in our statistical analysis, providing more robust and feasible results when comparing both groups regarding the outcomes [38, 40]. It is often challenging to determine the most distal segment reached by CCE and subsequently consider if the CCE reached the most proximal segment reached by the previous IC, especially in cases where no marking (tattoo or clip) was performed to determine the segment reached. Nevertheless, we believe that the independent review of CCE by two capsule endoscopy experts contributed to reduce interobserver variability bias. The optimal timing of CCE after IC is still unclear, but contrary to some data, CCE was not performed on the same day or the following day [18]. Furthermore, the choice of endoscope used was determined by endoscopist preference and not by a predetermined protocol. This study also represents the efforts of a single endoscopist, which may not be generalizable to all endoscopists. On the other hand, this also emphasizes that the experience of the endoscopist is an important factor for success in this context [13]. CCE may be perceived as a more expensive option upfront given its diagnostic-only nature and lack of therapeutic capabilities, potentially demanding further interventions, thus increasing overall costs. However, our data suggest that the percentage of patients requiring at least one subsequent investigation is similar between the two strategies. On the other hand, the true cost of a repeat colonoscopy following an incomplete procedure is uncertain, as the overall expense may surpass the typical costs of routine colonoscopies due to the requirement for expertise, specialized equipment, sedation, potential therapeutic interventions, and the logistical complexities of scheduling these typically longer procedures. Additionally, the overall cost of both procedures can vary significantly between countries due

to differences in healthcare systems and insurance coverage. Therefore, further investigation, including a dedicated cost-effectiveness analysis, is required to fully assess the economic impact of CCE in comparison to repeat colonoscopy and to provide more robust evidence to guide decision-making in this area.

In conclusion, our study provides real-world evidence contributing to the standardization of managing IC. Our findings suggest that both CCE and repeat conventional colonoscopy are effective and safe options for completing a previous IC. However, individualization based on the indications and reasons for IC, availability of techniques and resources, endoscopist expertise, and comorbidities should guide our clinical decisions in these cases.

Statement of Ethics

Ethical approval was waived by the Unidade Local de Saúde do Alto Ave's Ethics Committee. The study has been granted an exemption from requiring written informed consent by the Unidade Local de Saúde do Alto Ave's Ethics Committee given the retrospective nature of the study.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

T.L.C. was involved in the design of the study; collection, statistical analysis, and interpretation of the data; drafting of the article and in the final approval of the article. T.C.G., B.R., and J.C. were involved in the design of the study and in the final approval of the article.

Data Availability Statement

All data generated or analyzed during this study are included in this article. Further inquiries can be directed to the corresponding author.

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