Retrograde Device Assisted Enteroscopy as a Salvage Procedure for Failed Colonoscopy: The Experience of a large Australian Centre

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Abstract

Aim: Failed caecal intubation occurs in 4-25% of colonoscopies. The primary objective was to assess the technical success of retrograde Device Assisted Enteroscopy (rDAE) after failed colonoscopy. Secondary aims were to describe the diagnoses and interventions, and to identify factors affecting technical success.

Methods: Retrospective review of consecutive patients undergoing retrograde DAE at our institution between November 2004 and May 2016. Data were collected on: demographics, technical success, bowel preparation, diagnoses, interventions and adverse events.

Results: In total, 277 patients underwent retrograde DAE. Of these, 86 procedures were performed on 82 patients for incomplete colonoscopy, predominantly in redundant colon. Cecal intubation was achieved in 80 procedures (93%). Incomplete procedures were caused by unsatisfactory preparation in 5 cases (6%) and by colonic herniation in 1 case (1%). Of the 80 completed procedures, 2 were non-diagnostic due to poor bowel preparation and 20 showed no abnormalities. In the remaining 58 procedures, 66 diagnoses were made: adenomatous polyps (n=25), inflammatory bowel disease (n=14), angioectasias (n=7), colonic diverticulosis (n=6), strictures (n=5), laterally spreading tumours (n=3), adenocarcinomas (n=3), and ileal ulcers (n=2). Interventions performed were: snare polypectomy (n=29), biopsy (n=17), argon plasma coagulation (n=8), endoscopic mucosal resections (n=3), dilatation (n=3) and endoscopic clipping (n=4). No reported adverse events.

Conclusion: Salvage retrograde DAE has a high technical success in redundant colons and important diagnostic findings. DAE should be recommended in preference to repeat standard colonoscopy or CT colonography. There should be a strong focus on optimising bowel preparation, as it was the major factor influencing technical success and diagnostic yield.

Keywords: Colorectal disease; Colonoscopy; Pelvic surgery; Mucosal lesions

Introduction

Colonoscopy is the primary diagnostic modality for colorectal disease, allowing tissue acquisition as well as therapeutic interventions [1,2]. A key component of technical success of colonoscopy is caecal intubation; however this is not achieved in 4% to 25% of cases [2]. The importance of complete colonoscopy was demonstrated by Ridolfi et al, who showed that 12% of clinically significant lesions are missed by an incomplete index colonoscopy (21/179) [2]. Moreover, incomplete screening colonoscopy has been associated with a twofold increase in interval cancer of the proximal colon [3]. Colonic factors contributing to incomplete colonoscopy comprise redundant colon, loop formation, angulated or fixed segments, and stenosis [4]. Extra-colonic factors include female gender, advanced age, prior abdominal or pelvic surgery, and low BMI [5,6].

Computed Tomography Colonography (CTC) has become the default option after failed colonoscopy, despite multiple studies demonstrating that CTC’s sensitivity for detecting polypoid lesions <10 mm and flat sessile lesions of any size is significantly smaller than that of colonoscopy [7,8]. Moreover, repeat colonoscopy offers the advantage of being able to perform biopsy and therapeutic interventions [9]. However, even in expert hands colonoscopy is unsuccessful in up to 28% of cases. Therefore, Device Assisted Enteroscopy (DAE) has emerged as a salvage technique [10].

The primary aim of this study was to assess the technical success of retrograde DAE (rDAE) after incomplete colonoscopy, using either Single Balloon Enteroscopy (SBE) or Double Balloon Enteroscopy (DBE). Secondary aims were to describe the diagnoses, interventions, and adverse events, and to identify factors affecting technical success.

Methods

Patients

All patients with a prior incomplete colonoscopy who were therefore referred to our center for a retrograde DAE between November 2004 and May 2016 were included. Incomplete index colonoscopy was defined by failure to intubate the caecum. Other endoscopists, both from within and outside our institution, referred patients for this procedure.
Endoscopic procedures

After informed consent was obtained, DAE procedures were performed or supervised by two experienced gastroenterologists. The senior enteroscopist had performed more than 1,000 DAE procedures, of which more than 500 were done by the retrograde approach. The bowel preparation regimen varied over the studied period, but universally consisted of a split dose preparation. Carbon dioxide insufflation was used for all procedures.

DBEs were performed using the Fujinon EN-450T5 enteroscope (length 2,300 mm, outer diameter 9.4 mm) with a pump allowing for selective inflation of latex balloons on the enteroscope and overtube (length 1,450 mm, outer diameter 13.2 mm). SBEs were performed using the Olympus ST-SB1 enteroscope (length 2,345 mm, outer diameter 9.2 mm) with a silicone overtube (length 1,400 mm, outer diameter 13.2 mm) with attached balloon.

Procedures were performed under physician-administered conscious sedation, using intravenous midazolam and fentanyl, or anaesthetist-administered propofol sedation.

Technique

DAE consists of a 200 cm endoscope with an overtube. There are one (SBE) or two (DBE) inflatable balloons attached to the scope and/or overtube. With this technique the scope is advanced through the small bowel with alternately inflating and deflating the balloon(s). The balloons grip the walls of the small intestine and this brings the small bowel towards the endoscopist by pleating the small bowel over the overtube.

Data collection and statistics

Patient medical records, electronically searchable endoscopic records, and an established database of patients undergoing DAE procedures were reviewed. Data was collected retrospectively on patient characteristics, procedure characteristics, bowel preparation and safety. The primary outcome was technical success, defined as cecal intubation. Secondary outcomes were: proximal extent of examination, bowel preparation quality, endoscopic findings, interventions performed and adverse events. Descriptive statistics were calculated using Microsoft Excel 2016 (Microsoft, Redmond, Wash).

This study was performed in accordance with the Declaration of Helsinki and was approved by our local ethics committee (Sydney Local Health District, Research Ethics and Governance Office).

Results

Baseline characteristics

In total, 277 patients underwent retrograde DAE between November 2004 and May 2016. Of these, 86 procedures were performed on 82 patients (mean age 63.5 ± 13.9 years, 55% male) for the indication of prior incomplete colonoscopy. Patient characteristics are listed in Table 1. Procedure characteristics and results are listed in Table 2. The reasons for incomplete index colonoscopy were: redundant colon in 87% (n=71), angulation in 5% (n=4), adhesions in 5% (n=4) and stricture or obstructing mass in 4% (n=3). Five patients had undergone CTC prior to DAE. In two patients, CTC results (polyps) were confirmed at DAE. In another two cases, CTC findings were inaccurate: one had false positive findings (missed Crohn's colitis). In the fifth case, CTC was technically unsuccessful due to a large abdominal wall hernia impeding appropriate distension.

Bowel preparation

Information on bowel preparation was available for 41 cases. The bowel preparation was adequate in 29 (71%) patients and inadequate in 12 (29%) patients. Of the 6 cases in which technical success was not achieved and no diagnosis was made, 5 patients had inadequate bowel preparation (Table 2).

Table 1: Patient characteristics.

| Characteristics | N (%) |
|-----------------|-------|
| Patients        | 82    |
| Procedures performed | 86 |
| Repeat procedures | 4    |
| Mean age (SD)   | 63.5 years (+/- 13.9) |
| Gender Male     | 45 (55) |
| Female          | 37 (45) |

Table 2: Procedure characteristics.

| Reason for incomplete colonoscopy | N (%) |
|----------------------------------|-------|
| Redundant colon                  | 71 (86.6) |
| Tortuosity/sharp angulations     | 4 (4.9) |
| Adhesions                        | 4 (4.9) |
| Stricture or obstructing mass    | 3 (3.7) |

Bowel preparation

| Bowel preparation | N (%) |
|-------------------|-------|
| Adequate          | 29 (34) |
| Inadequate        | 12 (14) |
| Unknown           | 45 (52) |
| No diagnosis made | 8 (9.3) |
| Diagnosis made    | 65    |
| Normal            | 20 (23.3) |
| Adenomateous polyps | 25 (38.5) |
Table 2: Procedure characteristics.

| Author                | Modality | Type of study    | Patients | Caecal intubation rate |
|-----------------------|----------|------------------|----------|------------------------|
| Kaltenbach et al. [12]| DBE      | Prospective      | 20       | 19 (95%)               |
| Das et al. [13]       | DBE      | Small case series| 16       | 14 (87.5%)             |
| Gay et al. [14]       | DBE      | Retrospective    | 29       | 28 (96.6%)             |
| Monkemuller et al. [15]| DBE     | Retrospective    | 7        | 7 (100%)               |
| Pasha et al. [16]     | DBE      | Retrospective    | 16       | 14 (87.5%)             |
| Moreels et al. [17]   | DBE      | Retrospective    | 26       | 23 (88.5%)             |
| Moreels et al. [18]   | DBE      | Prospective      | 45       | 42 (93.3%)             |
| Matsushita et al. [19]| DBE      | Retrospective    | 24       | 24 (100%)              |
| Dzeletovic et al. [20]| DBE      | Retrospective    | 27       | 25 (92.6%)             |
| Gomez et al. [21]     | DBE      | Retrospective    | 51       | 46 (90.2%)             |
| Hotta et al. [22]     | DBE      | Prospective      | 110      | 110 (100%)             |
| Suzuki et al. [23]    | DBE      | Prospective      | 47       | 47 (100%)              |
| Yamada et al. [24]    | DBE      | Prospective      | 10       | 10 (100%)              |
| Becx et al. [25]      | DBE      | Retrospective    | 114      | 101 (88.6%)            |
| Nemoto et al. [26]    | DBE      | Prospective      | 28       | 28 (100%)              |

Interventions

In total, 64 interventions were performed in 53 out of 86 procedures (62%). These included: snare polypectomy (n=26), endoscopic mucosal resection (n=3), biopsy (n=17), argon plasma coagulation (n=8), endoscopic clipping (n=4), and balloon dilatation (n=3). No significant adverse events were reported.

Discussion and conclusion

This study demonstrates a very high technical success rate of 93% for DAE in patients who had a failed conventional colonoscopy. Previous data showed that the success rate of repeat standard colonoscopy in expert's hands was only 72% [10]. This may suggest that the characteristics of the balloon overtube are well suited as a salvage method after previous failed colonoscopy for redundant colons [11]. As explained in the method section DAE uses a different technique compared to regular colonoscopy. DAE uses balloon(s) which are alternately inflated and deflated to pleat the bowel towards the endoscopist. Our study is the third largest published series to date on this subject, and the largest in the southern hemisphere. Our findings are comparable to previous studies, which report success rates for DBE between 87% and 100%, and SBE between 93% and 100% [12-31]. In Table 3 we summarize the available literature. This study was not designed to assess the different success rates between DBE and SBE, as all procedures were reported as DAE in our database.

Table 2: Procedure characteristics.

Diagnoses

In 8 out of 86 procedures (9%) no diagnosis could be made: 6 because of inability to intubate the caecum (80% due to inadequate bowel preparation) and 2 due to inadequate bowel preparation in a completed procedure. Twenty out of the remaining 78 procedures showed no abnormalities. In the remaining 58 procedures, 65 diagnoses were made, including ≥ 1 adenomatous polyps (n=25), angioectasia (n=7), colonic diverticulosis (n=6), inflammatory bowel disease (n=14), strictures (n=5; 1 case related to IBD), laterally spreading tumour (n=3), adenocarcinoma (n=3), and ileal ulcers (n=2).
Hotta et al. reported only 1 case of asymptomatic mild mucosal tears,\[8,32\]. In a large Dutch cohort of 8,884 patients comparing colonoscopy with CTC it was demonstrated that colonoscopy detects a postprocedural bleeding out of 114 DBE procedures \[25\]. Similarly, from experienced enteroscopists in a large-volume, academic center.\[33\]. Caution is therefore needed in extrapolating these success rates to periprocedural adverse events were reported in our cohort. Despite cecal intubation the bowel preparation was inadequate.\[63\] of patients undergoing CTC for failed colonoscopies require repeat colonoscopy \[33\].

Moreover, CTC cannot be used to perform intervention. In our cohort, almost two third of patients (62%) needed an intervention. Despite sessile serrated polyps as precursor lesions to colorectal adenocarcinoma alternatives for CTC should be considered \[32\].

Our data highlights the importance of optimal bowel preparation to gain a high technical and diagnostic success rate. Inadequate bowel preparation was the reason for failure to intubate the cecum in 5 out 6 cases. In addition, in the 2 patients in whom a diagnosis was not made despite cecal intubation the bowel preparation was inadequate. This shows the need for adequate bowel preparation.

Although our study is limited by a retrospective study design, no periprocedural adverse events were reported in our cohort. Furthermore, most procedures were performed under conscious sedation, highlighting the safety and tolerability of DAE for this indication. Consistent with the literature. In 2014 Becx & Al-Toma reported only 2 minor adverse events (self-resolving, postprocedural bleeding) out of 114 DBE procedures \[25\]. Similarly, Hotta et al. reported only 1 case of asymptomatic mild mucosal tears, not requiring intervention, out of 110 DBE procedures \[22\].

A limitation of our study is the lack of an active comparison between DAE and other salvage option, such as CT colonography or repeat colonoscopy. Ultimately, to accurately compare these modalities a prospective trial would be required. Moreover, we present the data from experienced enteroscopists in a large-volume, academic center. Caution is therefore needed in extrapolating these success rates to daily practice as not all endoscopists are experienced in using DAE.

In conclusion, this study shows that retrograde DAE is a safe and effective salvage procedure after incomplete colonoscopy in redundant colons, with a high technical success rate in an expert center. It yields important findings, which may be expected to alter clinical management, and offers therapeutic potential. The main reason for failure of DAE in this setting seems to be inadequate bowel preparation. As such, we strongly feel DAE should be recommended after incomplete colonoscopy, rather than repeat standard colonoscopy or CT colonography.

**Table 3:** Summary of studies to date reporting caecal intubation rates using enteroscopy after failed colonoscopy.

| Study             | Procedure | Design    | Rate    | Success Rate |
|-------------------|-----------|-----------|---------|--------------|
| Yung et al. \[27\] | DBE       | Retrospective | 57      | 55 (96.5%)   |
| Teshima et al. \[28\] | SBE       | Prospective | 23      | 22/23 (96%)  |
| Keswani et al. \[29\] | SBE       | Prospective | 30      | 28/30 (93%)  |
| Coppola et al. \[30\]  | SBE       | Prospective | 79      | 74/79 (94%)  |
| Yamada et al. \[31\]  | SBE       | Prospective | 11      | 10/11 (91%)  |

In our study we showed a high rate of clinically significant diagnoses that were made after previous failed colonoscopy (73% of successful procedures). This highlights the importance of a complete colonoscopy. Despite its wide use, CTC fails to detect lesions with a diameter greater than 10 mm in 10-15% of patients \[7\]. Flat mucosal lesions, including sessile serrated polyps, are also frequently missed \[8,32\]. In a large Dutch cohort of 8,884 patients comparing colonoscopy with CTC it was demonstrated that colonoscopy detects a higher rate of high-risk sessile serrated polyps than CTC (3.1% vs. 0.4%) \[8\]. Given the importance of sessile serrated polyps as precursor lesions to colorectal adenocarcinoma alternatives for CTC should be considered \[32\].

Moreover, CTC cannot be used to perform intervention. In our cohort, almost two third of patients (62%) needed an intervention. Polypectomy was performed in 34% of cases, and beyond mitigating the risk of future colorectal adenocarcinoma, this enabled correct risk stratification and appropriate surveillance intervals. Radiological studies do not allow such interventions and 63% of patients undergoing CTC for failed colonoscopies require repeat colonoscopy \[33\].

Our data highlights the importance of optimal bowel preparation to gain a high technical and diagnostic success rate. Inadequate bowel preparation was the reason for failure to intubate the cecum in 5 out 6 cases. In addition, in the 2 patients in whom a diagnosis was not made despite cecal intubation the bowel preparation was inadequate. This shows the need for adequate bowel preparation.

Although our study is limited by a retrospective study design, no periprocedural adverse events were reported in our cohort. Furthermore, most procedures were performed under conscious sedation, highlighting the safety and tolerability of DAE for this indication. Consistent with the literature. In 2014 Becx & Al-Toma reported only 2 minor adverse events (self-resolving, postprocedural bleeding) out of 114 DBE procedures \[25\]. Similarly, Hotta et al. reported only 1 case of asymptomatic mild mucosal tears, not requiring intervention, out of 110 DBE procedures \[22\].

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In conclusion, this study shows that retrograde DAE is a safe and effective salvage procedure after incomplete colonoscopy in redundant colons, with a high technical success rate in an expert center. It yields important findings, which may be expected to alter clinical references.

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