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Patient adherence to surveillance colonoscopy after endoscopic resection of colorectal polyps and factors associated with loss to follow-up

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ABSTRACT

Background and study aims Post-polypectomy surveillance colonoscopy (SC) plays an integral role in efforts to reduce colorectal cancer risk, but its effectiveness is invariably dependent on patient compliance. This study aimed to evaluate patient adherence to SC after endoscopic resection (ER) of polyps ≥ 20 mm and identify potential barriers associated with loss to follow-up.

Patients and methods This was a single-center retrospective study evaluating adherence to SC after ER of polyps ≥ 20 mm between April 2018 to December 2021. Adherence to SC was defined as the proportion of patients who underwent follow-up colonoscopy. Multivariate logistic regression was performed to identify factors associated with loss to follow-up.

Results A total of 959 patients (mean age 67 years; 47.9% women) underwent endoscopic resection of colorectal polyps ≥ 20 mm (mean size 33.2 ± 13.7 mm). Nearly half of the patients (n = 478; 49.8%) were lost to follow-up. On multivariate analysis, factors associated with a higher likelihood of SC non-adherence were: lack of a primary care physician (odds ratio [OR] 1.7;95% confidence interval [CI] 1.3-2.3; $P < 0.05$), American Society of Anesthesiologists grade 3 or 4 (OR 1.4; 95% CI 1.1–1.9; $P < 0.05$), residence > 60 miles from the endoscopy suite (OR 1.6; 95% CI 1.2–2.3; $P = 0.02$), being referred by a physician outside of our healthcare system (OR 1.4; 95% CI 1.1–1.8; $P = 0.01$), and lack of written follow-up recommendations on the colonoscopy report (OR 3.6; 95% CI 1.4–10.2; $P = 0.01$).

Conclusions Nearly half of patients undergoing ER of colorectal polyps ≥ 20 mm are lost to follow-up. We identified several patient- and healthcare-related factors as barriers to SC adherence. Strategies to address these issues and targeting of high-risk populations are urgently needed to enhance SC programs.

Introduction

Colorectal cancer (CRC) is the third most common cancer in the United States [1]. Colonoscopy reduces CRC incidence and mortality by detection and resection of neoplastic polyps [2, 3]. Patients with polyps are at higher risk for metachronous advanced neoplasia as compared with those with no neoplasia detected on prior colonoscopy [4]. Given the increased risk for advanced neoplasia and CRC in these patients on follow-up, post-polypectomy surveillance colonoscopy (SC) plays an integral part in the effort to reduce CRC risk [4]. However, the effectiveness of SC as a tool is invariably dependent on patient compliance [5].

Patient non-adherence to screening colonoscopy has been well-documented, with rates ranging from 20% to 43% [6, 7]. Several studies document barriers to initial colonoscopy [8, 9], but even after the initial colonoscopy is performed, appropriate surveillance is often neglected with potential serious consequences [6, 10]. There is a paucity of data on patient adherence to SC [11, 12], specifically after endoscopic resection of large polyps ≥ 20 mm in size (about 0.79 in). This study aimed to evaluate patient adherence to SC and to identify potential barriers associated with loss to follow-up.

Patients and methods

Study population and data collection

The study was approved by the institutional review board (IRB) at AdventHealth, Orlando, Florida, United States. To be eligible for inclusion in this study, the prospectively maintained electronic endoscopy database (Provation, Minneapolis, Minnesota, United States) was retrospectively searched for all patients who had undergone colonoscopy between April 1, 2018 and April 22, 2022 at the Center for Interventional Endoscopy (CIE) at AdventHealth, Orlando, Florida, United States. Patients are scheduled for colonoscopy either by open access or following a consultation. Each colonoscopy report was then reviewed to identify those in which polyp resection had been performed as an index procedure at the CIE. Patients were excluded if they were undergoing colonoscopy for an indication other than CRC screening or polyp resection. Patients were also excluded from final analysis if their polyp histopathology showed invasive cancer because the follow-up interval and treatment plan in these patients differed from those with benign polyps or if they were instructed to undergo additional SC based on age/comorbidities. Baseline data included patient demographics, marital status, type of medical insurance, assignment of a primary care physician, distance of residence from the endoscopy unit, and whether the referring physician was part of our health care system (affiliated to AdventHealth Hospitals). Procedure data extracted from the colonoscopy and pathology reports included quality of bowel preparation, type of endoscopic resection, and polyp characteristics (number, location, size, histopathology).

Outcomes and definitions

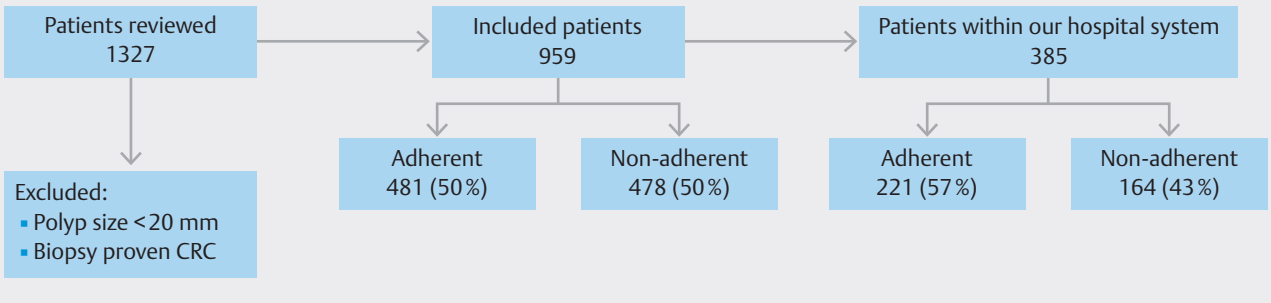
The primary outcome was to evaluate patient non-adherence, defined as failure to attend SC appointment at the CIE at any point after their index procedure. Patients were considered adherent if they arrived at their scheduled appointment, regardless of whether the SC was then cancelled or incomplete. Factors associated with non-adherence (loss to follow-up) to SC were examined as a secondary outcome.

Statistical analysis

Continuous variables were compared using the Wilcoxon rank sum test. Categorical variables were compared using the Chi-square or Fisher's exact test. Univariate logistic regression was used with respect to each covariate to identify variables significantly associated with the outcome, defined as those with $P < 0.20$. These variables were then included in a stepwise selection, multiple logistic regression analysis to identify those factors most significantly associated with the outcome, based on $P < 0.05$.

Results

The patient flow chart is shown in ▶ **Fig. 1**. A total of 4344 colonoscopies were performed at the CIE during the study period. Of these, 1327 patients underwent colonoscopy with endoscopic resection, of which 959 patients (mean age 67.0 years; 47.9% women) had polyps ≥ 20 mm in size and were included in the final analysis. Patient characteristics are summarized in ▶ **Table 1**. Most patients were of White race (796; 83.0%), American Society of Anesthesiologists (ASA) class I or II (665; 69.3%), married (633; 66%), and on either private insurance



▶ **Fig. 1** Patient flow chart.

▶ **Table 1** Baseline characteristics.

	Entire cohort (n = 959)
Age; median (IQR), years	68 (61–74)
Female; n (%)	459 (47.9)
BMI, mean (SD); kg/m^2	29.2 (10.8)
ASA grade; n (%)	
▪ I/II	665 (69.3)
▪ III/IV	294 (30.7)
Race; n (%)	
▪ White	796 (83.0)
▪ African American	58 (6.0)
▪ Asian	12 (1.3)
▪ Native American	3 (0.3)
▪ Other	90 (9.4)
Marital status; n (%)	
▪ Single	127 (13.2)
▪ Married	633 (66.0)
▪ Divorced/widowed	199 (20.8)
Health insurance; n (%)	
▪ Non-insured	93 (9.7)
▪ Commercial	427 (44.5)
▪ Government	439 (45.8)
Primary care physician; n (%)	
▪ No PCP	386 (40.3)
▪ Have PCP	573 (59.7)
Referring physician; n (%)	
▪ PCP	16 (1.7)
▪ Gastroenterologist	891 (92.9)
▪ Colorectal surgeon	34 (3.5)
▪ Other	18 (1.9)
Distance of residence from endoscopy unit	
▪ ≤ 60-mile radius	806 (84.0)
▪ > 60-mile radius	153 (16.0)

ASA, American Society of Anesthesiologists; BMI, body mass index; IQR, interquartile range; PCP, primary care physician; SD, standard deviation.

(427; 44.5%) or Medicare/Medicaid (439; 45.8%). Nearly two-thirds of the patients had an assigned primary care physician (PCP) (573; 59.7%) and approximately half were referred by a physician affiliated with our health care system (427; 44.5%). Most patient residences were located in a < 60-mile radius from the endoscopy unit (806; 84%).

Procedure characteristics are shown in ▶ **Table 2**. Median polyp size and number of polyps removed were 30 mm (IQR: 25–50 mm) and 1.0 polyp (IQR: 1.0–3.0), respectively. In all, most polyps were in the right colon (proximal to the splenic flexure) (784; 81.8%) and more than two-thirds were categorized as either lateral spreading granular (406; 42.3%) or non-granular lesions (270; 28.8%). Most lesions were adenomas (774; 80.7%), followed by serrated adenomas (156; 16.3%) and hyperplastic polyps (29; 3.0%). Post-procedure bleeding or perforation were reported in 2.6% and 0.1% of the cases, respectively. All adverse events were managed endoscopically and/or with medical therapy.

Surveillance colonoscopy and loss to follow-up

Of the 959 patients in this study, 481 (50.2%) underwent SC at a median of 6 months (IQR: 5–7 months); whereas 478 (49.8%) were lost to follow-up (did not have SC at CIE). Baseline and procedure characteristics between the two groups are available in the supplementary material. Factors associated with loss to follow-up are summarized in ▶ **Table 3**.

The following variables were associated with a higher likelihood for loss to SC follow-up on univariate analysis: patient ASA grade 3 or 4 (odds ratio [OR] 1.41; 95% CI 1.05–1.90; $P < 0.05$), patients living > 60-mile radius away from the endoscopy suite (OR 1.6; 95% CI 1.05–2.32; $P = 0.02$), lack of PCP (OR 1.74; 95% CI 1.31–2.31; $P = 0.0001$), being referred by a physician outside of the health care system (OR 1.40; 95% CI 1.06–1.84; $P < 0.0001$), and those in whom written follow-up recommendations for SC interval were not available on index colonoscopy report (OR 3.64; 95% CI 1.36–10.18; $P = 0.01$). All these variables remained as independent factors associated with a higher likelihood of loss to follow-up to SC on multivariate analysis.

Discussion

Compared with the general population, patients who undergo endoscopic resection of neoplastic polyps are at an increased risk of metachronous neoplasia [1, 2]. Hence, surveillance colonoscopy (SC) is recommended to reduce risk of developing CRC [4]. In this study, we demonstrate that only half of patients (50.2%) who undergo endoscopic resection of polyps ≥ 20 mm in size were adherent to SC. We identified several factors independently associated with a higher likelihood for loss to follow-up.

Data on patient compliance with SC after polypectomy remain scarce. In this study, nearly half the patients (49.8%) did not undergo SC after endoscopic resection of colorectal polyps ≥ 20 mm in size. This is somewhat slightly higher than the non-adherence rate to colonoscopy reported in prior studies, ranging between 20% and 43% [13, 14, 15, 16]. Patients undergoing endoscopic resection of ≥ 20 mm colorectal polyps are recommended to have repeat colonoscopy at 6 months [4]. We speculate that the shorter interval between index procedure and SC may, in part, contribute to the high patient nonadherence rate. Many patients lack understanding of the purpose of screening colonoscopy and the need for follow-up, and often underestimate risk of colon cancer in the asymptomatic stage [17]. These

▶ **Table 2** Procedure and polyp characteristics.

	Entire cohort (n = 959)
Procedure characteristics	
Quality of bowel prep, n (%)	
▪ Poor/fair	442 (46.1)
▪ Good/excellent	482 (50.3)
▪ Not available	35 (3.6)
Technique; n (%)	
▪ EMR	946 (98.6)
▪ ESD	13 (1.4)
Adverse event; n (%)	
▪ Bleeding	25 (78.1)
▪ Perforation	1 (3.1)
▪ Respiratory failure	2 (6.3)
▪ Abdominal pain	3 (9.4)
▪ Not available	1 (3.1)
Polyp characteristics	
Polyps removed during colonoscopy, median (IQR)	1 (1–3)
Polyp size; median (IQR), mm	30 (25–40)
Polyp location, n (%)	
▪ Ileocecal valve	43 (4.5)
▪ Cecum	209 (21.8)
▪ Ascending colon	326 (33.9)
▪ Transverse colon/HF	206 (21.5)
▪ Descending colon	62 (6.5)
▪ Sigmoid colon	74 (7.7)
▪ Rectum	39 (4.1)
Morphology; n (%)	
▪ Sessile	381 (39.7)
▪ Pedunculated	41 (4.3)
▪ Flat	68 (7.1)
▪ N/A	469 (48.9)
Lateral spreading; n (%)	
▪ Granular	406 (42.3)
▪ Non-granular	270 (28.2)
▪ Mixed	77 (8.0)
▪ N/A	206 (21.5)
Histopathology, n (%)	
▪ Hyperplastic polyp	29 (3.0)
▪ Tubular adenoma	411 (42.9)
▪ Villous adenoma	22 (2.3)
▪ Tubulovillous adenoma	341 (35.5)
▪ Serrated adenoma	156 (16.3)

EMR, endoscopic mucosal resection; ESD, endoscopic submucosal dissection; HF, hepatic flexure; IQR, interquartile range; SD, standard deviation.

▶ **Table 3** Univariate and multivariate analysis of factors associated with loss to follow-up colonoscopy after endoscopic resection of colorectal polyps.

Baseline characteristics	Univariate OR (95% CI)	Univariate *P* value	Multivariate OR (95% CI) for all *P* < 0.05	Multivariate *P* value
Age	1.01 (0.99–1.02)	0.12	1.01(0.99 – 1.02)	0.31
Female	1.26 (0.98–1.62)	0.07	1.21 (0.91- 1.60)	0.18
ASA class (III/IV vs I/II)	1.42 (1.07–1.87)	< 0.05	1.41 (1.045 – 1.90)	< 0.05
Marital Status (not married vs married)	1.27 (0.87–1.86)	0.22	1.24 (0.82 – 1.85)	0.31
Residence distance from endoscopy unit (> 60 miles vs ≤ 60 miles)	1.83 (1.27–2.66)	0.001	1.56 (1.05 – 2.32)	0.02
Lack of primary care physician (yes vs no)	1.88 (1.44–2.44)	< 0.0001	1.74 (1.31 – 2.31)	0.0001
Referring physician outside of our hospital system (yes vs no)	1.58 (1.22–2.04)	< 0.001	1.40 (1.06 – 1.84)	0.01
Lack of written surveillance recommendations on index colonoscopy report	4.34 (1.61–11.66)	0.003	3.64 (1.36 – 10.18)	0.01

ASA, American Society of Anesthesiologists; CI, confidence interval; OR, odds ratio.

issues may be further compounded by an open access setting, such as in our unit, in which patients can be scheduled without a prior clinic visit [14]. Potential strategies to improve adherence may include raising awareness and emphasizing the importance of SC at the time of the index procedure and preemptively scheduling repeat colonoscopy prior to discharge from the endoscopy unit. Furthermore, recent data suggest that extending the interval surveillance following piecemeal resection of large polyps may be safe and effective [18], which may also help ameliorate the lower compliance associated with shorter interval procedures [16]. Future studies aimed to enhance patient adherence are urgently needed because effectiveness of SC is foremost dependent on patient receptiveness.

This study identified several factors associated with nonadherence to SC. Insight into these factors is of paramount importance, because directed interventions may further help decrease the nonattendance rate. We classified factors affecting loss to follow-up into two main categories: patient-related factors and health care system-related factors.

Our results demonstrated that patients with more comorbidities (ASA grade 3 or higher) and those living farther away from the endoscopy unit were more likely to be lost to follow-up. Patients with higher ASA grade may have more restricted mobility and possibly more difficulty/intolerability of large-volume (polyethylene glycol) preparations, which may contribute to nonattendance [16]. Implementing a telephone call reminder at least 7 days prior to the procedure may help troubleshoot attendance issues and potentially identify patients who may not be able to attend due to either recent or present illness/hospitalization. Discussing barriers to bowel preparation at their index procedure may help identify potentially more acceptable bowel preparation alternatives for their repeat colonoscopy. Prior studies have that demonstrated long travel distance is a recurrent barrier to medical care, given the additional burden (time and cost of transportation) associated with these appointments [19, 20]. Alternatively, patients could be directed to their local health care providers for the SC. Nonetheless, it is imperative to implement a checking system in which completion of follow-up procedures can be confirmed. Developing and providing a transportation resource guide tailored to local settings has also been proposed as another strategy to assist those in under-resourced regions [19].

Healthcare-related factors may be more modifiable than patient-related factors [14, 16]. In this study, we identified lack of a PCP and of written instructions for follow-up on the colonoscopy report as two barriers to patient adherence to SC. It should be noted that these factors are not an indication of patient non-compliance, but rather, potentially modifiable factors that may contribute to non-adherence, simply due to lack of guidance for patients. Indeed, PCP engagement and support of patient care has been shown to be essential for effective health care delivery [21]. Several studies have demonstrated that PCP-led follow-up results in a significant increase in patient compliance [22, 23], irrespective of insurance status [24]. PCP recommendation has been shown to be one of the most common factors motivating patient decisions to proceed with testing, further underscoring the importance of the PCP [25]. In addition, our study also highlights that ensuring clear written instructions on the index colonoscopy report with regard to timing and need for SC is imperative. The report provides guidance to the PCP, referring physician, and patient regarding the recommendations and can also serve as a reminder on subsequent clinic visits. Furthermore, we also noted that patients who were referred by gastroenterologists within our healthcare system (AdventHealth) were more likely to undergo SC. Patients and referring physicians integrated into our center share the same electronic medical record (EMR) system, which facilitates reviewing reports, ordering, scheduling procedures, and communication between the different parties.

There are several strengths to this study. For one, there are many studies focused on physician adherence to post-polypectomy surveillance guidelines, but there are limited data on patient compliance with such recommendations. Furthermore, we included nearly 1000 patients in the final analysis, thereby providing one of the largest studies on this issue. We also specifically evaluated patient adherence after endoscopic resection of polyps ≥ 20 mm in size, thus excluding other patients with smaller polyps that may have introduced heterogeneity in the follow-up recommendations and data interpretation. Lastly, comprehensive review and acquisition of multiple data points was performed to identify patient- and systems-related barriers to patient nonadherence.

We also recognize the limitations of this study, including its retrospective design. Second, CIE is an open-access, tertiary care endoscopy unit. Although we routinely recommend that patients complete their first SC at CIE, it is possible that many patients may have elected to perform their repeat colonoscopy with their local provider. As such, we recognize that the definition for non-adherence in this context included all patients who did not follow-up at CIE, and may not necessarily equate with lack of compliance because many of them may have elected to follow up locally. Patients who may have completed these tests locally may not have been captured, leading to overestimation of the loss to follow-up rate. With this in mind, we performed a subgroup analysis (available in the supplementary material) including only patients whose referring gastroenterologists were within our health care system, to ensure that all colonoscopies after their index procedure at CIE would be available for review in the EMR. Among these 385 patients, the nonadherence rate was still high at 42.6%, which further validates the results for our entire cohort. Furthermore, multivariate analysis of factors associated with non-compliance with SC within this cohort showed that lack of a PCP remained a significant independent factor. This subgroup analysis further supports our overall findings and mitigates the possibility that our overall results were simply due to lack of follow-up data. Third, several patient-level factors were unavailable that would have been of interest because of their potential impact on adherence to surveillance recommendations (i. e., socioeconomic status and education). Fourth, the study period of 2018 to 2022 overlapped with the COVID-19 pandemic, which may have led to reduced healthcare utilization [26]. Nonetheless, our nonadherence rate was, to some extent, similar to those previously reported [27],

thereby mitigating the potential impact of COVID-19 on our findings.

Conclusions

In summary, our study suggests high nonadherence to SC in patients undergoing endoscopic resection of polyps ≥ 20 mm in size. Several patient- and healthcare-related factors were identified as potential barriers to adherence to SC recommendations. Nonadherence negatively impacts health care resource utilization and patient-related outcomes. Strategies to address these issues and targeting high-risk vulnerable populations are urgently needed to enhance adherence to SC.

Conflict of Interest

D. Yang is a consultant for Olympus, Fujifilm, Apollo Endosurgery, Medtronic, and Microtech. D. Yang receives research support from Microtech and 3D-Matrix. M.K. Hasan is a consultant for Boston Scientific, Microtech, and Olympus. M. Arain is a consultant for Boston Scientific and Olympus. N. Cosgrove is a consultant for Boston Scientific and Olympus. All other authors have nothing to disclose.

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