



Exploring the Association between Benign Anorectal Conditions and Colorectal Cancer from the Analysis of Lower Gastrointestinal Endoscopies

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Abstract

Objective Patients experiencing hemorrhoids or fissures may overlook other gastrointestinal (GI) symptoms, assuming that they are linked solely to their existing condition. However, colon cancer, often asymptomatic, can coincide with benign pathologies detected during colonoscopy. This study investigates the prevalence of colorectal cancer (CRC) in patients undergoing lower GI endoscopy for hemorrhoids and elucidates the correlation between cancer and benign pathologies identified during colonoscopy. Highlighting its potential to reveal hidden cancers emphasizes the critical role of colonoscopy in comprehensive health care.

Methods The primary objective was to thoroughly investigate the prevalence of CRC in patients who underwent lower GI endoscopy for hemorrhoids. A comprehensive analysis was conducted using a dataset spanning 7 years of lower GI endoscopy. The main focus of this investigation was to determine the incidence of cancer. Additionally, a meticulous examination of accompanying benign diagnoses was performed to provide a comprehensive evaluation.

Results The study cohort, comprising 6,268 patients, revealed a noteworthy coexistence of malignancies with common conditions. The revelation was of paramount significance that the total number of malignant cases within this cohort was 440. Polyps emerged as the most frequently observed condition, constituting 55.2% ($n = 243$) of the cases. Diverticulosis was present in 6.6% ($n: 29$) of cases, while ulcerative colitis was detected in 8% ($n: 2$) of cases. Hemorrhoids were identified in 20.7% ($n: 91$) of cases. The findings indicated a substantial association between these common conditions and malignancy. Specifically, it was discovered that approximately 1 in 22 individuals with hemorrhoids, 1 in 52 individuals with fissures, and 1 in 5.7 individuals with polyps were diagnosed with malignancy.

Keywords

- ▶ colonoscopy
- ▶ hemorrhoids
- ▶ benign pathologies
- ▶ malignant pathology
- ▶ clinical implications

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Conclusion This study highlights the pivotal role of colonoscopy in uncovering hidden cancers, especially in patients with hemorrhoids. The findings emphasize the significance of doctors and patients prioritizing colonoscopy, as it allows for early detection and intervention for potential malignancies, even in the presence of hemorrhoids.

Introduction

Colonoscopy is an essential tool in the detection and prevention of colorectal cancer (CRC). It involves inserting a flexible tube with a camera into the rectum and colon to examine the lining for abnormalities, such as polyps or tumors.¹ Colorectal cancer is the third most common cancer worldwide, and early detection is crucial for successful treatment and positive patient outcomes.² Colonoscopy is recommended for individuals at average risk of CRC starting at the age of 45 or 50 years, depending on the guidelines.^{3,4} Despite its importance, a significant proportion of the population still needs to undergo screening.⁴ However, misconceptions regarding gastrointestinal (GI) symptoms associated with benign anorectal conditions, such as hemorrhoids, can sometimes deter patients from undergoing colonoscopy examinations, leading to potential diagnostic challenges and delayed treatment.^{4,5}

The prevalence of cancer and benign pathologies in colonoscopy has been extensively studied. A retrospective Canadian study showed that the risk of cancer was 45% lower for patients with a negative baseline colonoscopy than that for the general population.⁵ Benign pathologies are noncancerous growths or abnormalities in the colon and rectum, such as polyps, diverticula, and hemorrhoids. While these abnormalities are not cancerous, they can still cause discomfort, bleeding, and other symptoms. Polyps are small growths that can develop inside the colon and rectum. While most polyps are benign, some can become cancerous over time. Diverticula are small pockets that can form in the lining of the colon. Hemorrhoids are swollen veins in the rectum and anus, but they also involve an inflammatory process underlying the condition. It is not uncommon for both cancer and benign pathologies to be present in the same colonoscopy.^{4,5}

In the field of health care, it is not uncommon for patients suffering from hemorrhoids or fissures to mistakenly assume that all GI symptoms they experience are solely related to their condition and, thus, disregard the necessity of a colonoscopy examination. This misconception can be challenging for medical professionals as it may lead to inaccurate diagnoses and hinder proper treatment. While hemorrhoids and fissures can cause symptoms such as rectal bleeding or discomfort during bowel movements, patients must understand that various other conditions, including CRC, inflammatory bowel disease (IBD), or polyps, can present with similar GI symptoms.^{1,4} Conducting a colonoscopy examination helps clinicians visualize the inner lining of the colon and rectum, enabling them to detect any abnormal growths or lesions that might not be identifiable through external examination alone. Encouraging patients to undergo this procedure despite their initial assumptions ensures comprehensive diagnostic evaluation

and improves patient outcomes by promptly identifying potential GI pathologies.³⁻⁵

This study aims to explore the association between benign anorectal conditions, with a focus on hemorrhoids, and CRC. Additionally, we seek to investigate the prevalence of CRC among patients undergoing lower GI endoscopy specifically for hemorrhoids.

Methods

Setting and Design

In this retrospective study, all patients who underwent lower GI endoscopy for hemorrhoids and a range of symptoms, such as pain, bleeding, and family history of cancer, including both colonoscopy and sigmoidoscopy procedures, were included in the analysis to capture a comprehensive overview of the patient population. Given the nature of the study design, which relied on retrospective analysis of endoscopy records, both colonoscopy and sigmoidoscopy procedures were considered, ensuring a more inclusive representation of patients presenting with hemorrhoids. The study utilized data from endoscopy reports obtained from a single center over 7 years.

Objectives

The primary objective was to assess the prevalence of CRC among patients undergoing lower GI endoscopy for hemorrhoids. Secondary objectives included identifying common benign pathologies observed during colonoscopy and comparing the prevalence of CRC between different patient groups based on demographic and clinical characteristics.

Selection of Cases

The study included patients who underwent lower GI endoscopy for hemorrhoids and a range of symptoms, such as pain, bleeding, and a family history of cancer. Patients with a known history of CRC or incomplete colonoscopy due to inadequate bowel preparation were excluded from the analysis. The inclusion criteria encompassed patients who underwent both colonoscopy and sigmoidoscopy procedures, ensuring a comprehensive evaluation of individuals with benign anorectal conditions. This approach was pivotal in capturing a diverse patient population and facilitating a thorough examination of the association between these conditions and CRC.

Data Collection

Data were retrospectively collected from endoscopy reports, electronic medical records, and pathology reports. Relevant

demographic information, clinical history, indications for colonoscopy, endoscopic findings, and histopathological diagnoses were extracted and analyzed. Patients who presented with symptoms suggestive of colorectal disease were promptly referred for endoscopy examinations. The average duration between the initial request for endoscopy and the actual procedure was within 1 month. This expedited timeline ensured timely evaluation and management of patients with suspected colorectal pathology.

Description of Our Colonoscopy Practice

Colon Preparation

Colon preparation protocols varied depending on physician preference and patient-specific factors. Patients were typically instructed to follow a clear liquid diet and to consume bowel-cleansing agents such as polyethylene glycol or sodium picosulfate-magnesium citrate solution. Detailed instructions are provided to ensure adequate bowel cleansing before the procedure.

Colonoscopy Procedure

Once the patient arrives for the procedure, vascular access is established, and intravenous fluids are administered. To ensure patient comfort, midazolam 1 to 5 mg was given as a sedative, and hyoscine-N-butyl bromide (scopolaminbutyl bromide) 20 to 50 mg was administered intravenously as a spasmolytic to those who have fasted for at least 24 hours. The colonoscopy used Fujinon and Olympus brand devices, ensuring the highest accuracy and precision.

Histopathological Evaluation

Biopsies were obtained from suspicious lesions, and polypectomies were performed as indicated. Tissue specimens obtained during colonoscopy were sent to the pathology laboratory for histopathological evaluation. Experienced pathologists examined the specimens for evidence of dysplasia, malignancy, or other pathological changes. The diagnosis of CRC was confirmed based on histopathological findings.

Statistical Analysis

The study assessed cancer detection and concurrent benign diagnoses, employing Statistical Package for Social Sciences (SPSS) version 21.0 for analysis. All the data (demographics and indications) and endoscopy findings were captured in the endoscopic unit database as usual practice. The prevalence of CRC and benign pathologies was calculated, and comparisons between different patient groups were made using appropriate statistical tests, such as chi-square tests or Fisher's exact tests. Adjustments for potential confounding variables were performed where applicable. Descriptive statistics were calculated for quantitative variables, including mean and standard deviations. Mean, standard deviation, median values, and interquartile range were also specified for certain variables. Proportions were calculated for qualitative variables. Furthermore, the analysis stratified patients based on age groups to assess variations in the prevalence of

CRC and benign pathologies across different demographic profiles. Statistical comparisons were performed to elucidate any significant associations between these variables, contributing to a deeper understanding of the research question.

Reporting Guidelines

Strengthening the Reporting of Observational Studies in Epidemiology guidelines were used when reporting this observational study (► **Supplementary Material Appendix 1**, available in the online version).

Results

Data Source

A total of 7,526 lower GI endoscopies were reviewed. After excluding 505 endoscopies of patients with known malignant pathology and 751 endoscopies with insufficient bowel preparation, the study cohort consisted of 6,268 patients. Of these, 3,697 were males (59%) and 2,571 were females (41%). The mean age of the study group was 55.1 ± 16.8 (range, 18–105) years old. In the study, 2,955 endoscopies (47.1%) were colonoscopies, and 3,313 (52.9%) were flexible rectosigmoidoscopies. ► **Fig. 1** provides a concise representation of the study's flow diagram.

Characteristics of Patients and Conditions

► **Table 1** shows the patient demographics and all identified pathologies. When examining the keywords associated with common diagnoses, we found that hemorrhoids were reported in 2,024 cases (32.6%) and polyps in 1,387 cases (22.1%). The histopathological report revealed that 11.5% of the polyps were neoplastic, classified as neoplastic polyps. Both neoplastic polyps and histopathologically proven cancer constituted the malignant group ($n: 440$) (► **Table 1**).

Associations Detected between Various Conditions

After stratifying by age groups, we found a significantly higher proportion of patients aged >50 years with polyps, cancer, and neoplastic polyps compared to the group aged ≤50 ($p < 0.001$, $p < 0.001$, and $p = 0.018$, respectively). There was also a higher proportion of benign conditions, such as hemorrhoids, anal fissure, anal fistula, and diverticulosis, in patients aged >50 compared to those ≤50 ($p < 0.001$ for all) (► **Table 2**).

Malignant cases were found to coexist with common conditions in our study. Polyps were the most frequently observed among these conditions, accounting for 55.2% ($n: 243$) of cases. Diverticulosis was present in 6.6% ($n: 29$) of cases, while ulcerative colitis was detected in 8% ($n: 2$) of cases. Hemorrhoids were also identified in 20.7% ($n: 91$) of cases. Notably, 55.2% of malignant cases were associated with polyps, and 20.7% of these cases coincided with the presence of hemorrhoids, as indicated in the colonoscopy reports (► **Table 3**). Our analysis revealed a notable association between the presence of polyps and CRC among patients with benign anorectal conditions, particularly hemorrhoids. While the majority of cases involved premalignant polyps, further investigation is warranted to understand the

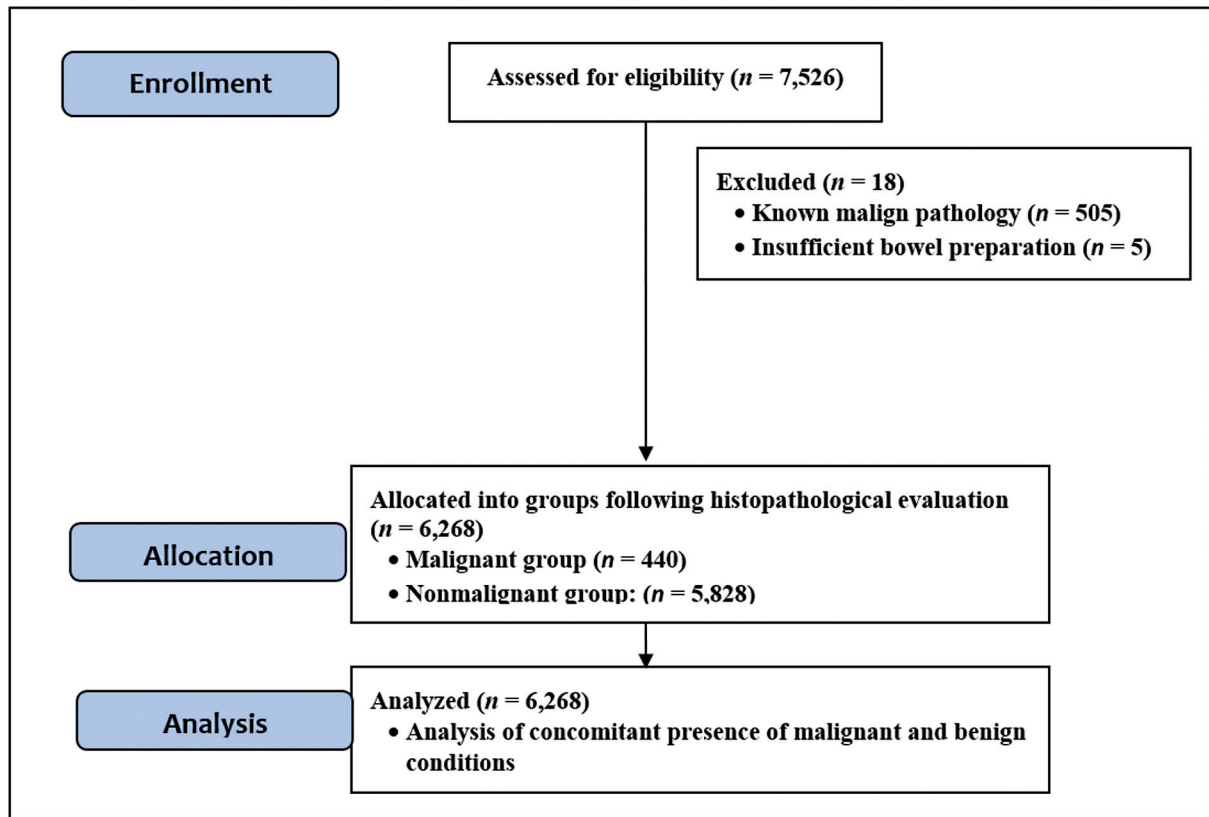


Fig. 1 Flow diagram of the study.

Table 1 Distribution of the pathologies

Pathology	Number (%)
Total endoscopy	6,268 (100)
Colonoscopy	2,955 (47.1)
Flexible sigmoidoscopy	3,313 (52.9)
Findings	
Normal	2,041 (32.6)
Hemorrhoid	2,024 (32.3)
Anal fissure	1,027 (16.4)
Anal fistula	298 (4.8)
Diverticulosis	480 (7.7)
Ulcerative colitis	32 (0.5)
Crohn's disease	5 (0.1)
Angiodysplasia	10 (0.2)
Volvulus	36 (0.6)
Polyp	1,387 (22.1)
Malignancy (all)	440 (7.0)
Types of malignancy	
Histopathologically proven cancer	282 (4.5)
Neoplastic polyp ^a	158 (2.5)

Abbreviation: n/a, not applicable; STROBE, Strengthening the Reporting of Observational Studies in Epidemiology.

^aDiagnosed after histopathological evaluation

underlying mechanisms and clinical implications of this association.

After stratifying by malignancy (malignant vs. nonmalignant), a statistical analysis was conducted to determine the probability (odds ratio) of being diagnosed as malignant, focusing on the association between various anorectal conditions and malignancy, including hemorrhoids, fissures, and polyps. The results indicated a significant difference between the two groups. Specifically, the malignant group had a lower proportion of hemorrhoids and fissures, while a higher proportion of polyps was observed ($p < 0.001$ for all). Further analysis using the odds ratio revealed some intriguing findings. It was found that approximately 1 in 22 individuals with hemorrhoids, 1 in 52 individuals with fissures, and 1 in 5.7 individuals with polyps were diagnosed with malignancy. These findings suggest a potential association between these anorectal conditions and the presence of malignancy, with polyps exhibiting the strongest correlation (► **Table 3**).

In addition to the aforementioned results, it's noteworthy that there were no significant perioperative complications such as unplanned readmission, perforation, or significant bleeding documented during the study period.

Discussion

Our study uncovered a significant association between benign anorectal conditions, especially hemorrhoids, and the presence of CRC. While the exact mechanisms behind this

Table 2 Comparative analysis across age groups (>50 vs. ≤50 years)

	>50 y	≤50 y	p-Value
Total numbers	3,763	2,505	–
Sex:			
Female	1,557	1,014	0.479
Male	2,206	1,491	
Findings ^a			
Hemorrhoid	1,130 (55.8) (30)	894 (44.2) (35.7)	<0.001
Anal fissure	421 (41) (11.2)	606 (59) (24.2)	<0.001
Anal fistula	116 (38.9) (3.1)	182 (61.1) (7.3)	<0.001
Diverticulosis	449 (93.5) (11.9)	31 (6.5) (1.2)	<0.001
Ulcerative colitis	17 (53.1) (0.5)	15 (46.9) (0.6)	0.427
Crohn's disease	1 (20) (0)	4 (80) (0.2)	0.067
Angiodysplasia	6 (60) (0.2)	4 (40) (0.2)	0.998
Volvulus	21 (58.3) (0.6)	15 (41.7) (0.6)	0.835
Polyp	1,076 (77.6) (28.6)	311 (22.4) (12.4)	<0.001
Malignant ^b	339 (77) (9)	101 (23) (4)	<0.001
Cancer	230 (81.6) (6.1)	52 (18.4) (2.1)	<0.001
Neoplastic polyp	109 (69) (2.9)	49 (31) (2)	0.018

^an (% within the row) (% within the column).

^bDiagnosed after histopathological evaluation.

association remain unclear, several hypotheses deserve consideration. Chronic inflammation is a common feature shared by both hemorrhoids and CRC, suggesting a potential link between the two conditions. Chronic inflammation in the anorectal region, as seen in hemorrhoids, may create a microenvironment conducive to the development of colorectal neoplasms through the release of proinflammatory cytokines and growth factors. Additionally, alterations in the gut microbiome associated with hemorrhoids have been implicated in promoting inflammation and dysregulating immune responses, which may contribute to carcinogenesis.^{6,7}

Although IBD, including Crohn's disease and ulcerative colitis, is a known risk factor for the development of CRC, our study did not specifically focus on this patient population.⁸ Nonetheless, it is essential to acknowledge the increased risk of CRC in patients with IBD and the importance of surveillance colonoscopy in this cohort. Guidelines such as those outlined by the British Society of Gastroenterology provide recommendations for surveillance colonoscopy intervals based on disease duration, extent, and severity of inflammation. Future studies may explore the impact of benign anorectal conditions on CRC risk stratification in patients with IBD and elucidate potential synergistic effects between these comorbidities.⁹

While benign pathologies are not cancerous, they can be a cause for concern because some benign growths, such as polyps, can become cancerous over time if they are not removed. Studies have shown that people with certain types of benign pathologies are at a higher risk of developing colon cancer. For example, people with a history of large or

multiple polyps are more likely to develop cancer than those with no polyps.¹⁰

Our analysis revealed a correlation between the presence of cancer and the existence of other benign pathologies. The prevalence of this occurrence was higher than expected, suggesting a potential relationship between the two. While the exact mechanism behind this correlation is not yet fully understood, previous studies have suggested that certain conditions, such as hypercoagulability, may be associated with the development of cancer.^{11–14} Additionally, tooth loss and periodontal disease are associated with conditions linked to CRC.¹⁵ Further research is needed to fully understand the relationship between cancer and benign pathologies in the colon.

Possible explanations for the relationship between cancer and benign pathologies in the colon include shared risk factors and underlying biological mechanisms. Certain risk factors, such as age and gender, may contribute to the development of both cancer and benign pathologies in the colon.⁹ Additionally, molecular biomarkers associated with CRC have been identified and may also play a role in the development of benign pathologies.¹⁶ As more research is conducted, a better understanding of the relationship between cancer and benign pathologies in the colon can be achieved, leading to improved diagnosis and treatment options for patients.

Patients who receive both cancer and benign pathologies diagnoses during colonoscopy may face unique clinical implications. It is important for health care providers to carefully consider the treatment plan for these patients, as

Table 3 Comparative analysis of groups based on malignancy presence

	Malignant n: 440	Nonmalignant n: 5,828	Positive LR	Posterior probability (odds)	p-Value
Gender, female/male	176/264	2,395/3,433	0.2		0.652
Age, mean ± SD	61.33 ± 15.02	54.70 ± 16.9	N/A		<0.001
Findings^a					
Hemorrhoid	91 (4.5) (20.7)	1,933 (95.5) (33.2)	0.62	4% (~1 in 22 with this condition are malignant)	<0.001
Anal fissure	20 (1.9) (4.5)	1,007 (98.1) (17.3)	0.26	2% (~1 in 52 with this condition are malignant)	<0.001
Anal fistula	15 (5) (3.4)	283 (95) (4.9)	0.70	5% (~1 in 20 with this condition are malignant)	0.150
Diverticulosis	29 (6) (6.6)	451 (94) (7.7)	0.85	6% (~1 in 17 with this condition are malignant)	0.373
Ulcerative colitis	1 (3.1) (0.2)	31 (96.9) (0.5)	0.43	3% (~1 in 32 with this condition are malignant)	0.335
Crohn's disease	0 (0) (0)	5 (100) (0.1)	N/A	N/A	0.393
Angiodysplasia	0 (0) (0)	10 (100) (0.2)	N/A	N/A	0.227
Volvulus	0 (0) (0)	36 (100) (0.6)	N/A	N/A	0.022
Polyp	243 (17.5) (55.2)	1,144 (82.5) (19.6)	2.81	18% (~1 in 5.7 with this condition are malignant)	<0.001

Abbreviations: LR: likelihood ratio, N/A: not applicable, SD, standard deviation.
^an (% within the row; % within the column).

the presence of both cancer and benign pathologies may complicate the course of treatment.¹² Further research is needed to better understand the relationship between cancer and benign pathologies in the colon, including whether the presence of benign pathologies increases the risk of developing cancer.^{13,16} Nonetheless, regular colonoscopy remains a crucial tool for early detection and prevention of both cancer and benign pathologies in the colon. By detecting and removing benign pathologies, colonoscopy can potentially prevent cancer development. Patients should adhere to recommended screening guidelines to ensure timely detection and treatment of any potential colon abnormalities.

Future research should focus on understanding the underlying mechanisms that contribute to the co-occurrence of both cancer and benign pathologies in the colon. This may include investigating the role of genetic and environmental factors.¹⁷ Additionally, research should aim to identify effective screening methods that can accurately detect both cancer and benign pathologies in the colon.¹⁶ By gaining a better understanding of the relationship between cancer and benign pathologies in the colon, health care providers can develop more effective treatment plans that address the unique needs of patients with both diagnoses.

Patients need to be aware of the potential risks associated with both cancer and benign pathologies in the colon. Individuals with a history of IBD or a family history of CRC may be at a higher risk of developing colon abnormalities. They should discuss appropriate screening options with their health care provider. While colonoscopy remains the gold standard for detecting abnormalities in the colon, noninvasive screening options such as FIT testing may also be appropriate for certain individuals.¹⁸ Overall, regular screening and early detection are crucial for improving outcomes for patients with both cancer and benign pathologies in the colon.

Hemorrhoids are a common condition affecting more than 50% of adults who have undergone colonoscopy in the United States.⁷ In our country, studies conducted in Erzurum, located in the Eastern Anatolian region, revealed a detection rate of 17.6%, while in Cyprus, the rate was 31%.⁶⁻⁹ Our study found that 32.6% of patients were diagnosed with hemorrhoids alone, while only 4.5% had both hemorrhoids and cancer. Although the rates are lower than those in the United States, we believe that individuals with hemorrhoids must undergo endoscopic examination to screen for colon cancer, as there may be an association between the two conditions.

In the present study, the majority of colon cancer cases were found to be associated with polyps, which are typically considered premalignant lesions. However, it is essential to recognize the significance of polyps in CRC screening and surveillance. Adenomatous polyps, in particular, have the potential to progress to malignancy if left untreated, underscoring the importance of their detection and removal during colonoscopy.¹⁹ Interestingly, we observed a notable prevalence of hemorrhoids coinciding with polyps among patients diagnosed with colon cancer. This observation highlights the potential association between benign anorectal

conditions, such as hemorrhoids, and underlying colorectal pathology, including polyps and cancer.

Several limitations of our study warrant consideration. Firstly, the study's retrospective nature introduces inherent biases, including selection bias and incomplete data capture. Secondly, the lack of standardized colon preparation protocols may have influenced the quality of bowel cleansing and subsequent colonoscopy findings. Additionally, the study's single-center design limits the generalizability of our findings to broader populations. Future research endeavors should address these limitations by conducting prospective, multi-center studies with standardized protocols and long-term follow-up to elucidate the complex interplay between benign anorectal conditions and CRC risk. Our study provides valuable insights into the association between benign anorectal conditions and CRC, but it is essential to acknowledge the limitations associated with the methodology. Including both colonoscopy and sigmoidoscopy procedures in the analysis may have introduced variability in the depth of examination and completeness of visualization, impacting the accuracy of cancer detection and potentially underestimating the true prevalence of CRC in patients with hemorrhoids.^{10,11} Future studies may benefit from stratifying analyses based on the type of endoscopic procedure to assess its impact on cancer detection rates and refine screening protocols accordingly.

This study underscores the critical role of colonoscopy in detecting hidden cancers, particularly among patients with hemorrhoids. Advocating for colonoscopy screenings remains paramount, as early identification and treatment of potential malignancies significantly impact preventing complications and preserving overall health. However, acknowledging the limitations inherent in retrospective cohort studies, such as recall bias and potential confounding factors, is crucial. Acknowledging these limitations, further prospective studies with larger sample sizes and meticulous data collection are necessary to validate and refine our understanding, emphasizing the imperative nature of colonoscopy in uncovering hidden cancers and ensuring comprehensive care for patients managing hemorrhoids.

Furthermore, benign anorectal conditions like hemorrhoids may serve as markers for underlying colorectal pathology, prompting further investigation and early detection of CRC. Patients presenting with hemorrhoids often undergo colonoscopy examinations, allowing for the visualization of the colon and rectum and the detection of any suspicious lesions or abnormalities. This proactive approach to screening may lead to the earlier detection of CRC, potentially improving patient outcomes.

Our analysis revealed a notable association between the presence of polyps and CRC among patients with benign anorectal conditions, particularly hemorrhoids. While the majority of cases involved premalignant polyps, further investigation is warranted to understand the underlying mechanisms and clinical implications of this association. These findings underscore the importance of comprehensive evaluation and tailored management plans for patients presenting with benign anorectal conditions, with particular attention to the detection and surveillance of polyps to mitigate the risk of

CRC. However, it is essential to acknowledge that our study's observational nature precludes definitive conclusions regarding causality. While we observed a significant association between hemorrhoids and CRC, further research is needed to elucidate the precise mechanisms underlying this relationship. Prospective studies exploring longitudinal associations and experimental studies investigating the molecular pathways involved are warranted to validate our findings and provide insights into potential therapeutic targets.

In summary, our study highlights the potential interplay between benign anorectal conditions, particularly hemorrhoids, and the risk of CRC. By recognizing and investigating these associations, health care providers can develop more effective strategies for CRC screening and early detection, ultimately improving patient outcomes. Further research is needed to unravel the complex pathophysiological mechanisms underlying this relationship and explore novel interventions for CRC prevention and management.

Conclusion

The study sheds light on the coexistence of malignant cases with common conditions, particularly polyps and hemorrhoids, underscoring the need for comprehensive evaluations and tailored management plans for patients with these conditions. Further research is warranted to elucidate the underlying mechanisms and establish guidelines for optimal patient care.

Authors' Contributions

FB worked on Conceptualization, Methodology, Software, Writing. YKÇ, YBA looked into Visualization, Investigation, Supervision. Software, Validation, Writing- Reviewing and Editing. All authors contributed to study design.

Compliance with Ethical Principles

This retrospective chart review study with human participants conformed to the ethical standards of the institutional and national research committee and the 1964 Declaration of Helsinki and its subsequent amendments or comparable ethical standards. No prior ethical approval is required for this retrospective cohort study due to the nature of the data collection and consent process. All patients and/or their patients and/or guardians signed a general consent form allowing anonymous use of data for education, research, and quality improvement. The authors confirmed that the data were collected anonymously.

Funding

None.

Conflict of Interest

None declared.

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