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Original Article

Influence of Sedated Endoscopy on Colorectal Adenoma Detection Rate: A Multicenter Study

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Abstract

Background and objectives: Studies on the effect of sedated endoscopy on adenoma detection rate (ADR) and advanced adenoma detection rate (AADR) remain scarce. The present study aims to determine whether sedation can help improve ADR and AADR.

Methods: Colonoscopies conducted in four endoscopy centers from January 2012 to July 2019 were included to create a propensity score-matched cohort, and compare the endoscopic factors.

Results: The colonoscopies of 216,400 cases were included. The ADR (32.24% vs. 31.63%, $p < 0.05$), AADR (5.59% vs. 5.39%, $p < 0.05$), and polyp (20.61% vs. 20.21%, $p < 0.05$) increased in the sedated endoscopy group, especially for flat adenomas (44.80% vs. 43.95%, $p < 0.05$) and adenomas of 0–5 mm (66.99% vs. 66.24%, $p < 0.05$). However, there was no significant difference, in terms of lesion site. Furthermore, the number of biopsies per colonoscopy was significantly higher in the sedated group (0.79 ± 0.93 vs. 0.56 ± 0.80, $p < 0.001$). Moreover, there was a significant increase in electronic (0.92% vs. 0.83%, $p < 0.05$) and chemical staining (0.57% vs. 0.45%, $p < 0.001$) in the sedated group.

Conclusions: The ADR, AADR and polyp detection rate increased for sedated colonoscopy, especially for flat adenomas and adenomas of 0–5 mm. In addition, the frequency of staining, image enhancement techniques, and number of biopsies per colonoscopy increased in sedated colonoscopy.

Introduction

Colorectal cancer, which originates from the colorectal mucosal epithelium, is one of the most common clinical malignant tumors of the gastrointestinal tract.[1] The prognosis of colorectal cancer is correlated to whether it is diagnosed and treated at its early stage, and the 5-year survival rate of most patients with early detection can reach 90%, while this can be less than 10% at advanced stages.[2–5] Therefore, early detection and prevention are crucial.

Colorectal adenoma is one of the most important precancerous lesions of colorectal cancer, accounting for more than 85–90% of all pre-cancerous colorectal diseases.[6,7] Colorectal adenomas can develop further into colorectal cancer through the adenoma-adenocarcinoma pathway, accounting for approximately 85% of colorectal carcinogenesis pathways.[4] Advanced adenoma is the more invasive form of non-advanced adenoma, which is more closely associated with colorectal carcinogenesis.[8,9] Therefore, early resection of colorectal adenomas, especially for advanced adenoma, to reduce the incidence of colorectal cancer is one of the important means of colorectal cancer prevention.[10]

Keywords: Early detection of cancer; Anesthesia; Endoscopy; Adenoma.

Abbreviations: ADR, adenoma detection rate; AADR, advanced adenoma detection rate; BMI, body mass index; PDR, polyp detection rate; PSM cohort, propensity score-matched cohort.

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Colonoscopy is the gold standard for the early diagnosis of colorectal cancer, but there are still missed lesions during the examination.[11] Sedated colonoscopy, which is an important form of colonoscopy, is widely used at present to improve the acceptability and comfort of the procedure, through sedating the patient with general anesthesia, when compared to regular colonoscopy.[12] Studies on the adenoma detection rate (ADR) and polyp detection rate (PDR) by sedated endoscopy have been reported. Some of the reported results revealed that sedated endoscopy has no positive effect on ADR and PDR,[13–17] while another study reported an opposite result.[18] In addition, studies on the effect of sedated endoscopy on ADR still lack the further specific delineation of lesion types, such as the advanced adenoma detection rate (AADR), and analysis of the location, morphology and endoscopic correlation of detected lesions.

The present study further classified the detected adenoma lesions into advanced adenomas and non-advanced adenomas using the colonoscopy data obtained from a multicenter dataset. The PDR data was also collected. The impact of sedated colonoscopy on ADR and AADR, and its possible relationship with endoscopic factors and lesion characteristics were explored and analyzed.

Materials and methods

Study design

A multicenter, retrospective design was used for the present study. The data, which included the information of colonoscopy charts obtained from January 2012 to July 2019, was obtained from the quality control system of the gastrointestinal endoscopy center of four hospitals (Qilu Hospital of Shandong University, Qilu Hospital of Shandong University [Qingdao], Weihai Municipal Hospital, and Affiliated Hospital of Binzhou Medical University).

The study protocol was approved by the Medical Ethics Committee of Qilu Hospital of Shandong University (No. KYLL-2019[KS]-348). The present study did not contain any experiments on humans or animals, and/or the use of human tissue samples performed by any of the investigators. The individual informed consent for the present retrospective study was waived. The colonoscopy biopsy pathology results were used as the standard of diagnosis. The data of patients who met the criteria were included for collection.

Study subjects

Patients were included for the outpatient diagnostic colonoscopy based on the following criteria: (1) patients >18 years old, and (2) patients who received diagnostic colonoscopies. Exclusion criteria: (1) previous diagnosis of malignancy, including colorectal cancer; (2) history of colorectal surgery; (3) emergency endoscopy or endoscopy of treatment cases; (4) missing baseline data or medical records.

The anesthesiologist teams for the sedated endoscopy during the study period comprised of the same anesthesiologists at each center, and sedated endoscopy patients received propofol-based deep general anesthesia without tracheal intubation.[19,20] This team of anesthesiologists was responsible for the patient's anesthesia status, and kept the patient under deep sedation during the entire examination. Both the study and control data sets were obtained from the same group of patients, and were classified according to the sedation.

Data collection

The baseline information and medical history data of the study subjects were extracted and summarized from the Gastrointestinal Endoscopy Center Research system of the four centers mentioned above. The specific variables of the obtained medical records included the following: age, gender, body mass index (BMI), history of alcohol consumption, history of smoking, history of diabetes, economic status, endoscopy-related indicators, pathological diagnosis, lesion morphology, lesion size, endoscopist information, and endoscopic assist technique. The endoscopic biopsy was performed by endoscopists, and biopsy forceps were used to clamp the histological biopsies of suspicious lesions. These biopsies were performed for necessary suspicious lesions. All polyps and adenomas were removed by biopsy or resected. The number of pieces to be clamped was determined by the endoscopist, according to the morphological characteristics of the lesion. The biopsy samples were fixed in 4% paraformaldehyde, and sent to the pathology department of each center for subsequent processing for pathological diagnosis. The diagnostic results were judged by two pathologists, and this was combined with the opinions of three pathologists for comprehensive judgment, in case of any disagreement. The pathological diagnosis results and image results were recorded in the pathology system after the judgment was completed. These were linked to the research library system of the endoscopy center, and exported through the endoscopy information.

BMI was directly calculated from the height and weight data of patients recorded in the system, and was classified into three categories in the system, based on the cut-off values defined by the World Health Organization:[21] low weight (BMI < 18.5 kg/m^2), normal weight (18.5 kg/m^2 ≤ BMI < 25 kg/m^2), and overweight and obesity (BMI ≥ 25 kg/m^2). History of alcohol use was defined as a history of sustained alcohol use, regardless of the duration. History of smoking was defined as the continued active use of cigarettes or tobacco products other than cigars, chewing tobacco, and e-cigarettes for any length of time. Economic status referred to the patient's self-assessment of whether their economic status influenced their choice of gastrointestinal endoscopy type (sedated or general). Lesion morphology was classified as flat, sessile, and pedunculated. The endoscopy-related indicators comprised of whether the endoscope was a sedated endoscope, and the biopsy site. Endoscopic assist techniques included the use of chemical staining (indigo carmine and acetic acid staining), electronic staining, or image enhancement (including i-Scan, optical enhancement, narrow band imaging, Fuji intelligent color enhancement), and magnification endoscopy.

Outcome definition

The primary outcome was the ADR and AADR between sedated and unsedated endoscopies. The secondary outcomes included polyp detection, lesion morphology, lesion location, number of biopsies, and the use of endoscopic assist techniques. Advanced adenomas included adenomas larger than 1 cm in diameter, and those that contained villous features or contained high-grade dysplasia.[22]

Statistical analysis

The present study applied propensity score matching (PSM) to match each sedated colonoscopy patient who underwent sedation with another general colonoscopy patient, based on the greedy nearest neighbor matching rule, with a matching ratio of 1:1. The balancing target in matching was nine covariates, which might affect the detection rate, including age, gender, BMI, history of smoking, history of alcohol consumption, history of diabetes, economic status, total number of colonoscopies performed by endoscopists annually, years of endoscopist experience, and variables that were not preferentially matched when there was no sig-

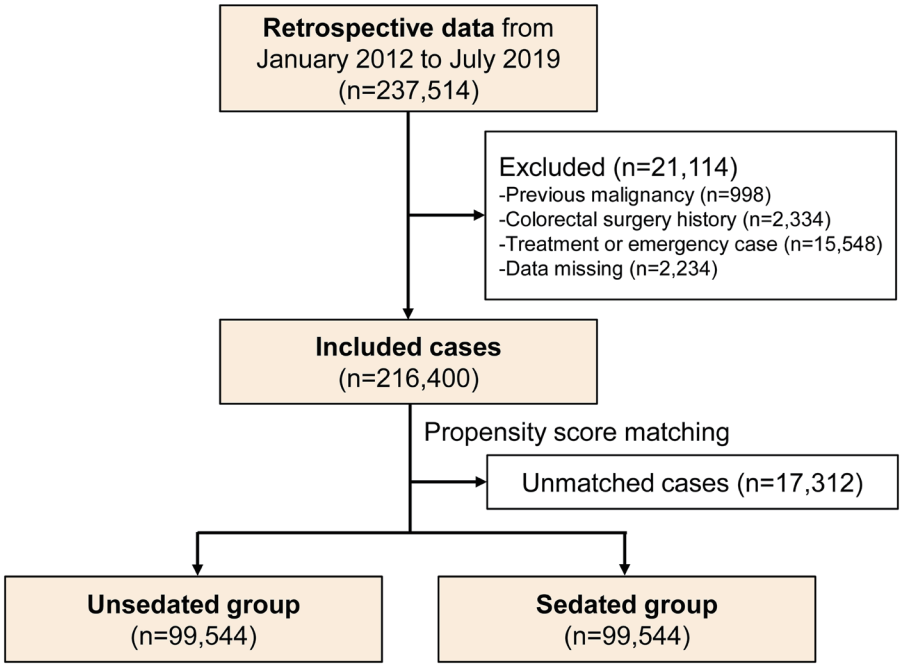

Fig. 1. Flowchart for the patient enrolment.

nificant difference in the original dataset. At the end of matching, the standardized difference (SD) was calculated for each variable in two newly generated data sets, and an SD of <10% was considered as well-balanced for that variable.

The statistical software R (v4.2.2) was used for data processing, analysis and picture plotting in the study. Comparisons between continuous variables were made using independent samples *t*-test or Wilcoxon test. Comparisons between categorical variables were made using chi-square test. All tests were performed using a two-sided test with a test level of $\alpha = 0.05$. The sample differences were considered statistically significant when $p < 0.05$.

Results

Baseline data and PSM

A total of 237,514 colonoscopy cases were proposed to be collected, and 21,114 cases were excluded. As shown in Figure 1, the final 216,400 patients were included for final analysis in the present study. Among these patients, 99,544 (46.0%) patients were sedated endoscopies. After PSM, two different groups were distinguished for the subsequent analysis, based on whether these patients underwent sedation.

As shown in Table 1, there were significant differences in some variables of baseline information between patients who underwent plain endoscopy, and those who underwent sedated endoscopy. As shown in Table 2, the SDs were less than 10%, indicating good matching results.

Detection of adenomas and polyps

As shown in Table 3, the ADR (32.24% vs. 31.63%, $p < 0.05$) and PDR (20.61% vs. 20.21%, $p < 0.05$) significantly increased in the sedated group, when compared to the control group. Furthermore, significantly more advanced adenomas were detected in the sedated group (5.59% vs. 5.39%, $p < 0.05$). The detection rate for non-advanced adenomas also significantly increased (26.64% vs. 26.24%, $p < 0.05$).

Characteristics of adenomas

All lesion sites were not statistically different between the two groups. In terms of lesion morphology, more flat lesions were detected in the sedated group (44.80% vs. 43.95%, $p < 0.05$). Furthermore, the proportion of lesions of <5 mm in size significantly increased in adenomas detected in the sedated group (66.99% vs. 66.24%, $p < 0.05$; Table 4).

Endoscopic factors

The number of biopsies per colonoscopy was significantly higher in the sedated endoscopy group (0.79 ± 0.93 vs. 0.56 ± 0.80, $p < 0.001$). Furthermore, electronic staining (0.92% vs. 0.83%, $p < 0.05$) and chemical staining (0.57% vs. 0.45%, $p < 0.001$) were applied more in the sedated group. However, the proportion of magnification endoscopy application did not reveal a significant difference ($p = 0.563$, Table 5)

Discussion

The present study determined the effect of sedated endoscopy on ADR, AADR and PDR, based on large data sets, and identified the lesion characteristics and endoscopic factors. In the multi-center data set balanced by PSM, ADR and PDR were significantly higher, and AADR was significantly higher under sedated endoscopy, which may have been achieved by the increase in the number of biopsies, and the increase in application of electronic and chemical staining techniques, resulting in the increased detection of flat, <5 mm sized colorectal adenomas.

Previous studies have suggested that sedated colonoscopies may have an impact on ADR and PDR.[23,24] The results of a study that included 24,795 colonoscopy patients suggested that the ADR

Table 1. Clinical features of patients (*n* = 216,400)

Factors	Control group (*n* = 116,856)	Sedated group (*n* = 99,544)	*p*
Baseline data			
Age, year (mean ± SD)	55.27 ± 8.29	58.23 ± 8.32	<0.001
Gender, male (%)	58,937 (50.44)	50,188 (50.42)	0.935
BMI			
BMI < 18.5 (%)	6,868 (5.88)	5,757 (5.78)	0.353
18.5 ≤ BMI < 25 (%)	71,743 (61.39)	61,032 (61.31)	
BMI ≥ 25 (%)	38,245 (32.73)	32,755 (32.91)	
Drink history[a] (%)	30,318 (25.94)	30,379 (30.52)	<0.001
Smoke history[b] (%)	15,003 (12.84)	14,989 (15.06)	<0.001
Diabetes (%)	7,097 (6.07)	7,163 (7.20)	<0.001
Economic burden[c] (%)	6,883 (5.89)	6,986 (7.02)	<0.001
Endoscopist factors			
Volume[d]			
Volume < 300 (%)	6,639 (5.68)	5,686 (4.87)	0.759
300 ≤ Volume < 700 (%)	30,645 (26.22)	25,730 (22.02)	
Volume ≥ 700 (%)	79,572 (68.09)	68,128 (58.30)	
Experience[e]			
Experience < 5 (%)	37,310 (31.93)	31,840 (27.25)	0.774
5 ≤ Experience < 10 (%)	39,295 (33.63)	33,430 (28.61)	
Experience ≥ 10 (%)	40,251 (34.44)	34,274 (29.33)	

[a]Drink history: history of sustained alcohol use, regardless of the duration; [b]Smoke history: continued active use of cigarettes or tobacco products for any length of time; [c]Economic burden: patients whose choice of endoscopy was influenced by financial concerns; [d]Volume: the number of colonoscopies carried out by endoscopists annually; [e]Experience: years since completing colonoscopies independently; BMI, body mass index.

Table 2. Demographic characteristics and lesions in each group after PSM (*n* = 199,088)

Factors	Control group (*n* = 99,544)	Sedated group (*n* = 99,544)	*SD*
Age, year (mean ± SD)	58.27 ± 8.291	58.23 ± 8.317	0.05
Gender, male (%)	50,207 (50.44)	50,188 (50.42)	0.00
BMI			
BMI < 18.5 (%)	5,858 (5.88)	5,757 (5.78)	0.00
18.5 ≤ BMI < 25 (%)	61,121 (61.4)	61,032 (61.31)	
BMI ≥ 25 (%)	32,565 (32.71)	32,755 (32.91)	
Drink history[a] (%)	30,318 (30.46)	30,379 (30.52)	0.00
Smoke history[b] (%)	15,003 (15.07)	14,989 (15.06)	0.00
Diabetes (%)	7,097 (7.13)	7,163 (7.20)	0.00
Economic burden[c] (%)	6,883 (6.91)	6,986 (7.02)	0.00
Volume[d]			
Volume < 300 (%)	5,653 (5.68)	5,686 (5.71)	0.00
300 ≤ Volume < 700 (%)	25,635 (25.75)	25,730 (25.85)	
Volume ≥ 700 (%)	68,256 (68.57)	68,128 (68.44)	
Experience[e]			
Experience < 5 (%)	31,778 (31.92)	31,840 (31.99)	0.00
5 ≤ Experience < 10 (%)	33,477 (33.63)	33,430 (33.58)	
Experience ≥ 10 (%)	34,289 (34.45)	34,274 (34.43)	

BMI, body mass index; SD: standardized difference. [a]Drink history: history of sustained alcohol use, regardless of the duration; [b]Smoke history: continued active use of cigarettes or tobacco products for any length of time; [c]Economic burden: patients whose choice of endoscopy was influenced by financial concerns; [d]Volume: the number of colonoscopies carried out by endoscopists annually; [e]Experience: years since completing colonoscopies independently.

Table 3. Adenoma detection after PSM

	Control group (n = 99,544)		Sedated group (n = 99,544)		*p*
	Detected number	Detection rate (95% CI) per 10,000 cases	Detected number	Detection rate (95% CI) per 10,000 cases	
Adenoma (%)	31,483 (31.63)	3,162.72 (3,161.96, 3,163.48)	32,091 (32.24)	3,223.8 (3,223.04, 3,224.56)	0.003
Advanced adenoma (%)	5,367 (5.39)	539.16 (538.4, 539.92)	5,569 (5.59)	559.45 (558.69, 560.21)	0.047
Non-advanced adenoma (%)	26,116 (26.24)	2,623.56 (2,622.81, 2,624.32)	26,521 (26.64)	2,664.25 (2,663.49, 2,665.01)	0.040
Polyp (%)	20,114 (20.21)	2,020.61 (2,019.86, 2,021.37)	20,518 (20.61)	2,061.2 (2,060.44, 2,061.96)	0.025

between sedated and unsedated groups was 27.4% and 21.2%, respectively, suggesting that sedated endoscopy may have an elevated effect on ADR.[18] In contrast, an Austrian colonoscopy study that included 196 endoscopists and 52,506 patients revealed an opposite result. That is, the anesthesia state did not enhance the ADR or PDR.[17] Some findings even indicated that ADR and PDR may be higher with general endoscopy without anesthesia.[25] In the present study, it was found that sedated endoscopy improved the ADR, AADR and PDR, suggesting that sedation can help enhance the diagnostic ability of colonoscopy. Thus, sedation should be considered as a potential quality influencing factor. The recommendation for patients to undergo sedated colonoscopy may result in increased ADR and PDR, which can benefit patients. ADR has been reported to be mainly influenced by quality indicators of colonoscopies. The analysis of endoscopic factors may inform the improvement of ADR and AADR.

Adequate and accurate biopsies are one of the requirements for the quality control of colonoscopies, which has the potential to significantly influence the efficacy of the pathological diagnosis.[26] A standard biopsy should be representative. That is, this should reflect the true pathologic nature of the lesion.[1] The pathologic diagnostic ability of colorectal malignancy increased when the number of biopsies improved from 1 to 2, revealing substantial gains through more biopies.[27] Although no direct association between the number of biopsies and ADR has been reported, this may laterally reflect the quality of the examination, and influence the results. On one hand, a sufficient number of biopsies can clarify the nature of the pathology, and thereby be beneficial for the detection of ADR and AADR. On the other hand, an increase in the number of biopsies in colonoscopy means that the endoscopist might have more suspicious lesions to detect, thereby reducing the missed diagnoses, and possibly contributing to the increase in ADR. However, rare studies have been reported on the number of biopsies in relation to sedated colonoscopies. In the present study, by comparing data obtained from sedated colonoscopy with the data obtained from unsedated colonoscopy, it was found that the number of biopsies per colonoscopy was significantly higher in the sedated group. The increase in the number of biopsies may be due to the less stressful examination environment for the physician in the sedated endoscopy setting, the increase in focus on the examination itself, and more opportunities for the biopsy of suspicious lesions. The improved detection of advanced lesions could be beneficial to AADR. The increase in biopsy number allows for the higher likelihood of a suspicious lesion being successfully sent for examination, thereby improving ADR and PDR, especially AADR. However, the evidence related to this conjecture still requires further studies.

Electronic staining or image enhancement techniques have been proven to be able to enhance the diagnostic efficacy of the colonoscopy by improving the sensitivity and specificity of lesion detection.[28] Assistant techniques enable for the more accurate prediction of endoscopic case types, thereby enhancing the accuracy of biopsies.[29] Chromoscopy is another important adjunct to the diagnosis of colorectal cancer. An analytical study noted that pigmented endoscopy significantly increased the proportion of patients with one or more neoplastic lesions, including polyps, in the population examined (OR: 1.53, 95% CI: 1.31, 1.79).[28] For adenomatous lesions, another meta-analysis based on 10 randomized controlled studies also suggested a significantly higher ADR with chromoscopy, when compared to conventional colonoscopy (48.1% vs. 39.3%, RR: 1.20, 95% CI: 1.11–1.29).[30] Advanced adenomas led to similar results (RR: 1.21, 95% CI: 1.03–1.42). In the present study, the analysis of the application of assistant techniques sug-

Table 4. Characteristics of detected adenomas after PSM

	Control group (*n* = 31,483)	Sedated group (*n* = 32,091)	*p*
Lesion site			
Ileocecal (%)	623 (1.98)	597 (1.86)	0.276
Ascending (%)	6,545 (20.79)	6,615 (20.61)	0.585
Transverse (%)	6,277 (19.94)	6,458 (20.12)	0.557
Descending (%)	5,574 (17.7)	5,624 (17.53)	0.552
Sigmoid (%)	9,207 (29.24)	9,362 (29.17)	0.844
Rectum (%)	3,257 (10.35)	3,435 (10.7)	0.141
Lesion morphology			
Pedunculated (%)	6,424 (20.4)	6,501 (20.26)	0.646
Sessile (%)	8,573 (27.23)	8,541 (26.61)	0.080
Flat (%)	13,836 (43.95)	14,377 (44.80)	0.030
Lesion size			
0–5 mm (%)	20,855 (66.24)	21,498 (66.99)	0.045
>5 mm (%)	10,628 (33.76)	10,593 (33.01)	0.045

PSM, propensity score-matched.

gested that the increase in electronic and chemical staining may play an important role in improving the ADR, AADR and PDR for sedated endoscopy. The increase in use of electron staining techniques and chemical staining may have improved the sensitivity and specificity of lesion detection. Electronic staining or image enhancement techniques should be considered as one of the main influencing factors induced by sedated colonoscopy.

In general, flat and smaller lesions are prone to cause oversight during examinations.[22,24] Previous studies have revealed that the detection ability of sessile, flat lesions are more likely to be enhanced under the assistant system, when compared to pedunculated colorectal lesions, revealing that sessile, flat lesions may be more easily missed.[31] Among the adenomas detected in the present study, there was a significant increase in flat adenomas, when compared to other forms. This suggests that the increase in ADR and AADR may be due to the improvement in electronic staining or image enhancement techniques, the less stressful examination environment, and the increase in biopsies. The increase in proportion of advanced adenomas of <5 mm in size further reveals that sedated endoscopy increases the probability of detecting smaller lesions. The possible reasons for this include the use of assistive technology, and the thorough observation of the colonic mucosa due to the more concentrated environment by sedation. No significant change in lesion location was identified in the present study, indicating that the improvement in ADR and AADR by sedated endoscopy may be effective for all segments of the colon.

The incidence of anesthesia-related complications is one of the important indicators for evaluating the quality of sedated endoscopy. In the present study, the incidence of anesthesia-related complications was not further analyzed due to the limitations of previous data, and because the relevant results need to be referred to existing studies. The results of a large cohort study revealed that sedated colonoscopy may increase the risk of patient complications, including any complication within 30 days after the procedure (OR: 1.13, 95% CI: 1.12, 1.14), perforation (OR: 1.07, 95% CI: 1.00, 1.15), and bleeding (OR: 1.28, 95% CI: 1.27, 1.30).[32] This result suggests the importance of patient complication risk assessment before performing sedated colonoscopy. In another study based on a database with a 3.05 million patient population, the researchers revealed that sedated endoscopy did not increase the risk of bowel perforation (OR: 0.99, 95% CI: 0.84, 1.16) and kidney injury (OR: 1.09, 95% CI: 0.62, 1.90).[33] The assessment of the safety of sedated endoscopy needs to be explored in further studies.

The experimental design of the present study had a relatively strong confounding control and extrapolation validity. In addition, the present study more comprehensively investigated the diag-

Table 5. Endoscopic factors in the post-PSM subgroup (*n* = 199,088)

	Control group (*n* = 99,544)	Sedated group (*n* = 99,544)	*p*
Biopsy			
Biopsy number per case	0.56 ± 0.80	0.79 ± 0.93	<0.001
Assistant techniques			
Electronic staining (%)	829 (0.83)	916 (0.92)	0.036
Magnification (%)	477 (0.48)	495 (0.50)	0.563
Chemical staining (%)	449 (0.45)	567 (0.57)	<0.001

PSM, propensity score-matched.

nostic efficacy of sedated endoscopy for colorectal advanced adenomas, which was rarely explored before. Finally, the subgroup analysis section summarized several common endoscopic factors, and comparisons and judgments were made on the relationships with lesion detection.

The present study had some limitations. First, although multicenter data were collected, the retrospective nature of the present study limited its extrapolation. Second, several factors influenced the outcome of the study, including type of endoscopy, preparation for examination, experience of the endoscopist, systematicity of the observation, examination time, biopsy, etc. Although the balanced analysis of endoscopist-related data, biopsy, and assistant techniques maximally controlled the confounding of results, the endoscopic factors and lesion-related factors in the present study did not cover all clinical quality indicators and complications, such as withdrawal time, bowel preparation, and anesthesia-related complications. The reason for this was due to the absence of relevant data in the database. This part of the clinical information was incomplete, and could not be evaluated, which suggests that there may be a matching imbalance between the two groups. However, considering the population basis and relatively large sample size of the present study, the relevant findings were still informative. Third, the attribution of improved detection efficacy may not be comprehensive, and relevant data needs to be referred to other existing studies. Finally, the present study merely focused on the diagnostic efficacy of sedated colonoscopy, without analyzing its participation and economic benefits. These data still needs to be obtained through more screening-related studies.

In conclusion, ADR, AADR and PDR increase in sedated colonoscopy, especially flat adenomas and adenomas of 0–5 mm. In addition, the frequency of staining and image enhancement techniques, and the number of biopsies per colonoscopy increases in sedated colonoscopy. This finding may make endoscopists aware of the impact of sedated endoscopy on ADR, AADR and PDR, when helping patients in their endoscopy choices. The specific ways in which anesthesia affects endoscopic ADR and AADR still need to be validated through larger prospective studies.

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Conflict of interest

One of the authors, Prof. Yanqing Li, has been an Associate Editor of Cancer Screening and Prevention since March 2022. The authors have no other conflict of interests related to this publication.

Author contributions

Study concept and design (JWZ, ZL), acquisition of data (JWZ, AJZ, KKW, CXL, QN, YLC, XFS), analysis and interpretation of data (JWZ, ZL, RJ, PZW), drafting of the manuscript (JWZ) and study supervision (YQL, XLZ). All authors contributed significantly to this study and approved the final manuscript.

Ethical statement

The study protocol was approved by the Medical Ethics Committee of Qilu Hospital of Shandong University (no. KYLL-2019[KS]-348). The study does not contain any experiments on humans or animals, and/or the use of human tissue samples performed by any of the authors. The individual informed consent for the retrospective study was waived.

Data sharing statement

The data that supports the findings of the study are available from the first author (JWZ) upon reasonable request.

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