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ORIGINAL RESEARCH—CLINICAL

Morphology, Histopathology, and Anatomical Distribution of Sporadic Colorectal Polyps in Chinese Patients

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BACKGROUND AND AIMS: There are limited data regarding the morphology, histopathology, and anatomical distribution of sporadic colorectal polyps in Chinese patients. We evaluated these characteristics of sporadic polyps to guide the endoscopic detection and excision of colorectal polyps. **METHODS:** This was a retrospective single-center observational study involving 7381 patients with sporadic colorectal polyps. All polyps were removed endoscopically. The morphology and histopathology of polyps were evaluated according to the Paris classification and the World Health Organization classification, respectively. **RESULTS:** A total of 22,174 polyps removed endoscopically from 7322 patients were included. In the sigmoid colon, 24.70% of colorectal polyps occurred, followed by the transverse colon (18.58%) in frequency. 0-Is type polyps accounted for 60.60% of all sporadic colorectal polyps. Polyps with 0-Ip, 0-Isp, and 0-IIa types were frequently found in the sigmoid colon, but laterally spreading lesions usually occurred in the ascending colon (24.61%) and rectum (20.51%). Irrespective of the Paris classification and anatomical location, as the polyps enlarge, the proportion of adenomatous polyps gradually increases while the proportion of serrated lesions decreases. Polyps with size $\geq$1 cm located in the left-sided colon were more likely to have villous/tubulovillous or high-grade dysplasia histology than those located in the right-sided colon, and about 1% of them were demonstrated with adenocarcinoma. **CONCLUSION:** Sigmoid colon should be detected adequately during colonoscopy, and polyps with size $\geq$1 cm should be treated carefully, especially in the left-sided colon.

Keywords: Colonic adenomas; Endoscopy; Histopathology; Colonic neoplasms

Introduction

Colorectal cancer is the most common type of gastrointestinal cancer. Due to changes in lifestyle, the incidence of colorectal cancer is rising worldwide. The concept of a polyp-cancer sequence suggests detection and endoscopic removal of colorectal adenoma as a means of reducing the incidence of colorectal cancer. The presence of recognizable precursor lesions and well-developed screening tests has led to a worldwide introduction of population screening over the past decade. However, the frequency of colorectal polyp changes in different anatomical sites of the colorectum as well as the pathology. It is vital for endoscopists to discover high-risk polyps during colonoscopy to prevent colorectal cancer. This necessitates a more comprehensive description including morphology, anatomical distribution, and histopathology of those precursor lesions within the entire colon.

Among patients with sporadic colorectal polyps, it is important to identify those at risk for malignancy. According to histopathology, polyps have different potential for colorectal cancer. For serrated polyps, small distal hyperplastic polyps (HPs) have no substantial malignant potential and do not affect colonoscopic surveillance intervals. However, sessile serrated lesions (SSL) and traditional serrated adenomas (TSA) increase the risk of colorectal carcinoma. Generally, high-risk adenoma refers to patients with 1 or more of the following findings: 3 or more adenomas, adenoma $\geq$10 mm in size, and adenoma with tubulovillous/villous or high-grade dysplasia (HGD) histology.[1–3]

Herein, we analyzed a series of 22,174 colorectal polyps endoscopically removed from 7322 patients with sporadic polyps in our unit during 9 years (Figure A1, Table A1). The retrieved polyps were completely analyzed to clarify the morphology, anatomical distribution, and histopathology of sporadic colorectal polyps.

Materials and Methods

Study population

Patient selection was conducted according to the flow chart (Figure A1). Endoscopic classification and pathological files of patients who underwent endoscopic resection of sporadic colorectal polyps between April 2011 and January 2020 in the

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Second Affiliated Hospital of Zhejiang University were collected and reviewed. Patients with the following criteria were excluded: 1) with inflammatory bowel disease; 2) with family history or personal history of colorectal carcinoma, hereditary syndrome such as familial adenomatous polyposis, Cowden syndrome, Canada-Cronkhite syndrome, or serrated polyposis syndrome; 3) other protruding lesions except sporadic colorectal epithelial polyps, such as submucosal tumor-like lesions (lipoma, gastrointestinal stromal tumor, neuroendocrine neoplasm, and schwannoma), endometriosis, mucosa-associated lymphoid tissue lymphoma, cystic lesions; 4) polyps without clear anatomical site, Paris classification, or histology. A total of 7322 patients who underwent endoscopic resection and were diagnosed as having sporadic colorectal polyps were selected for further analysis in this study. Patient consent was waived by the institutional review board of the Second Affiliated Hospital of Zhejiang University as this study was retrospective and patients' information was protected.

Anatomical sites of colorectum

According to the book entitled 大腸内視鏡挿入法 軸保持短縮法のすべて (the 2nd edition), the anatomical position was comprehensively judged, combined with the insertion length of endoscope and the characteristics of colorectal lumen. Generally, when the endoscopic axis is straight and shortening, the insertion length can be referred to as anatomical positions as follows: rectosigmoid (10～15 cm), junction of sigmoid and descending colon (30 cm), splenic flexure (40 cm), hepatic flexure (60 cm), and cecum (70～80 cm). The characteristics of colorectal lumen are often displayed as follows: rectosigmoid (the bending angle is large and it is difficult to observe the lumen), descending colon (linear lumen, usually with fluid retention), splenic flexure (blue spots could sometimes be observed), transverse colon (triangular lumen, usually with annular fold), hepatic flexure (blue spots could be observed generally), ascending colon (linear lumen, usually with deep fold), and the cecum (identified by the appendix opening and ileocecal valve). Moreover, in this study, the right-sided colon included ileocecal valve, cecum, ascending colon, hepatic flexure, and transverse colon, while the left-sided colon included splenic flexure, descending colon, rectosigmoid, and rectum. All the anatomical locations of colorectal polyps were confirmed by 3 endoscopists. Polyps without clear anatomical site were excluded.

Endoscopic classification of colorectal polyps

Lesions were carefully examined in vivo by the investigators at the initial endoscopy and classified according to the Paris classification, which is a consensus international standard for defining superficial gastrointestinal lesion morphology.[4] Polyp size was measured using the tip of snare catheter (2.5 mm). Generally, elevated (>2.5 mm above the surrounding normal mucosa) sessile lesions are described as Type 0-I and sessile lesions <2.5 mm classed as 0-IIa (slightly elevated), 0-IIb (flat), or 0-IIc (slightly depressed). Excavated or ulcerated lesions with deep ulcer below mucosa are classed as 0-III. Type 0-I is divided into 3 subtypes: pedunculated (0-Ip), 0-Isp (subpedunculated), and sessile (0-Is) lesions. Laterally spreading lesions (LST) has been characterized as non-protruding elevated colonic lesions with diameter more than 10mm. Combined types also occurred, such as 0-IIc + IIa, 0-IIa + IIc, 0-III + IIc or 0-IIc + III lesions. In this study, we focused only on the main type of morphology and the polyps with combined types were excluded, and the Paris classification of all the colorectal polyps were reconfirmed by 3 endoscopists. Polyps without clear Paris classification were excluded.

Histopathology of colorectal polyps

We defined the histology of colorectal polyps in this study according to the World Health Organization classification of digestive system (the 5th edition). In general, the benign epithelial tumors and precursors include both conventional adenomas and serrated lesions. Colorectal serrated lesions are characterized by a serrated (sawtooth or stellated) architecture of the epithelium, including HPs, SSL, and TSA. Conventional colorectal adenoma, distinguishing from serrated lesions, is a benign, premalignant neoplasm composed of dysplastic epithelium. It usually contains several subtypes including tubular adenoma with low-grade dysplasia or HSD/intraepithelial neoplasia, villous adenoma with low- or high-grade dysplasia/intraepithelial neoplasia, tubulovillous adenoma with low-grade dysplasia or HGD/intraepithelial neoplasia. Moreover, hyperplastic, inflammatory, and juvenile polyps are nonneoplastic lesions; their potential for progression to neoplasia is nil or very small, while serrated adenomas harbor a neoplastic component. Nonneoplastic polyps are frequent in the colon.[5] The histopathology of all the colorectal polyps were confirmed by gastroenterology pathologists. In this study, the high-risk histology was defined as polyps with villous/tubulovillous or HGD histology. Polyps without confirmed histology were excluded.

Results

24.70% of colorectal polyps occurred in the sigmoid colon, and 60.60% of colorectal polyps were with 0-Is type

Herein, we first analyzed macroscopic appearance of each polyp in different localizations. As shown in Figure 1, the largest number of each form of polyp occurred in the sigmoid colon (24.70%, n = 5478/22,174), followed by the transverse colon in frequency (18.58%, n = 4119/22,174) (Figure A1, Table A1). The anatomical location of occurrence for different type of polyp in Paris was analyzed. It demonstrated that polyp with 0-Is type occupied the majority in any anatomical location of colon, and the number of polyps with type 0-IIb or 0-IIc were 1, 8, respectively (Table A1), and type 0-III was not observed. So, the polyps with type 0-IIb, 0-IIc, or 0-III were all excluded for further analysis. Among the 22,174 sporadic polyps, the proportions of polyps with different Paris types were as follows: 60.60% (0-Is), 6.90% (0-Ip), 13.64% (0-Isp), 16.42% (0-IIa), and 2.31% (LST) (Figure 2A). 0-Is polyps were frequently found in the sigmoid colon (23.05%), followed by transverse colon (20.02%) and rectum (16.32%). Polyps with 0-Ip, 0-Isp, and 0-IIa were frequently found in the sigmoid colon, but LST usually occurred in the ascending colon (24.61%) and rectum (20.51%). Moreover, the

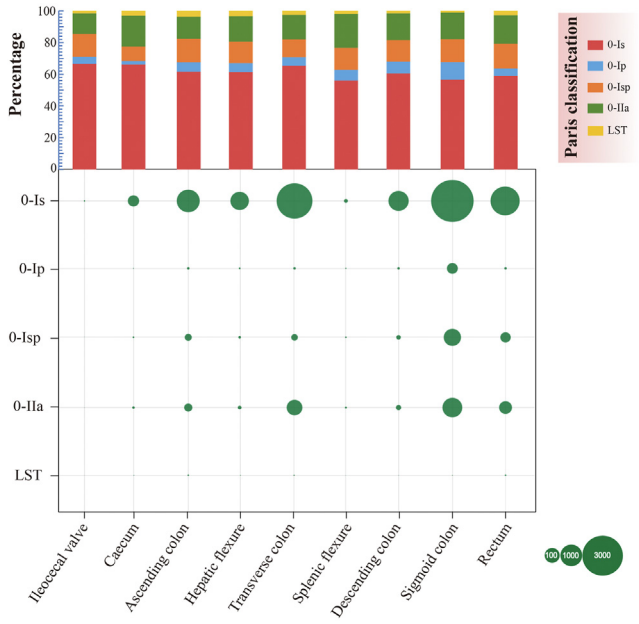

Figure 1. Distribution of colorectal polyps with different Paris classification in different anatomical locations. The frequency of 0-Is polyps in different anatomical positions was more than 50% (red color bar in the upper side of the figure). Polyp with 0-Is type occupied the majority in any anatomical location of colon, and the polyps with type 0-IIb, or 0-IIc were rare, and type 0-III was not observed (the down side of the figure). And polyps with 0-Is, 0-Ip, 0-Isp, or 0-IIa were frequently found in the sigmoid colon, but LST usually occurred in the ascending colon and rectum.

frequency of 0-Is polyps in different anatomical positions was as follows: 66.67% (ileocecal valve), 66.14% (cecum), 61.67% (ascending colon), 61.40% (hepatic flexure), 65.31% (transverse colon), 56.15% (splenic flexure), 60.54% (descending colon), 56.55% (sigmoid colon), and 59.08% (rectum) (Figure 1).

We further analyzed the correlation between Paris classification of the colorectal polyp and its histopathology in different anatomical locations, as shown in Figure 2. We divided the pathological types of polyps into 4 categories: no significant findings under microscopy, adenomatous polyp (including tubular adenoma, villous adenoma, and tubulovillous adenoma), serrated lesions (including HPs, SSL, and TSA), and others (including inflammatory polyp, adenocarcinoma, and juvenile polyposis). Moreover, polyp size, long recognized as a factor, was shown to be importantly related to malignant change.[6] We further divided polyps into 3 groups according to their size: ≤5 mm, 5–10 mm, and ≥10 mm. For 0-Is polyps, 48.12% were ≤5 mm in size, 42.95% were 5–10 mm, and 8.93% were ≥10 mm. The proportion of adenoma was 43.34% in polyp with ≤5 mm in size, 69.28% in 5–10 mm polyps, and 79.58% in ≥10 mm polyps in 0-Is polyps. For 0-Ip polyps, polyps with ≥10 mm in size were dominant (80.97%), and among these polyps, 83.12% were adenomatous polyps. For 0-Isp polyps, 9.52% were ≤5 mm in size, 51.21% were 5–10 mm, and 39.27% were ≥10 mm. For 0-IIa lesions, 78.20% were ≤5 mm in size, and 12.80% were 5–10 mm. The proportions of colonic mucosal tissue or chronic inflammation, adenomatous polyp, and serrated polyp were 32.72%, 35.53%, and 31.43%, respectively in 0-IIa polyp with diameter ≤5 mm and 21.13%, 53.21%, and 25.41%, respectively in 0-IIa polyp with diameter 5–10 mm. For LST, the proportion of colonic mucosal tissue or chronic inflammation, adenomatous polyp, and serrated polyp were 6.05%, 68.75%, and 23.44%, respectively. For 0-Is and 0-Isp polyps, as the polyps enlarged, the adenomatous polyps' component gradually increased and the serrated lesions decreased (Figure 2A and B). For 0-Is polyps with size ≤5 mm, the components of adenomatous and serrated dysplasia were 43.34% and 26.36%, respectively (Figure 2A and B). The proportion was different between the right-sided and left-sided colon. For example, the proportion of adenoma in 0-Is polyps with size ≤5 mm was 57.06% in the right-sided colon and 30.84% in the left-sided colon, and the proportion of serrated lesions was 13.61% in the right-sided colon and 38.55% in the left-sided colon (Figure 2C). Similar phenomena were also observed in 0-Isp, 0-Ip, and 0-IIa polyps with size ≤5 mm. It prompts us to adequately screen and process polyps with size ≤5 mm in the right-sided colon. However, for polyps with size 5–10 mm and ≥10 mm, there was no significant difference in pathological types between the left-sided and right-sided colon. For LST, the proportion of adenomatous polyp was 66.88% (right-sided colon) and 71.64% (left-sided colon), and serrated dysplasia was 25.40% (right-sided colon) and 20.40% (left-sided colon), respectively.

Polyps larger than 1 cm located in the left-sided colon were more likely to have high-risk histology, and about 1% of them were adenocarcinomas

We further analyzed the presence of high-risk histology in polyps with different Paris classification according to their anatomical location (Figure 3). As previously stated, the high-risk histology included tubular adenoma with HGD, serrated dysplasia with HGD, villous or tubulovillous adenoma, or adenocarcinoma. It was shown that in each region, most polyps were benign and that the highest incidence of dysplasia or carcinoma in situ occurred in polyps with size ≥10 mm. The proportion of premalignant or malignant polyps with size ≤5 mm was very low (less than 0.5%). However, more attention should be paid to the 0-Is and 0-IIa polyps with size ≤5 mm in the right-sided colon because these 2 types of polyps had higher probability of high-risk adenoma in the right colon than in the left colon, which was 0.47% vs 0.15% in 0-Is and 0.26% vs 0.12% in 0-IIa, respectively (Figure 3A and B).

The malignant transformation of colon polyps almost all occurred in polyps with size ≥10 mm, except for 0-Isp

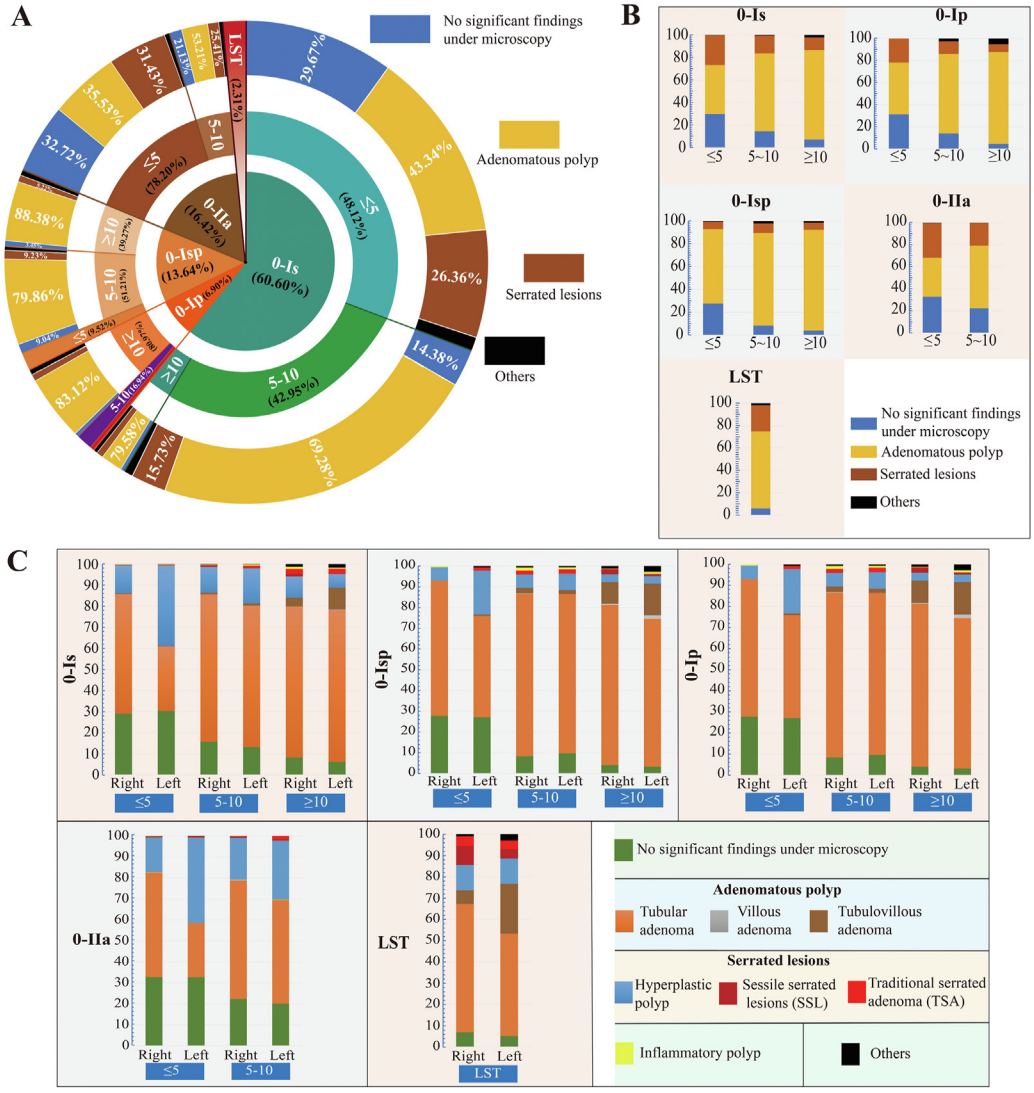

Figure 2. Histopathology of colorectal polyps with different Paris classification in different anatomical positions. (A and B), Interpret the pie chart from the inside out. The innermost layer of the pie chart showed the proportion of colorectal polyps with different Paris types, eg 0-Is type accounted for 60.60% of all polyps followed by 0-IIa type with 16.42%. Furthermore, we divided colorectal polyps into 3 groups according to the size: ≤5 mm, 5–10 mm and ≥10 mm groups. The proportion of polyps with different sizes in different Paris types was shown in the middle layer of the pie chart. For 0-Is type polyps, ≤5 mm intestinal polyps accounted for 48.12%, 5–10 mm with 42.95%, and ≥10 mm with 8.93%. The outermost side of the pie chart showed the histology of polyps with different Paris types and sizes. As the polyp enlarged, the proportion of adenomatous polyp gradually increased while the proportion of serrated lesions decreased. (C), For polyps with size ≤5 mm, the components of chronic inflammation, adenomatous and serrated dysplasia were different between the right-sided and left-sided colon. However, for polyps with size 5–10 mm and ≥10 mm, there was no significant difference in pathological types between the left-sided and right-sided colon.

polyps with a size of 5–10 mm in the left-sided colon (the positive rate for carcinomatous rate is 0.13%). For polyps with size ≥10 mm, regardless of the Paris classification, the proportion of polyps in the left colon with high-risk adenomas was significantly higher than that in the right colon. The positive rates for high-risk histology were 7.46% (right-sided colon) vs 16.80% (left-sided colon) in 0-Is polyps, 14.29% (right-sided colon) vs 24.97% (left-sided colon) in 0-Isp, 23.00% (right-sided colon) vs 36.19% (left-sided colon) in 0-Ip, or 14.47% (right-sided colon) vs 37.81% (left-sided colon) in LST, respectively. Moreover, the positive rates for adenocarcinoma in 0-Is with size ≥10 mm was 0.42% (right-sided colon) and 0.58% (left-sided colon), respectively (Figure 3B). And the positive rates for adenocarcinoma were 0.17% and 0.84% in 0-Isp polyps, 0.16% and 1.05% in 0-Ip polyps, 0.59% and 0.98% in LST polyps (Figure 3). No malignant transformation was found in 3642 0-IIa lesions less than 10 mm in our study. Of note, carcinoma was found even in 0-I type polyps less than 1 cm in diameter, and the percentage was 0.02% (2/12,238) in 0-Is

	Number of polyps			Number of polyps with different size			Number of polyps with HGD, Villous or tubulovillous, or adenocarcinoma histology					
							≤5mm (n*,%)		5~10mm (n,%)		≥10mm (n,%)	
	total number	right-sided	left-sided	≤5mm	5~10mm	≥10mm	Right colon	Left colon	Right colon	Left colon	Right colon	Left colon
0-Is	13438	6411	7027	6467	5771	1200	15/3160, 0.47%	5/3307, 0.15%	29/2688, 1.08%	34/3083, 1.10%	42/563, 7.46%	107/637, 16.80%
0-Isp	3025	1267	1758	288	1549	1188	0/155, 0.00%	2/133, 1.50%	22/685, 3.21%	32/864, 3.70%	61/427, 14.29%	190/761, 24.97%
0-Ip	1529	531	998	32	259	1238	0/20, 0.00%	0/12, 0.00%	2/124, 1.61%	11/135, 8.15%	89/387, 23.00%	308/851, 36.19%
0-IIa	3643	1544	2099	2848	795	-	3/1148, 0.26%	2/1700, 0.12%	2/395, 0.51%	2/400, 0.50%		
LST	512	311	201	-	-	512					45/311, 14.47%	76/201, 37.81%

*: number/total number in related anamtocal location

	Numbere of high-risk Polyps with size ≥10mm (n,%)
0-Is	149/1200, 12.42%
0-Isp	251/1188, 21.13%
0-Ip	397/1238, 32.07%
LST	121/512, 23.63%

	Tubular adenoma with HGD (n,%)	Villous or tubulovillous adenoma (n,%)
0-Is	44/1200, 3.67%	92/1200, 7.67%
0-Isp	62/1188, 5.22%	177/1188, 14.90%
0-Ip	98/1238, 7.92%	283/1238, 22.86%
LST	45/512, 8.79%	67/512, 13.09%

	Serrated lesions with HGD (n,%)	Adenocarcinoma(n,%)
0-Is	1/1200, 0.08%	12/1200, 1.00%
0-Isp	0/1188, 0.00%	12/1188, 1.01%
0-Ip	1/1238, 0.08%	15/1238, 1.21%
LST	1/512, 0.20%	8/512, 1.56%

Figure 3. Characteristics of advanced adenomas. (A), Distribution of colorectal polyps with the high-risk histology included tubular adenoma with high-grade dysplasia (HGD), serrated dysplasia with HGD, villous or tubulovillous adenoma, or adenocarcinoma. (B), Polyps larger than 1 cm located in the left-sided colon were more likely to have high-risk histology. (C), The histopathology of polyps larger than 1 cm, and about 1% of them were demonstrated with adenocarcinoma.

polyp, 0% (0/291) in 0-Ip polyp, and 0.11% (2/1837) in 0-Isp polyp, respectively.

We further analyzed the frequency of carcinoma in situ and invasive cancer in colorectal polyp with size ≥10 mm according to their anatomical location (Figure 3A and C). Adenomatous polyps were the major pathological component regardless of the Paris typing of polyps with size ≥10 mm, with 79.58% in 0-Is, 88.38% in 0-Isp, 83.12% in 0-Ip, and 68.75% in LST, respectively (as shown by using yellow color in the upside-figure of Figure 3C). For serrated dysplasia, the percentage was 11.08% in 0-Is, 5.22% in 0-Isp, 7.11% in 0-Ip, and 23.44% in LST, respectively (as shown by using orange color in the upside-figure of Figure 3C). We further break down the occurrence of pre-malignant and malignant changes according to the category of polyp and found that the percentage of polyps with HGD or carcinoma was different in polyp with size ≥10 mm of the Paris typing (as shown in the table of Figure 3C), such as 12.42% in 0-Is polyps, 21.13% in 0-Isp polyps, 32.07% in 0-Ip polyps, and 23.63% in LST. Importantly, herein we showed that the percentage of adenocarcinoma in polyps with size ≥10 mm was 1.00%–1.56%.

Discussion

We present our experience with over 22,000 colorectal polyps removed endoscopically from 7322 patients and correlate the histopathology of polyps with their anatomical location and morphology. It demonstrated that: (1) the sigmoid colon was the best site for polyps except for LST, which usually occurred in the ascending colon and rectum; (2) pathologically high-risk polyps mostly occurred in polyps with size ≥1 cm, especially in the left-sided colon; and (3) the positive rate for adenocarcinoma in polyps larger than 1 cm was estimated at 1%.

Firstly, we emphasize that morphological classification is mainly due to the obvious correlation between morphological manifestations and disease progression. We found that the polyps with 0-Is or 0-Isp type accounted for about 75% of colorectal polyps and generally occurred in the left-side colon. Polyps with 0-IIc or 0-IIb type, which were reported to usually occur in the proximal colon, were very rare. SSL, which were reported to account for about 15% of superficial colorectal tumor lesions, usually occur in the proximal colon.[7] In the published series[8] from Niigata Hospital, protruding polyps including pedunculated or sessile disease represented approximately 50% of all lesions; elevated (0-IIa) polyp accounted for 44% of all cases; completely flat lesions (0-IIb) were very rare; depressed lesions (0-IIc) are not frequent; and excavated lesions (0-III) almost never occurred. Similar figures were reported in the series (9533 cases) in the Akita Red Cross Hospital,[9] in which the proportion of nonprotruding lesions was 43%. Of note, the precursors of colorectal cancer do not consist exclusively of protruding lesions[10,11]; a recent study from Sweden suggests that more than 40% of advanced colorectal cancers develop from a nonprotruding precursor.[12]

Moreover, sigmoid colon should be detected adequately during colonoscopy to increase the adenoma detection rate. Each 1.0% increase in the adenoma detection rate was associated with a 3.0% decrease in the risk of cancer.[13] It is currently a widely held view that missed cancers occur rarely during the follow-up period after a negative colonoscopy.[14] However, more realistic figures are obtained when the histories of patients with confirmed cancer are investigated. The miss rate for small adenomas ($<$ 1 cm) during colonoscopy is high in the United States of America and other countries.[15] In a cohort of 557 patients, 5.2% were found to have had one or more negative colonoscopies during the 5 years before the diagnosis of cancer.[16] A recent population study confirmed a 4% rate of false-negative findings for cancer; in 2654 individuals, 105 had had at least one colonoscopy within 3 years of their admission for surgical resection of a right-sided colon cancer.[17] Many studies have found that the withdrawal time of colonoscopy is significantly related to the detection rate of colonic adenoma, so that many guidelines recommend the withdrawal time of colonoscopy.[18–20] In this study, we showed that the sigmoid colon was the best site for polyps except for LST, which usually occurred in the ascending colon and rectum. Therefore, we believe that in addition to the withdrawal time, it is also important to focus on the prone sites of colonic polyps, such as sigmoid colon.

Furthermore, serrated pathway is a rapidly evolving concept in colorectal carcinogenesis, and it was postulated that 15%–30% of colorectal cancer arises via this alternative pathway.[21] Interval colorectal cancer detected during the surveillance phase after colonoscopy tends to occur proximally and it is closely related to CpG island methylator phenotype-high and microsatellite instability-positive sessile serrated adenoma/polyp. Therefore, the WHO Gastrointestinal Tumor Classification recommends that all polyps with a diameter of $\leq$5 mm should be removed clinically except these located in rectum and sigmoid colon. Most serrated polyps are asymptomatic and therefore an incidental finding at endoscopy.

Polyps with size $\geq$10 mm should be treated carefully, especially in the left-sided colon. The advancing incidence of malignancy with increasing polyp size has long been recognized. We know that the morphologic classification helps predict the extent of invasion into the submucosa and, thus, the choice between endoscopic or surgical treatment. In the large bowel, the proportion of protruding precursors is around 50%, and pedunculated polyps account for approximately one-third of the precursors of advanced cancer. In the absence of adverse qualitative criteria, endoscopic mucosectomy is safe in nonprotruding lesions when the depth of invasion into the submucosa is less than 1000 μm. For nonprotruding and depressed lesions, the risk of lymphatic metastases is high, while it is extremely small for nonprotruding and elevated lesions. The cut-off value of 1000 μm has to be adjusted to some extent for sessile protruding lesions with a broad implantation in the submucosa and for pedunculated lesions with a stalk.[22] In these cases, the extent of the width is considered well as the depth, and more flexible criteria have been proposed combining 2 cut-off values: 2000 μm for the depth and 4000 μm for total submucosal width of the carcinoma.[23,24] Moreover, herein we showed that pathologically high-risk polyps mostly occurred in polyps with size $\geq$10 mm and the positive rates for adenocarcinoma in these polyps was estimated at 1%. Of note, for polyps with size $\geq$10 mm, the proportion of premalignant or malignant changes was much higher in left-sided colon than that in right-sided colon. For the endoscopist, training and experience depend on constant interaction with the pathologist. In specimens resected at endoscopy, the depth of invasion into the submucosa is checked and measured with a micrometer in order to confirm the justification for endoscopic treatment. Although polyp size, long recognized as a factor, was shown to be importantly related to malignant change, we also showed that invasive cancer could be found even in polyps less than 10 mm in diameter.

Conclusion

Since the incidence of carcinoma of the colon is on the rise and burgeoning evidence supports a polyp-cancer sequence, we suggest that a vigorous program for endoscopic detection and excision of colorectal polyps will favorably influence the management of this disease.

Supplementary Materials

Material associated with this article can be found in the online version at https://doi.org/10.1016/j.gastha.2023.06.002.

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Authors' Contributions:
Chunpeng Zhu, Yuqi Wang, Hanyun Zhang, Qi Yang, Yi Zou, Yongli Ye, and Yuyi Li acquired the data. Chunpeng Zhu, Yuqi Wang, and Qi Yang did the statistical analyses and wrote the original draft. Chunpeng Zhu and Caihua Wang conceived, designed the study, analyzed and interpreted the data. All authors critically revised the manuscript, approved the final version of the manuscript and agreed to be accountable for the accuracy of the work.

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Ethical Statement:
The corresponding author, on behalf of all authors, jointly and severally, certifies that their institution has approved the protocol for any investigation involving humans or animals and that all experimentation was conducted in conformity with ethical and humane principles of research.

Data Transparency Statement:
All data will be made available to other investigators upon request, with limitations to proprietary information such as the patient's privacy.

Reporting Guidelines:
CONSORT.