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Lesion Size Marks a Histologic and Morphologic Transition in Colorectal Polyps: A 16-Year Cohort of 1,026 Endoscopically Resected Lesions

Saydimurad I. Ismailov[1,2]

nodira.bakieva2221@gmail.com

Republican Specialized Scientific and Practical Medical Center of Surgery named after Academician V. Vakhidov,

D. A. Djumaniyazov[1]

Republican Specialized Scientific and Practical Medical Center of Surgery named after Academician V. Vakhidov,

Kh. G. Polvonniyozov[1,2]

Republican Specialized Scientific and Practical Medical Center of Surgery named after Academician V. Vakhidov,

B.D. Abdullaev[3]

CITY MED Medical Center

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Abstract

Background

A clinically useful colorectal polyp study should identify findings that change risk assessment and management, not merely describe lesion counts. We tested whether increasing lesion size marks a coordinated transition in histology and gross morphology and examined the implications for complete-colon evaluation, endoscopic treatment complexity, and surveillance.

Methods

This retrospective single-center cohort comprised 393 patients undergoing 421 polypectomy procedures during 2010–2025, with 1,026 treated colorectal lesions. Source cross-tabulations were reconstructed for seven size strata, four histologic categories, and five gross morphology categories. Global associations were assessed with Pearson χ^2 tests and Cramér's V. Villous-containing histology (tubulovillous or villous adenoma) was compared between lesions > 2.0 cm and ≤ 2.0 cm using an odds ratio (OR) with 95% confidence interval (CI).

Results

Histologic composition changed strongly across size strata (χ^2=1069.9, df = 18, P < 0.001; Cramér's V = 0.590). Villous-containing histology increased from 1.6% in 0.3–0.5-cm lesions to 85.7% in lesions > 5.1 cm. Lesions > 2.0 cm had villous-containing histology in 119/174 (68.4%) versus 197/852 (23.1%) lesions ≤ 2.0 cm (OR 7.19, 95% CI 5.03–10.28; P < 0.001). Gross morphology also shifted with size (χ^2=161.8, df = 4, P < 0.001; Cramér's V = 0.40): spreading morphology increased from 3/852 (0.4%) among lesions ≤ 2.0 cm to 28/174 (16.1%) among lesions > 2.0 cm, while broad-based morphology decreased from 56.8% to 31.6%. Of 174 large lesions, 138 (79.3%) required fragmentation resection and seven required a planned second stage. Bleeding occurred in 11/421 procedures (2.6%), all controlled endoscopically, and no perforations were recorded. Among 74 patients with a distal lesion previously detected by sigmoidoscopy, full colonoscopy identified additional proximal polyps in 39 (52.7%) and malignant tumors in six (8.2%).

Conclusion

Increasing lesion size marked a clinically important phenotypic transition rather than a simple increase in diameter: larger lesions were substantially more likely to contain villous architecture, had a different macroscopic configuration, and more often required complex resection. The high yield of proximal pathology after distal lesion detection further supports complete-colon examination. These findings

identify lesion size as an integrative marker for histologic risk, technical complexity, and surveillance planning.

Introduction

Colorectal polypectomy is a cornerstone of colorectal cancer prevention, and regional literature has likewise emphasized differentiated treatment strategies for colorectal polyps and polyposis [23]; long-term data from the National Polyp Study demonstrated reductions in colorectal cancer incidence and mortality after adenoma removal [1, 2]. The clinical significance of an individual lesion, however, depends on more than its presence. Size, morphology, location, optical features and histologic architecture influence malignant potential, technical resectability, risk of incomplete excision and the intensity of subsequent surveillance [3–6].

Contemporary guidelines increasingly stratify resection by lesion phenotype. Regional and earlier endoscopic literature has similarly described mucosal resection, morphology-based assessment, and endoscopic treatment of superficial colorectal neoplasia [19–22,24–30]. The 2024 ESGE guideline recommends cold-snare polypectomy for diminutive and small lesions, conventional EMR for most large (≥ 20 mm) nonpedunculated adenomatous polyps, margin thermal ablation after piecemeal hot EMR, and en bloc techniques when superficial invasive carcinoma is suspected [3]. The US Multi-Society Task Force likewise emphasizes lesion-specific selection of resection technique and complete endoscopic removal [4]. Modern management of large nonpedunculated colorectal polyps also depends on careful optical assessment of morphology and surface pattern before choosing EMR, ESD or other advanced resection strategies [5–7]. Yet long-horizon real-world datasets from Central Asia remain underrepresented in the literature.

The present study was designed around a clinically consequential hypothesis: lesion size may function as an integrative marker of a broader phenotypic transition, simultaneously reflecting histologic risk, macroscopic configuration and technical complexity. The primary objective was therefore to quantify the size–histology relationship and its effect size. Secondary objectives were to determine whether gross morphology changed materially above the 2-cm threshold, characterize large-lesion resection complexity, assess the diagnostic yield of full colonoscopy after a previously detected distal lesion, and describe recorded safety and surveillance outcomes.

Materials and Methods

Design, setting and cohort

This retrospective single-center cohort used archived outpatient charts, endoscopy reports and histopathology from the endoscopy service of the Republican Specialized Scientific and Practical Medical Center of Surgery named after Academician V. Vakhidov, Tashkent, Uzbekistan, covering 2010–2025. The source clinical program comprised 4,109 outpatient colonoscopies. A total of 393 patients

underwent 421 colonoscopic polypectomy procedures, during which 1,026 benign-appearing colorectal lesions measuring approximately 0.2–7.0 cm were treated.

Endoscopy, morphology and histology

Procedures were performed using OLYMPUS CV-170 and FUJINON systems. Source records documented lesion location, size and gross base configuration as broad-based, narrow-based, short-stalked, long-stalked or spreading. Histology was categorized as hyperplastic polyp, tubular adenoma, tubulovillous adenoma or villous adenoma. Villous-containing histology was defined as tubulovillous or villous adenoma. These historical morphology categories are reported as recorded; contemporary practice additionally uses standardized classifications such as Paris morphology and validated optical systems [6, 8].

Resection and follow-up

Historical treatment categories included coagulation, single-stage snare electroexcision, snare fragmentation/piecemeal resection and electroresection incorporating surrounding mucosa. These terms are reported as documented and are not presented as current preferred techniques. Modern recommendations favor cold-snare techniques for small lesions and EMR or selected en bloc approaches for larger or invasion-suspicious lesions [3–7]. Intraprocedural bleeding, bleeding within 1–7 days, perforation, need for surgery and available surveillance findings were extracted.

Statistical analysis

Counts and percentages were reconstructed from the archived study tabulations. The global association between seven lesion-size strata and four histologic categories was assessed with Pearson's chi-square test and summarized with Cramer's V. The morphology distribution of lesions > 2.0 cm and < = 2.0 cm was compared across five morphology categories using Pearson's chi-square test and Cramer's V. Villous-containing histology in lesions > 2.0 versus < = 2.0 cm was summarized by an odds ratio (OR) with 95% confidence interval (CI) and Fisher's exact test. For the morphology-by-histology analysis, only source-documented descriptive proportions were reported because complete individual-level cross-classified data were not available for valid re-analysis. No patient-level multivariable model was fitted because individual lesion-level covariates required to account for within-patient clustering and confounding were unavailable.

Ethics

The study was approved by the Ethics Committee of Urgench State Medical Institute (Ref. No. ASC358746778). The study was conducted in accordance with applicable institutional ethical

requirements and the principles of the Declaration of Helsinki. Informed consent was obtained from all participants.

Results

Cohort and anatomic distribution

The 393 patients included 175 men (44.5%) and 218 women (55.5%). Across 421 procedures, 1,026 lesions were treated. The rectum (n = 299) and sigmoid colon (n = 433) accounted for 71.3% of lesions. Overall, 850 lesions (82.8%) were left-sided and 176 (17.2%) right-sided. Gross morphology comprised 539 broad-based (52.5%), 149 narrow-based (14.5%), 105 short-stalked (10.2%), 202 long-stalked (19.7%) and 31 spreading lesions (3.0%). The size-by-histology distribution is presented in Table 1, while source-supported morphology–histology observations are summarized in Table 2.

Size–histology gradient

Histologic composition changed markedly across the seven size strata (Pearson χ^2=1069.9, df = 18, P < 0.001; Cramér's V = 0.59), indicating a large association between size category and histologic phenotype. Villous-containing histology rose from 1.6% at 0.3–0.5 cm to 27.4% at 0.6–1.0 cm, 40.8% at 1.1–2.0 cm, 55.1% at 2.1–3.0 cm, 85.0% at 3.1–4.0 cm, 83.3% at 4.1–5.0 cm, and 85.7% above 5.1 cm. In the clinically interpretable threshold comparison, 119/174 (68.4%) lesions > 2.0 cm contained a tubulovillous or villous component versus 197/852 (23.1%) lesions ≤ 2.0 cm (OR 7.19, 95% CI 5.03–10.28; Fisher exact P < 0.001). This graded transition is shown in Fig. 1, and the corresponding shift in the complete histologic composition is shown in Fig. 2.

Source-supported morphology–histology patterns

Macroscopic configuration was also associated descriptively with histologic phenotype: 71/81 (87.7%) villous adenomas were spreading or broad-based; 149/234 (63.7%) tubulovillous adenomas were stalked; and 96.9% of hyperplastic polyps were broad-based (Table 2). Because complete individual-level morphology-by-histology data were unavailable, these proportions are presented descriptively and no additional morphology-specific odds ratios were calculated.

Size-defined morphologic transition

Gross morphology changed substantially across the 2-cm threshold (Pearson χ^2=161.8, df = 4, P < 0.001; Cramér's V = 0.40). Among 852 lesions ≤ 2.0 cm, 484 (56.8%) were broad-based and only 3 (0.4%) were spreading. Among 174 lesions > 2.0 cm, broad-based lesions decreased to 55 (31.6%), whereas spreading lesions increased to 28 (16.1%) and long-stalked lesions to 59 (33.9%). Thus, increasing size corresponded to a genuine change in macroscopic phenotype, not merely enlargement of otherwise similar lesions. The full size-by-morphology cross-tabulation is provided in Table 3 and visualized in Fig. 3.

Large-lesion resection strategy

Of 174 lesions measuring 2.1–7.0 cm, 36 (20.7%) underwent single-stage electroexcision and 138 (79.3%) fragmentation resection. The source additionally describes resection incorporating surrounding mucosa for 28 spreading villous lesions and nine lesions > 3.5 cm. Seven large flat or nodular rectosigmoid lesions required a planned second resection stage 12–14 days later. Two local recurrences were documented six months after resection of large flat rectal lesions and were removed endoscopically; subsequent examinations at six months and one year showed scars without further pathological growth. These observations are clinically consistent with the recognized increase in technical complexity and recurrence risk of large lesions treated piecemeal [5, 9, 10].

Safety

Eleven bleeding events occurred across 421 procedures (2.6%): eight intraprocedural and three within 1–7 days. All were controlled endoscopically and none required surgery. No perforations were recorded (Table 4). These rates should be interpreted cautiously because adverse-event ascertainment was retrospective and the study spans 16 years. Contemporary evidence identifies lesion size, right-colon location, anticoagulant exposure and EMR as important determinants of delayed post-polypectomy bleeding risk [11, 12].

Complete-colon yield and surveillance

Among 74 patients whose rectal or distal sigmoid lesions had previously been identified by sigmoidoscopy, subsequent full colonoscopy found additional proximal polyps requiring removal in 39 (52.7%) and malignant tumors in six (8.2%). This clinically important diagnostic yield is shown in Fig. 4 and summarized in Table 4. Surveillance colonoscopy was documented in 271/393 patients (69.0%). The source reports 14 recurrences and 31 new polyps among patients returning after removal of lesions < 3.5 cm; it also describes one later cecal malignancy. Because follow-up intervals and mutually exclusive patient-level denominators were not uniformly available, these observations were not converted into time-to-event estimates.

Table 1
Size and histology of 1,026 lesions

Size (cm)	Hyperplastic	Tubular	Tubulovillous	Villous	Total
0.3–0.5	213	26	4	0	243
0.6–1.0	13	287	111	2	413
1.1–2.0	1	115	62	18	196
2.1–3.0	0	40	26	23	89
3.1–4.0	0	9	28	23	60
4.1–5.0	0	3	4	11	18
> 5.1	0	1	2	4	7

Table 2
Source-supported morphology–histology observations

Source-supported observation	Numerator	Denominator	Proportion
Villous adenomas broad-based or spreading	71	81	87.7%
Tubulovillous adenomas with a stalk	149	234	63.7%
Tubular adenomas with a short or long stalk	151	484	31.2%
Hyperplastic polyps broad-based	220	227	96.9%

Table 3
Morphology by lesion size

Morphology	≤ 2.0 cm	> 2.0 cm	Total
Broad base	484	55	539
Narrow base	133	16	149
Short stalk	89	16	105
Long stalk	143	59	202
Spreading	3	28	31

Table 4
Key clinical outcomes

Outcome	n/N	Rate
Any recorded bleeding	11/421	2.6%
Intraprocedural bleeding	8/421	1.9%
Early delayed bleeding	3/421	0.7%
Perforation	0/421	0%
Documented surveillance	271/393	69.0%
Additional proximal polyps after distal finding	39/74	52.7%
Malignant tumor after distal finding	6/74	8.2%

Discussion

The principal scientific finding is that the 2-cm threshold identifies more than a change in lesion diameter. It marks a coordinated phenotypic transition. Above this threshold, the prevalence of villous-containing histology nearly tripled in absolute terms (68.4% vs 23.1%), corresponding to approximately sevenfold higher odds, while the macroscopic distribution shifted sharply toward spreading and long-stalked configurations. This is consistent with the broader literature showing that large colorectal lesions carry greater risk of advanced histology and require increasingly selective resection strategies [5–7, 13]. The combined histologic and morphologic transition provides a biologically and technically coherent explanation for why large lesions demand more careful optical assessment, resection planning and surveillance.

The large-lesion treatment data reinforce the clinical relevance of that transition. Nearly four of five lesions > 2 cm required fragmentation resection in the historical program, and a subset required planned staged treatment. Although these techniques reflect the era in which the cohort was treated and should not be promoted over modern EMR/ESD standards, the pattern demonstrates that lesion size tracked technical complexity as well as histologic risk. Current guidelines and contemporary reviews emphasize complete lesion assessment, selective en bloc resection when invasion is suspected, and recurrence-prevention strategies after piecemeal EMR [3–7]. Earlier and regional reports also document the technical evolution of EMR and related endoscopic approaches for colorectal neoplasia [19–22,24,27–30].

A separate finding with direct practice relevance was the yield of full colonoscopy after a previously detected distal lesion. Additional proximal polyps were found in 52.7% of this selected subgroup and malignant tumors in 8.2%. These percentages are not population prevalence estimates, but they provide a strong service-level argument against limiting examination to the distal colon after a polyp is found by

sigmoidoscopy. This interpretation is consistent with the preventive principle that colonoscopy should permit detection and removal of synchronous neoplasia throughout the colon [1, 2, 14].

The recorded bleeding rate was low and no perforations were documented, but safety comparisons with contemporary cohorts are limited by retrospective ascertainment, evolution of equipment and technique, and the absence of standardized modern adverse-event definitions. Delayed bleeding remains a clinically important complication of colorectal endoscopic resection, particularly for larger and right-sided lesions [11, 12]. The study's value is therefore its long-horizon phenotype and service-level experience, not proof that historical thermal techniques outperform modern approaches.

Surveillance is the major unresolved weakness. Only 69% of treated patients had documented follow-up, and aggregate source reporting does not permit robust recurrence-free survival analysis. Recurrence after piecemeal EMR has been well documented, with early surveillance traditionally recommended for large lesions [9, 10]. More recent data suggest that surveillance timing may be individualized for selected low-risk lesions, while margin thermal ablation substantially reduces recurrence after piecemeal EMR [15–17]. The observed recurrences, metachronous lesions and later cecal malignancy in this cohort therefore support structured surveillance but cannot establish precise cumulative incidence.

Strengths and limitations

Strengths are the 1,026-lesion sample, 16-year clinical horizon, unusually detailed cross-tabulation of size, gross morphology and histology, explicit large-lesion treatment data, and procedure-level adverse-event counts. Limitations include the retrospective single-center design; aggregate rather than individual-level analytic data; inability to account for multiple lesions within the same patient; absence of multivariable adjustment; evolving endoscopic technology; nonuniform surveillance; and possible under-ascertainment of events treated elsewhere. The morphology effect estimates are therefore descriptive/unadjusted and should be validated in a patient-level contemporary cohort.

Conclusions

In this 1,026-lesion cohort, increasing colorectal polyp size identified a clinically meaningful transition in lesion biology and technical phenotype. Lesions > 2.0 cm had approximately sevenfold higher odds of villous-containing histology and a markedly different gross morphology, with a sharp rise in spreading lesions and greater reliance on complex historical resection strategies. These observations make lesion size an integrative marker of histologic risk and procedural complexity rather than a purely dimensional characteristic. In addition, the high yield of proximal neoplasia after a previously detected distal lesion supports complete-colon examination. The most important implication is therefore not that a specific historical resection method should be reproduced, but that size and morphology should be integrated early to guide optical assessment, referral/resection strategy, histologic evaluation and surveillance.

Declarations

Author information: Saydimurad I. Ismailov[1,2], D.A. Djumaniyazov[1], Kh.G. Polvonniyozov[1,2], B.D. Abdullaev[3]

Affiliations: [1] Republican Specialized Scientific and Practical Medical Center of Surgery named after Academician V. Vakhidov, Tashkent, Uzbekistan; [2] Tashkent State Medical University, Tashkent, Uzbekistan; [3] CITY MED Medical Center, Uzbekistan

Corresponding author: Saydimurad I. Ismailov; Email: nodira.bakieva2221@gmail.com

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Reporting guideline: STROBE principles were followed in structuring this observational report; a completed checklist should accompany submission if requested.

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Figures

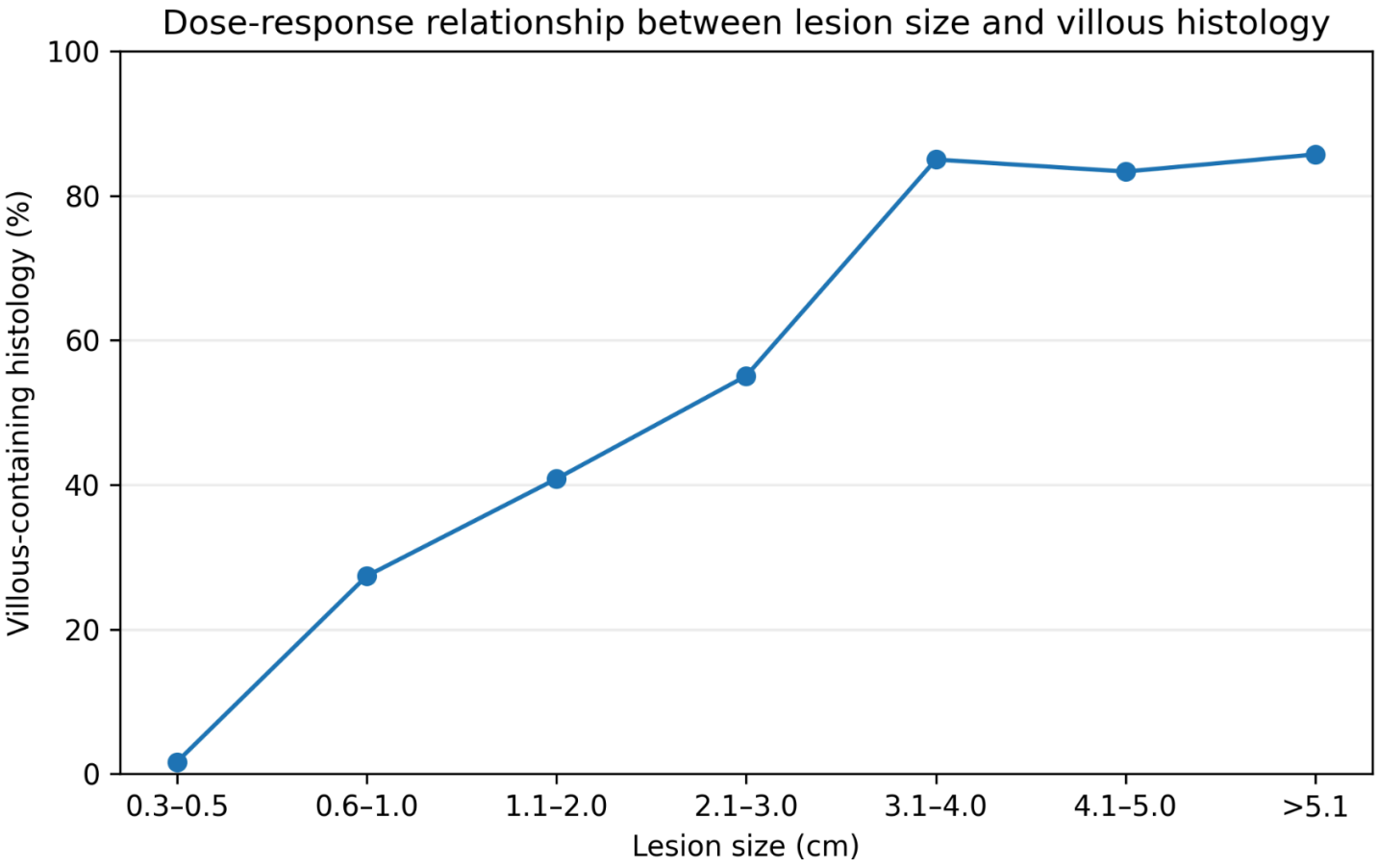

Figure 1

Graded increase in villous-containing histology across lesion-size strata.

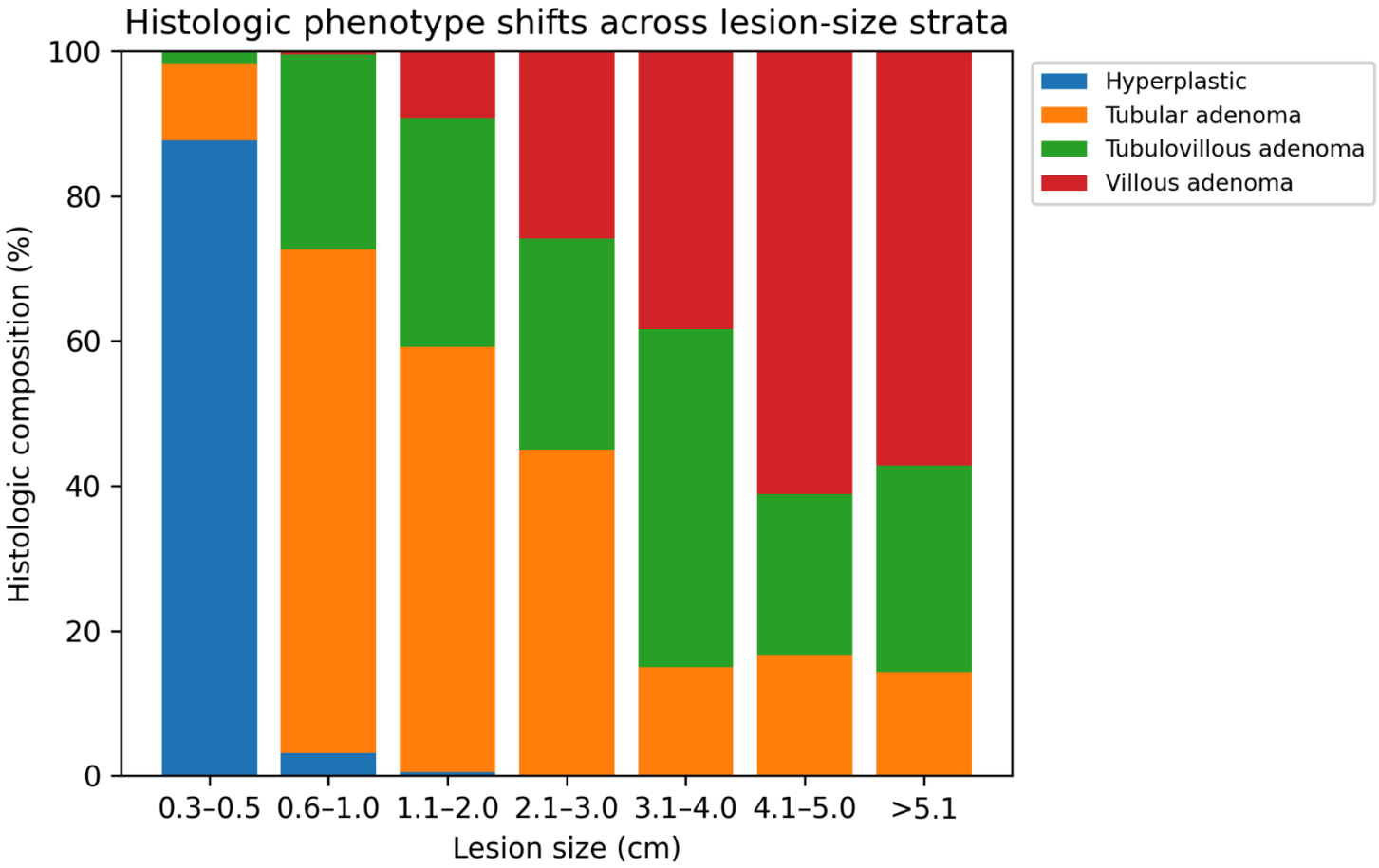

Figure 2

Histologic composition across seven lesion-size categories

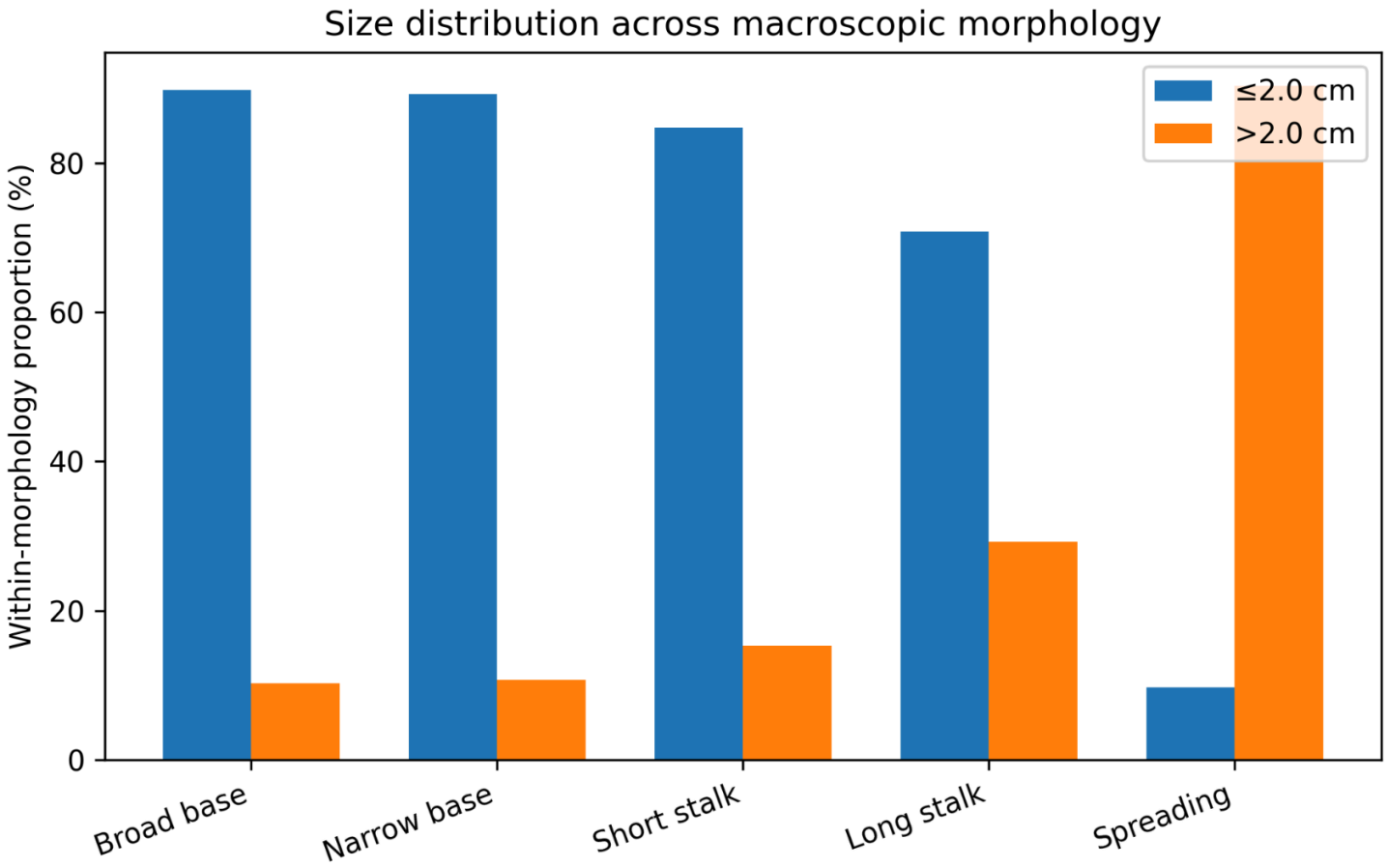

Figure 3

Size-defined shift in macroscopic morphology.

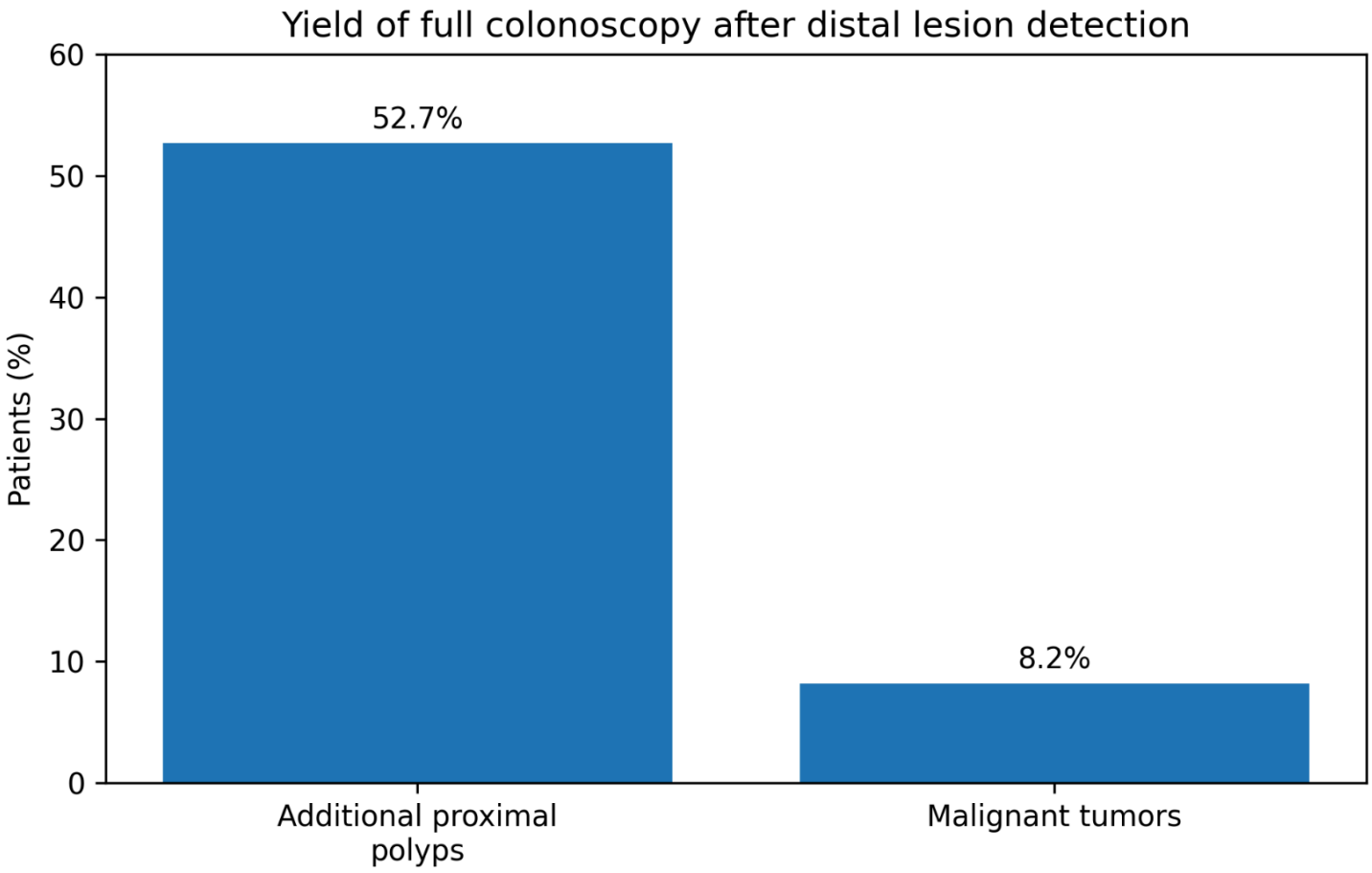

Figure 4

Diagnostic yield of full colonoscopy after a previously detected distal lesion (n=74).