

Diagnostic Accuracy of Colonoscopy and Histopathological Yield of Routine Biopsy: A Prospective Cohort Study in a Tertiary Care Hospital

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Abstract

Background

Colonoscopy is the gold standard investigation for lower gastrointestinal symptoms, but the diagnostic value of routine biopsy particularly in macroscopically normal mucosa remains debated, and reported concordance between colonoscopic and histopathological findings varies widely. This study evaluated diagnostic yield, colonoscopy histopathology concordance, diagnostic accuracy for malignancy, and clinical predictors of malignancy in a prospective cohort.

Methods

This prospective observational study included 323 consecutive patients undergoing colonoscopy with biopsy at a tertiary care centre between January 2024 and March 2026. Colonoscopic impressions and histopathological diagnoses were independently categorized into six comparable groups (malignancy/growth, TB/granulomatous, IBD, colitis/inflammatory, polyp, and normal/no significant pathology). Concordance was assessed using Cohen's kappa. Diagnostic accuracy of colonoscopic impression for malignancy was calculated against histopathology as the reference standard. Multivariable logistic regression identified independent predictors of histologically confirmed malignancy.

Results

Mean age was 43.4 ± 16.4 years (range 8–81) with a male predominance (M:F 3.25:1). Colonoscopy was abnormal in 56.7% of patients. Histopathology showed no significant pathology in 34.4%, non-specific colitis/inflammatory or ulcerative change in 30.0%, hyperplastic polyps in 11.1%, malignancy in 9.9%, IBD in 4.3%, solitary rectal ulcer syndrome in 5.0%, and TB/granulomatous pathology in 2.2%. Overall colonoscopy–histopathology concordance was substantial (82.6% agreement; $\kappa = 0.761$). Colonoscopic impression of malignancy/growth showed 100% sensitivity, 97.9% specificity, 84.2% positive predictive value, and 100% negative predictive value against histopathology. Among 140 patients with a macroscopically normal colonoscopy, 21.4% had abnormal histopathology, almost entirely non-specific colitis. On multivariable analysis, a mass lesion on colonoscopy (odds ratio [OR] 89.1, 95% CI 51.8–157.1) and age > 50 years (OR 2.67, 95% CI 1.47–5.08) were independent predictors of malignancy; the clinical-features-only model (age and rectal bleeding, without endoscopic findings) had an area under the curve (AUC) of 0.736.

Conclusions

Colonoscopy demonstrates substantial concordance with histopathology and excellent accuracy for detecting malignancy. Routine biopsy of macroscopically normal mucosa identifies clinically relevant inflammatory pathology in approximately one-fifth of patients, supporting its continued use even when the colonoscopic appearance is unremarkable. Age over 50 years and the presence of a mass lesion independently predict malignancy and may help guide clinical prioritization.

INTRODUCTION

Colonoscopy remains the cornerstone investigation for evaluating lower gastrointestinal symptoms, enabling direct mucosal visualization together with targeted biopsy for histopathological confirmation (1, 2). While colonoscopic impression often guides immediate management decisions, histopathology remains the final arbiter of diagnosis, and the degree of agreement between the two has direct implications for how confidently surgeons can act on visual findings alone (3).

A persistent area of debate is the value of routine biopsy in patients whose colonoscopy appears macroscopically normal. Conditions such as microscopic colitis, early inflammatory bowel disease, and other subtle mucosal pathology may produce no visible change on endoscopy, and several studies have reported variable yields from biopsies of apparently normal mucosa (4, 6, 11). If a meaningful proportion of such biopsies are abnormal, this would support routine sampling even in the absence of visible lesions; if not, selective biopsy strategies may be more appropriate.

Separately, identifying which clinical and endoscopic features most strongly predict malignancy can help prioritize patients for urgent evaluation, particularly in resource-limited settings where colonoscopy access may be constrained (8).

This study aimed to evaluate, in a prospective cohort from a tertiary care centre: (i) the diagnostic yield of colonoscopy and the spectrum of histopathological findings; (ii) the degree of concordance between colonoscopic impression and histopathology; (iii) the diagnostic accuracy of colonoscopic impression for malignancy; (iv) the histopathological yield of biopsy in macroscopically normal colonoscopy; and (v) independent clinical and endoscopic predictors of malignancy.

METHODS

Study Design and Setting

This was a prospective observational study conducted at a tertiary care centre.

Duration: January 2024 to March 2026

Sample size: 323 patients

Inclusion Criteria

- Patients undergoing colonoscopy for lower gastrointestinal symptoms, with biopsy performed irrespective of colonoscopic findings

Exclusion Criteria

- Anal fissure

Since it is diagnosed on routine per-rectal examination and do not require colonoscopic biopsy.

Data Collection and Categorization

For each patient, the indication for colonoscopy, the colonoscopic finding and impression, and the final histopathological diagnosis were recorded. To enable structured comparison between colonoscopic impression and histopathology, both were independently classified into six mutually exclusive categories: (1) Malignancy/growth, (2) TB/granulomatous, (3) Inflammatory bowel disease (ulcerative colitis or Crohn's disease), (4) Colitis/inflammatory/non-specific ulceration (including solitary rectal ulcer syndrome), (5) Polyp (hyperplastic or adenomatous, with or without dysplasia), and (6) Normal/no significant pathology. Records that could not be unambiguously assigned to one of these categories on either side were excluded from the concordance analysis only (29/323).

Sample Size Justification

Assuming an expected colonoscopy–histopathology concordance of approximately 70% (based on previously reported series) with a precision (margin of error) of 5% at 95% confidence, the minimum required sample size was calculated as $n = Z^2 p(1-p)/d^2 = (1.96)^2 \times 0.7 \times 0.3 / (0.05)^2 \approx 323$. The final sample of 323 patients closely matched this calculation and therefore concordance and diagnostic accuracy analyses, which is calculated using an Open Epi Info Software version 7.2.5

Statistical Analysis

Continuous variables are presented as mean $\pm$ standard deviation, and categorical variables as frequencies and percentages with 95% confidence intervals (CI) calculated using the Wilson score method, which performs reliably even for proportions close to 0% or 100%. Agreement between colonoscopic impression and histopathological category was assessed using simple percentage agreement and Cohen's kappa (κ), interpreted as: <0.20 slight, 0.21–0.40 fair, 0.41–0.60 moderate, 0.61–0.80 substantial, and 0.81–1.00 almost perfect agreement (7); 95% CI for κ was obtained by bootstrap resampling (2,000 iterations). Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of colonoscopic impression of malignancy/growth were calculated against histopathology-confirmed malignancy as the reference standard, with Wilson 95% CIs.

Univariable associations between candidate predictors (age >50 years, presence of a mass lesion on colonoscopy, and PR bleeding) and histopathology-confirmed malignancy were first assessed using Fisher’s exact test, given the small number of malignancy events in some strata. Variables were then entered into a multivariable logistic regression model to identify independent predictors of malignancy, with odds ratios (OR) and 95% CIs derived via bootstrap resampling (2,000 iterations) to avoid reliance on large-sample (Wald) approximations given the relatively small number of malignancy events (n = 32). Collinearity among predictors was assessed prior to model fitting; no pairwise correlation exceeded 0.4. Discriminative performance of the multivariable model, and of a reduced model restricted to pre-endoscopy clinical variables (age >50 years and PR bleeding), was summarized using the area under the receiver operating characteristic curve (AUC), with 95% CIs obtained by bootstrap resampling (2,000 iterations).

All 323 patients had complete data for all variables included in the analyses. A two-sided p-value <0.05 was considered statistically significant throughout. Analyses were performed in Python 3.10.12, pandas 2.1.4 and scikit-learn 1.3.

RESULTS

Demographic Profile

A total of 323 patients were included. The mean age was 43.4 ± 16.4 years (range 8–81 years), with the majority in the 21–40 year age range. There was a marked male predominance, with a male-to-female ratio of approximately 3.25:1. Demographic characteristics are summarized in Table 1.

Table 1
Demographic characteristics of the cohort (n = 323; mean age 43.4 ± 16.4 years, range 8–81).

Characteristic	n	%
Age ≤ 20 years	20	6.2
Age 21–30 years	64	19.8
Age 31–40 years	69	21.4
Age 41–50 years	59	18.3
Age 51–60 years	49	15.2
Age 61–70 years	44	13.6
Age > 70 years	18	5.6
Male	247	76.5
Female	76	23.5

Indications for Colonoscopy

Indications were chronic constipation (26.5%), chronic abdominal pain (22.5%), chronic diarrhea (22.2%), per-rectal (PR) bleeding (21.9%), anemia under evaluation (4.0%), and associated weight loss (2.2%); categories were not mutually exclusive as some patients presented with combined symptoms.

Colonoscopic Findings

Colonoscopy was abnormal in 183/323 patients (56.7%) and macroscopically normal in 140/323 (43.3%). The detailed spectrum of colonoscopic impressions is summarized in Table 2.

Table 2
Spectrum of colonoscopic impressions across the full cohort (n = 323).

Colonoscopic Impression	n	%
Normal	140	43.3
Colitis / inflammatory / ulcer	72	22.3
Polyp	39	12.1
Malignancy / growth (suspected)	38	11.7
Other	24	7.4
Inflammatory bowel disease	18	5.6
Solitary rectal ulcer syndrome (SRUS)	11	3.4
TB / granulomatous	3	0.9

Histopathological Spectrum

The overall histopathological spectrum across all 323 patients is summarized in Table 3.

Table 3
Histopathological spectrum across the full cohort (n = 323).

Histopathological Category	n	%
No significant pathology	111	34.4
Colitis / inflammatory / non-specific ulcer	97	30.0
Hyperplastic polyp	36	11.1
Malignancy (adenocarcinoma / melanoma)	32	9.9
Solitary rectal ulcer syndrome (SRUS)	16	5.0
Inflammatory bowel disease	14	4.3
TB / granulomatous	7	2.2
Adenoma with dysplasia (pre-malignant)	5	1.5
Other polyp	4	1.2
Other (condyloma acuminatum)	1	0.3

Among the 140 patients with a macroscopically normal colonoscopy, histopathology was unremarkable (“no significant pathology”) in 110 (78.6%). The remaining 30 patients (21.4%; 95% CI 15.4–28.9%) had abnormal histopathology – almost entirely non-specific colitis/inflammatory change (29 patients, 20.7%), with one patient showing a hyperplastic polyp on biopsy of normal-appearing mucosa. Notably, no cases of tuberculosis, inflammatory bowel disease, or malignancy were identified among patients with normal colonoscopic findings in this study.

Colonoscopy–Histopathology Concordance

Of 323 records, 322 (99.7%) could be assigned to a comparable category on both colonoscopic impression and histopathology and were included in the concordance analysis (one record with condyloma acuminatum was excluded as a unique finding not fitting any standard category). Overall agreement was 82.6% (266/322; 95% CI 78.1–86.4%), with a Cohen’s kappa of 0.761 (95% CI 0.70–0.81), indicating substantial agreement. The most common source of discordance was a normal colonoscopic impression in patients subsequently found to have histopathological colitis/inflammatory change (26 cases), reflecting the contribution of routine biopsy in macroscopically normal mucosa described above. Smaller areas of discordance occurred between the colitis/inflammatory and TB/granulomatous or polyp categories.

Diagnostic Accuracy of Colonoscopy for Malignancy

Using colonoscopic impression suggestive of malignancy/growth as the index test and histopathology-confirmed malignancy as the reference standard, colonoscopy demonstrated the following accuracy (Table 4):

Table 4
Diagnostic accuracy of colonoscopic impression for malignancy
(n = 323).

Metric	Value	95% CI
Sensitivity (32/32)	100.0%	89.3–100.0%
Specificity (285/291)	97.9%	95.6–99.1%
Positive predictive value (32/38)	84.2%	69.6–92.6%
Negative predictive value (285/285)	100.0%	98.7–100.0%
Overall accuracy (317/323)	98.1%	96.0–99.1%

All 32 histopathology-confirmed malignancies were correctly identified as suspicious on colonoscopy (zero false negatives). Six lesions considered suspicious for malignancy on colonoscopy were benign on histopathology (false positives), underscoring the continued importance of histopathological confirmation even for visually “obvious” lesions.

Univariable Analysis

Candidate predictors were first assessed individually against histopathology-confirmed malignancy using Fisher’s exact test (Table 5).

Table 5
Univariable associations between candidate predictors and histopathology-confirmed malignancy.

Predictor	Crude Odds Ratio	Fisher’s exact p-value
Mass lesion on colonoscopy	1262.1	< 0.0001
Age > 50 years	8.02	< 0.0001
PR bleeding	1.83	0.168

Multivariable Predictors of Malignancy

On multivariable logistic regression, the presence of a mass lesion on colonoscopy and age > 50 years remained independently associated with histopathology-confirmed malignancy (Table 6). PR bleeding was not an independent predictor.

Table 6
Multivariable predictors of histopathology-confirmed malignancy (95% CIs by bootstrap resampling, 2,000 iterations).

Predictor	Adjusted OR (95% CI)	Significant
Mass lesion on colonoscopy	89.1 (51.8–157.1)	Yes
Age > 50 years	2.67 (1.47–5.08)	Yes
PR bleeding	0.92 (0.46–1.71)	No

The full model, including endoscopic findings, achieved an AUC of 0.987 (95% CI 0.974–0.997). As the presence of a visible mass lesion is itself a strong determinant of biopsy-confirmed malignancy, a second model restricted to pre-endoscopy clinical variables (age > 50 years and PR bleeding) was constructed to assess discriminative ability prior to colonoscopy; this model achieved an AUC of 0.736 (95% CI 0.665–0.824), suggesting modest but meaningful clinical risk stratification is possible based on presentation alone.

DISCUSSION

This prospective cohort demonstrates substantial agreement between colonoscopic impression and histopathological diagnosis (82.6%; $\kappa = 0.761$), in keeping with, and at the higher end of, previously reported concordance rates for colonoscopy (3, 7, 12, 13). High agreement supports the reliability of colonoscopic impression for immediate clinical decision-making, while the residual discordance – predominantly normal-appearing mucosa later found to harbor histological colitis – highlights the specific, limited circumstances in which visual assessment alone is insufficient.

Colonoscopy showed excellent diagnostic accuracy for malignancy, with 100% sensitivity and negative predictive value. This is consistent with the well-established role of colonoscopy in detecting colorectal neoplasia (1, 2, 8). The 84.2% positive predictive value – reflecting six histologically benign lesions among 38 colonoscopically suspicious findings – reinforces existing guidance that histopathological confirmation should be obtained even when a lesion appears unequivocally malignant on endoscopy, since a minority of such lesions prove benign (9).

Approximately one in five patients with a macroscopically normal colonoscopy in this cohort had abnormal histopathology, almost exclusively non-specific colitis. This figure is closely in line with a recent systematic review and meta-analysis of 21 studies (3,322 patients), which reported a pooled significant histopathological change rate of 30% on random biopsy of normal-appearing colonic mucosa in patients with chronic diarrhea, including a 15% pooled rate of microscopic colitis (11). The present findings are therefore consistent with, if somewhat more conservative than, the broader literature on biopsy of endoscopically normal mucosa, particularly for microscopic and non-specific colitis (4–6, 11). While this cohort did not identify tuberculosis, inflammatory bowel disease, or malignancy in macroscopically normal segments, the meaningful yield of non-specific colitis still supports a policy of

routine biopsy in symptomatic patients even when the colonoscopic appearance is unremarkable, particularly in those presenting with chronic diarrhea or abdominal pain where microscopic colitis is a recognized, biopsy-only diagnosis (5, 6).

The overall prevalence of tuberculosis/granulomatous pathology in this cohort (2.2%, 7/323) is notably lower than the proportions often quoted for intestinal tuberculosis in colonoscopic series from India, where it is frequently cited as an important differential for ileocaecal and colonic lesions, particularly in patients with stricturing or ulcerative disease (10). The relatively low yield in this cohort may reflect the predominantly diagnostic, symptom-driven referral pattern of this population rather than a true regional difference in disease burden, and intestinal tuberculosis should remain an important differential diagnosis – particularly alongside Crohn’s disease – in colonoscopic practice in this setting, even though it was not a major contributor to the present findings.

The independent association between a visible mass lesion and malignancy is expected and largely confirms the validity of visual assessment; more clinically useful is the finding that age over 50 years remains an independent predictor even after accounting for endoscopic appearance, and that a model based on age and presenting symptoms alone (AUC 0.74) provides meaningful, if modest, discrimination. In settings where colonoscopy access is limited, such pre-endoscopy risk stratification may help prioritize patients for earlier evaluation (8).

A small number of uncommon and clinically noteworthy findings merit separate mention. One patient was found to have condyloma acuminatum on colonoscopy and histopathology – an unusual presentation in the context of a lower GI symptom workup, highlighting the importance of histopathological sampling of unexpected mucosal lesions. One patient with terminal ileal nodularity on colonoscopy was found on biopsy to have moderate chronic ileitis with partial villous atrophy and increased intraepithelial lymphocytes – a pattern suggestive of early Crohn’s ileitis or, alternatively, coeliac-type enteropathy involving the terminal ileum, and one that would not have been captured without routine biopsy sampling. These cases, while numerically small, underscore that routine histopathological examination of mucosal biopsies may occasionally reveal pathology of a nature and severity unexpected from the endoscopic appearance alone.

The cohort was notable for a marked male predominance (M:F 3.25:1), higher than typically reported in colonoscopy series, and predominantly comprised symptomatic patients referred for diagnostic evaluation rather than asymptomatic screening. This distinction is important: adenoma detection rate benchmarks apply to asymptomatic screening populations and are not appropriate quality metrics for predominantly symptomatic diagnostic cohorts such as this one.

Limitations

- Single-centre design, which may limit generalizability to other settings and populations.

- Categorization of free-text colonoscopic and histopathological findings into standardized groups, performed retrospectively, introduces potential for misclassification despite efforts at consistent criteria.
- Inter-observer variability in endoscopic impression and histopathological interpretation was not separately assessed.

CONCLUSION

In this prospective cohort, colonoscopic impression showed substantial agreement with histopathology and excellent diagnostic accuracy for malignancy. Routine biopsy of macroscopically normal mucosa identified clinically relevant inflammatory pathology in approximately one-fifth of patients, supporting its continued use in symptomatic patients regardless of endoscopic appearance. Age over 50 years and the presence of a visible mass lesion were independent predictors of malignancy and may assist in clinical risk stratification.

Abbreviations

AUC: Area under the receiver operating characteristic curve; CI: Confidence interval; IBD: Inflammatory bowel disease; NPV: Negative predictive value; OR: Odds ratio; PPV: Positive predictive value; PR: Per-rectal; SRUS: Solitary rectal ulcer syndrome; TB: Tuberculosis.

Declarations

Ethics approval and consent to participate: This study was approved by the Ethics Committee of Dr D Y Patil Medical College Hospital and Research Centre, Dr D Y Patil Vidyapeeth (IESC/PGS/2024/84). Written informed consent from all participants (or their legal guardians for participants under 18 years of age) for colonoscopy procedure had been obtained prior to intervention.

Consent for publication: Not applicable.

Availability of data and materials: The datasets generated and analyzed during this study are not publicly available due to restrictions imposed by the ethics committee to protect patient confidentiality. Additional de-identified data are available from the corresponding author Dr VINAY BADANGI on reasonable request.

Competing interests: VK, VB, AG, GS, and SS declare that they have no competing interests.

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Authors' contributions: Study concept and design by VK. Critical revision of the manuscript for important intellectual content by AG. Analysis and interpretation of data, and drafting of the manuscript by VB. Data collection by GS and SS. All authors read and approved the final manuscript

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