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Original research

CLINICAL PREDICTORS OF MALIGNANT COLORECTAL LESIONS AMONG HOSPITALIZED PATIENTS UNDERGOING COLONOSCOPY

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ABSTRACT

Background: *Colorectal cancer (CRC) is a common malignancy, and colonoscopy remains the most important diagnostic modality. However, not all hospitalized patients with lower gastrointestinal symptoms have malignant lesions. Identifying clinical predictors is essential for optimizing colonoscopy indications. This study aims to identify clinical predictors of malignant colorectal lesions among hospitalized patients undergoing colonoscopy.*

Methods: *A retrospective analytical cross-sectional study was conducted in 148 hospitalized patients who underwent colonoscopy. Clinical characteristics, comorbidities, and laboratory data were collected. Logistic regression analysis was used to identify independent predictors. Model performance was evaluated using receiver operating characteristic (ROC) analysis, Hosmer - Lemeshow goodness-of-fit test, and decision curve analysis.*

Results: *The prevalence of malignant colorectal lesions (adenocarcinoma) was 8.8%. In multivariable analysis, unexplained weight loss (OR = 16.96; p = 0.004) and type 2 diabetes mellitus (OR = 6.12; p = 0.019) were independent predictors. Hematochezia and body mass index showed borderline associations but were not significant after adjustment. The prediction model demonstrated good discrimination (AUC = 0.85) and provided net clinical benefit across relevant threshold probabilities .*

Conclusions: *Unexplained weight loss and type 2 diabetes mellitus were independently associated with malignant colorectal lesions in hospitalized patients. The proposed model may support preliminary risk stratification, although further validation in larger multicenter studies is needed.*

Key words: *Colorectal cancer; Colonoscopy; Clinical predictors; Alarm symptoms; Risk stratification.*

I. INTRODUCTION

Colorectal cancer (CRC) is one of the leading causes of cancer-related mortality worldwide. According to GLOBOCAN 2020, CRC ranks third in incidence and second in cancer-related mortality globally, with more than 1.9 million new cases and nearly 935,000 deaths annually [1]. In Vietnam, colorectal cancer is also a significant public health concern, with an increasing incidence in recent years, contributing to a rising burden of disease and healthcare costs [2].

Colonoscopy remains the gold standard for diagnosing colorectal lesions, particularly precancerous lesions and early-stage cancer. However, in clinical practice, not all patients presenting with lower gastrointestinal symptoms harbor malignant lesions. The widespread use of colonoscopy, while essential for detecting colorectal cancer, may result in increased healthcare costs, overburdened medical systems, and carry potential risks of procedural complications. Therefore, there is a pressing need to identify clinical predictors of malignant colorectal lesions to ensure more targeted use of colonoscopy, optimize healthcare resources, and facilitate early cancer detection [3].

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Several studies have identified certain symptoms and risk factors associated with colorectal cancer, including unexplained weight loss, changes in bowel habits, anemia, and rectal bleeding. Additionally, international clinical guidelines also emphasize the role of "alarm symptoms" in the early detection as well as screening of colorectal cancer [4]. Furthermore, chronic conditions such as type 2 diabetes mellitus have been associated with an increased risk of colorectal cancer, largely due to mechanisms such as insulin resistance and chronic inflammation [5].

In inpatient clinical settings, many patients undergo colonoscopy for a wide range of clinical presentations. However, data on clinical predictors of malignant colorectal lesions among hospitalized patients in Vietnam remain limited. Identifying these predictors is crucial, as it can help clinicians recognize high-risk individuals early, thereby optimizing colonoscopy indications and improving the efficiency of colorectal cancer detection.

Therefore, we conducted this study with the aim of identifying clinical predictors of malignant colorectal lesions in hospitalized patients undergoing colonoscopy.

II. MATERIALS AND METHODS

2.1. Study population

The study population included hospitalized patients aged ≥ 18 years at the Department of Gastroenterology, Da Nang Hospital during the study period. Patients were selected based on the following inclusion and exclusion criteria.

Inclusion criteria: Hospitalized patients who underwent colonoscopy; Availability of complete clinical and laboratory data; Availability of colonoscopy results and/or histopathological findings

Exclusion criteria: Medical records lacking key variables relevant to the study; Absence of histopathological results for suspected malignant lesions

2.2. Methods

This was a retrospective analytical cross-sectional study conducted in hospitalized patients undergoing colonoscopy, using clinical, laboratory, and endoscopic data collected from medical records and the hospital endoscopy database.

The study was conducted at the Department of Gastroenterology, Da Nang Hospital, including patients who underwent colonoscopy between May 2025 and February 2026. Clinical, laboratory, and endoscopic data were collected from medical records and the hospital's endoscopy database.

A total of 148 hospitalized patients who underwent colonoscopy during the study period were included. The sample size was based on all eligible cases available. For multivariable logistic regression, variable selection was restricted according to the events-per-variable principle to minimize overfitting.

Data were collected using a standardized case report form, including: Baseline characteristics: age, sex, body mass index (BMI). Clinical symptoms: hematochezia, abdominal pain, melena, unexplained weight loss (5 kg in 2 months) [6], based on physician-recorded clinical history and/or patient-reported symptoms during hospitalization, without an immediately identifiable benign explanation during routine clinical evaluation. Comorbidities and risk factors: hypertension, type 2 diabetes mellitus, smoking, excessive alcohol intake. Laboratory findings: hemoglobin, white blood cell count. Endoscopic and histopathological findings: Endoscopic findings were categorized based on lesion characteristics. Suspected lesions were biopsied and confirmed by histopathological examination. Lesions were classified as benign or malignant (colorectal adenocarcinoma).

Histopathological findings were considered the gold standard for the diagnosis of malignancy.

2.3. Study procedure

All hospitalized patients undergoing colonoscopy during the study period were screened for eligibility. Eligible patients were included, and clinical, laboratory, and endoscopic data were collected using a standardized form.

Colonoscopy findings were reviewed. In patients with multiple lesions, classification was based on the lesion with the greatest clinical significance and/or histopathological confirmation. Lesions with endoscopic features suspicious for malignancy, including mass lesions, ulceroinfiltrative lesions, irregular mucosal patterns, friability, spontaneous bleeding, or luminal narrowing, were biopsied for

histopathological confirmation according to routine endoscopic practice and current recommendations. Histopathology was considered the gold standard for the diagnosis of malignant colorectal lesions [7]. Patients were then classified into malignant and non-malignant groups.

Logistic regression analysis was performed to identify predictors of malignancy. Model performance was evaluated using ROC analysis, calibration (Hosmer-Lemeshow test), and decision curve analysis.

2.4. Statistical analysis

Data were entered and analyzed using SPSS version 22.0. Continuous variables were presented as median and interquartile range (IQR), while categorical variables were expressed as frequencies and percentages. Comparisons between patients with and without malignant lesions were performed using appropriate statistical tests.

To identify predictors of malignant colorectal lesions, logistic regression analysis was conducted. Variables with statistical significance in univariate analysis or with clinical relevance were included in the multivariable logistic regression model to identify independent predictors.

The predictive performance of the model was evaluated using receiver operating characteristic (ROC) curves and the area under the curve (AUC). The Hosmer - Lemeshow test was used to assess model calibration, and the Youden index was applied to determine the optimal cutoff value.

In addition, Decision Curve Analysis (DCA) was performed to assess the clinical utility of the prediction model across different threshold probabilities.

A p-value < 0.05 was considered statistically significant.

III. RESULTS

3.1. Study population and baseline characteristics

A total of 148 hospitalized patients who underwent colonoscopy were included in this analysis (Table 1). Of these, 13 patients (8.8%) were diagnosed with colorectal adenocarcinoma based on histopathological examination. The median age of the patients was 60 years (IQR 47-70), and 55.4% were male.

Patients with malignant lesions had a significantly lower BMI than those without malignancy (median 19.7 vs. 22.1 kg/m², p = 0.015). Regarding clinical presentation, unexplained weight loss was significantly more frequent in the malignant group (23.1% vs. 3.0%, p = 0.015), hematochezia showed a non-significant trend toward a higher prevalence in the malignant group (69.2% vs. 40.7%, p = 0.076), while the prevalence of melena and abdominal pain was similar between the two groups.

Among comorbidities and risk factors, type 2 diabetes was more common in patients with malignant lesions (30.8% vs. 8.1%, p = 0.029). The presence of hypertension, smoking, and excessive alcohol intake did not differ significantly between the two groups. Laboratory values, including hemoglobin and WBC, were comparable between patients with malignant and non-malignant lesions.

Table 1: Baseline characteristics of patients with and without malignant colorectal lesions

Variable	Total (n=148)	Non-malignant (n=135)	Malignant (n=13)	p value
Age, years, median (IQR)	60 (47 - 70)	59 (46 - 70)	61 (55 - 69)	0.432
Male sex, n (%)	82 (55.4)	74 (54.8)	8 (61.5)	0.774
BMI, kg/m², median (IQR)	21.9 (19.4 - 23.6)	22.1 (19.5 - 23.7)	19.7 (18.7 - 21.5)	0.015
Clinical symptoms				
Hematochezia, n (%)	64 (43.2)	55 (40.7)	9 (69.2)	0.076
Abdominal pain, n (%)	72 (48.6)	66 (48.9)	6 (46.2)	0.847
Unexplained weight loss, n (%)	7 (4.7)	4 (3.0)	3 (23.1)	0.015
Melena, n (%)	12 (8.1)	11 (8.1)	1 (7.7)	1.000

Variable	Total (n=148)	Non-malignant (n=135)	Malignant (n=13)	p value
Comorbidities and risk factors				
Hypertension, n (%)	45 (30.4)	44 (32.6)	1 (7.7)	0.110
Type 2 diabetes, n (%)	15 (10.1)	11 (8.1)	4 (30.8)	0.029
Smoking, n (%)	24 (16.2)	23 (17.0)	1 (7.7)	0.694
Excessive alcohol intake, n (%)	31 (20.9)	30 (22.2)	1 (7.7)	0.303
Laboratory findings				
Hemoglobin, g/L, median (IQR)	124 (97 - 137)	125 (98 - 138)	109 (91 - 122)	0.122
WBC, ×109/L, median (IQR)	7.0 (5.4 - 9.9)	7.0 (5.3 - 10.0)	7.2 (6.4 - 9.5)	0.238

3.2. Endoscopic and histopathological findings

Endoscopic findings are shown in Table 2. Among 148 hospitalized patients undergoing colonoscopy, hemorrhoids were the most frequent finding (23.0%), followed by polyps (18.9%) and inflammatory/ulcerative lesions (14.9%). A normal colonoscopy was observed in 14.2% of patients, whereas mass lesions were identified in 6.1%.

Histopathological assessment was available in 42 patients (28.4% of the total cohort) in Table 3. Among these, adenomatous or dysplastic lesions were the most common finding (42.9%), followed by adenocarcinoma (31.0%) and inflammatory lesions (23.8%). Overall, 13 patients (8.8% of the total cohort) had histologically confirmed colorectal adenocarcinoma. Among these patients, the rectum was the most common tumor location (46.2%), followed by the sigmoid colon (23.1%). Fungating masses were the predominant endoscopic morphology (69.2%), and most lesions involved more than half of the bowel circumference (84.6%).

Table 2: Endoscopic findings in hospitalized patients undergoing colonoscopy (n = 148)

Endoscopic finding	n	%
Normal colonoscopy	21	14.2
Hemorrhoids	34	23.0
Polyps	28	18.9
Inflammatory/ulcerative lesions	22	14.9
Mass lesions (tumor)	9	6.1
Diverticula	9	6.1
Anal fissure	7	4.7
Anal papilla	2	1.4

Note: Multiple findings could be present in the same patient; therefore, percentages do not total 100%.

Table 3: Histopathological findings among patients who underwent biopsy/histopathological assessment (n = 42)

Histopathological finding	n	% among biopsied patients	% among total cohort (n = 148)
Adenocarcinoma	13	31.0	8.8
Adenomatous / dysplastic lesions	18	42.9	12.2
Inflammatory lesions	10	23.8	6.8
Suspected neuroendocrine tumor	1	2.4	0.7

3.3. Logistic regression analysis for predictors of malignant colorectal lesions

Univariate analysis identified several clinical features associated with malignant colorectal lesions, including unexplained weight loss, type 2 diabetes mellitus, and lower BMI. Hematochezia showed a borderline association with malignancy (p = 0.058), but was not significant in multivariable analysis.

In multivariable analysis, unexplained weight loss (adjusted OR 16.96, p = 0.004) and type 2 diabetes (adjusted OR 6.12, p = 0.019) remained independent predictors, whereas hematochezia and BMI did not remain significant after adjustment (Table 4).

The predicted probability of malignancy was calculated from the final logistic regression equation as follows: Logit (P) = -4.12 - 0.21 × BMI + 1.39 × hematochezia + 2.83 × unexplained weight loss + 1.81 × type 2 diabetes.

The probability was calculated using the formula: P = 1 / (1 + e^(-logit (P))).

Table 4: Logistic regression analysis for predictors of malignant colorectal lesions

Variable	Unadjusted OR (95% CI)	p value	Adjusted OR (95% CI)	p value
Age (per year)	1.02 (0.98 - 1.05)	0.417	-	-
Male sex	1.32 (0.41 - 4.24)	0.642	-	-
Hematochezia	3.27 (0.96 - 11.16)	0.058	4.02 (0.97 - 16.65)	0.055
Abdominal pain	0.90 (0.29 - 2.79)	0.847	-	-
Unexplained weight loss	9.83 (1.93 - 50.11)	0.006	16.96 (2.53 - 113.68)	0.004
Hypertension	0.17 (0.02 - 1.37)	0.096	-	-
Type 2 diabetes	5.01 (1.33 - 18.93)	0.018	6.12 (1.34 - 27.99)	0.019
BMI (per kg/m²)	0.78 (0.62 - 0.98)	0.032	0.81 (0.62 - 1.04)	0.094
Hemoglobin (per g/L)	0.99 (0.96 - 1.01)	0.196	-	-
WBC (per $\times 10^9$/L)	1.07 (0.94 - 1.22)	0.298	-	-

3.4. Model performance

The performance of the prediction model was evaluated using the receiver operating characteristic (ROC) curve and the area under the curve (AUC). The model demonstrated good discrimination, with an AUC of 0.85 (95% confidence interval [CI] 0.71 - 0.95), indicating a strong ability to distinguish malignant from non-malignant lesions. (Figure 1)

The Youden index was used to determine the optimal cut-off probability for malignancy, which was found to be 0.08, corresponding to a sensitivity of 84.6% and specificity of 73.3%. Additional threshold probabilities and their corresponding sensitivities and specificities are shown in Table 5.

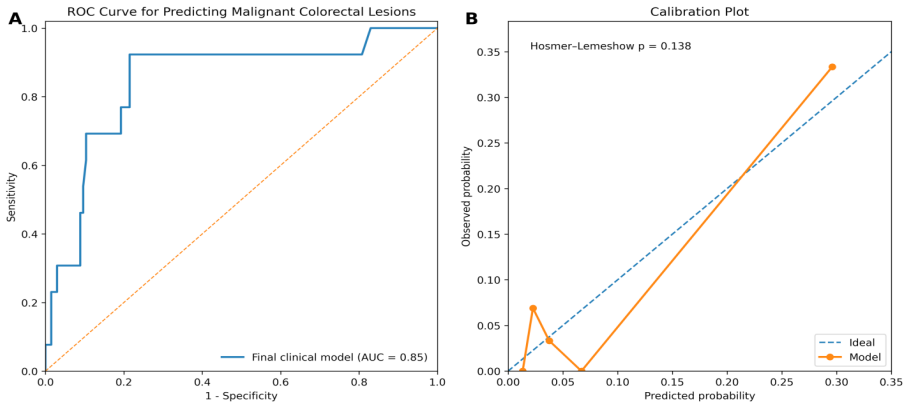

Figure 1: Model performance of the clinical prediction model

(A) Receiver operating characteristic (ROC) curve showing good discrimination (AUC 0.85, 95% CI 0.71 - 0.95). (B) Calibration plot demonstrating good agreement between predicted and observed probabilities, with no evidence of lack of fit (Hosmer-Lemeshow p = 0.138).

Table 5: Optimal cut-off analysis of the prediction model using the Youden index

Predicted probability Cut-off	Sensitivity	Specificity	Youden Index
0.05	92.3%	58.5%	0.51
0.08	84.6%	73.3%	0.58
0.10	76.9%	78.5%	0.55
0.15	61.5%	86.7%	0.48

3.6. Decision curve analysis

Decision curve analysis showed that the model provided a higher net benefit than both "treat-all" (colonoscopy for all patients) and "treat-none" (no colonoscopy) strategies across threshold probabilities of 0.05 - 0.20 (Figure 2). This suggests that the model may optimize patient selection for colonoscopy, reducing unnecessary procedures while maintaining detection of malignant lesions. These findings support the potential clinical utility of the model for risk stratification in hospitalized patients undergoing colonoscopy.

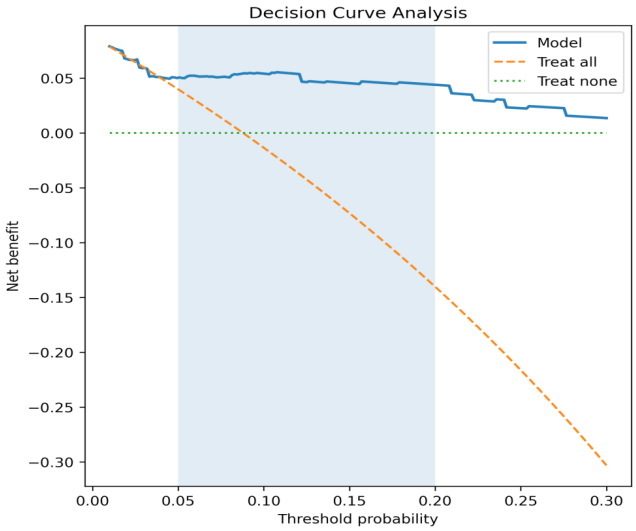

Figure 2: Decision curve analysis of the clinical prediction model. The shaded area indicates the clinically relevant range of threshold probabilities (0.05 - 0.20), within which the model shows greater net benefit than treat-all and treat-none strategies.

IV. DISCUSSION

In this study, we evaluated the clinical predictors of malignant colorectal lesions in hospitalized patients undergoing colonoscopy. The malignancy rate in our overall cohort was 8.8%, with a higher rate of 31.0% among those who underwent biopsy (Table 3). These findings are consistent with real-world clinical practice, where colonoscopy is often performed in hospitalized patients presenting with lower gastrointestinal symptoms or suspected structural lesions. In this clinical context, identifying predictive factors for CRC is crucial to optimizing the use of colonoscopy, improving early cancer detection, and better allocating healthcare resources.

Our results showed no significant differences in age or sex between patients with malignant and non-malignant lesions (Table 1). This is consistent with findings from several predictive models, which indicate that while age and sex are well-established risk factors for CRC in the general population, they are not always strong discriminators in symptomatic populations [8]. This is likely because most CRC cases are diagnosed after symptom onset rather than through screening, which diminishes the predictive value of baseline demographic factors in patients already selected for colonoscopy [9]. Thus, age and sex alone may not be reliable markers for malignancy in hospitalized individuals and should be considered in combination with other clinical factors when deciding whether to perform a colonoscopy.

Our results showed that patients with malignant lesions had a significantly lower BMI compared to those without malignancy (Table 1). This may reflect cancer-related cachexia or the presence of more advanced disease stages, which is consistent with existing literature reporting unexplained weight loss and poor nutritional status as common features in CRC patients [9]. However, when we adjusted for other clinical variables in the multivariable analysis, BMI was no longer an independent predictor (Table 4). This suggests that while BMI may indicate a patient's nutritional status, its role as a predictive factor for CRC may be confounded by other factors, such as unexplained weight loss and comorbid conditions.

Via our study, unexplained weight loss emerged as in the strongest independent predictor of malignant lesions (adjusted OR 16.96; p = 0.004). This finding aligns with previous studies indicating that unexplained weight loss is one of the most important "alarm symptoms" of CRC [9]. A study conducted in a resource-limited setting also demonstrated that the combination of weight loss and changes in bowel habits significantly increased the likelihood of CRC and improved risk stratification [10].

Although hematochezia (rectal bleeding) was associated with malignant lesions in univariate analysis, this association lost statistical significance after adjustment (Table 4). This is in line with recent systematic reviews indicating that although rectal bleeding is a common symptom of CRC, its standalone predictive value is relatively low because it frequently occurs in benign conditions such as hemorrhoids [11,12]. Therefore, rectal bleeding should not be used in isolation as a predictor of CRC but should be interpreted in the broader context of other clinical symptoms and findings.

An important finding of our study is that type 2 diabetes mellitus was an independent predictor of malignant colorectal lesions. This is in line with existing evidence showing that diabetes increases CRC risk through mechanisms involving hyperinsulinemia, insulin resistance, and chronic inflammation [5]. Given the increasing prevalence of type 2 diabetes globally, including in patients presenting with gastrointestinal symptoms, this finding emphasizes the need for careful evaluation of diabetic patients for potential colorectal malignancy.

The logistic regression model developed in this study demonstrated good discriminative ability with an AUC of 0.85, suggesting a potentially useful ability to differentiate between patients with malignant and non-malignant lesions in this cohort. This performance is comparable to previously reported symptom-based prediction models, which typically achieve AUC values ranging from 0.75 to 0.85 when multiple clinical variables are combined [8]. Additionally, decision curve analysis further showed that the model provided greater net benefit than both the "treat-all" and "treat-none" strategies across clinically relevant threshold probabilities (0.05 - 0.20). This suggests that the model may have potential utility for preliminary risk stratification and prioritization for colonoscopy in hospitalized patients (Figure 2).

Our findings suggest that unexplained weight loss and type 2 diabetes may be clinically relevant factors associated with malignant colorectal lesions in hospitalized patients. In resource-limited settings, where healthcare resources may be constrained, this model may help identify higher-risk individuals who could potentially benefit from prioritized colonoscopic evaluation. Previous studies have also emphasized that combining multiple symptoms improves risk stratification and enhances CRC detection efficiency [9,10]. Although the model showed promising discriminative performance in this cohort, the findings should be interpreted cautiously because of the relatively small number of malignant cases, wide confidence intervals for some predictors, and the absence of external validation.

However, this study has several limitations. First, this was a single-center retrospective analytical cross-sectional study, which may limit the generalizability of the findings. Second, the relatively small number of malignant cases may reduce the stability of the prediction model and contribute to wide confidence intervals for some predictors in the multivariable model. Third, histopathological confirmation was not available in all patients, which may introduce potential misclassification bias. In addition, some clinical variables, particularly unexplained weight loss, were retrospectively obtained from medical records and patient-reported history; therefore, alternative causes could not be systematically excluded. Finally, because the study included only hospitalized patients undergoing colonoscopy, selection bias cannot be excluded. Further multicenter studies with larger sample sizes are needed to externally validate the proposed model.

V. CONCLUSION

Unexplained weight loss and type 2 diabetes mellitus were associated with malignant colorectal lesions in this hospitalized population. The proposed model showed promising discriminative performance. However, the findings should be interpreted cautiously given the small number of malignant cases and the single-center retrospective design. Further multicenter studies are needed to externally validate the model before clinical application.

Conflict of Interest

The authors declare that there are no conflicts of interest related to this study, its authorship, or publication.

Ethics Approval

The study was approved by the Ethics Committee of Da Nang Hospital (Approval No. 50/BVĐN-HĐYĐ, dated January 7, 2025). It was conducted in accordance with the ethical principles of biomedical research and the Declaration of Helsinki. All collected data were used solely for research purposes and were anonymized and kept confidential in accordance with applicable regulations.

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