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Evaluation of Effectiveness of Hemogram Parameters In Colorectal Cancer Screening

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ABSTRACT

Colorectal cancer (CRC) frequency and cancer-related death rates can be reduced with screening methods. Due to the invasiveness of the colonoscopy procedure and the high rate of false positivity of stool-based tests, it was aimed to investigate whether hemogram parameters could be a potential alternative to assist screening methods.

Between January 2023 and December 2024 at Van YYU Faculty of Medicine Hospital, 605 patients who underwent colonoscopy for various indications were divided into groups and the age, gender, hemogram parameters taken before colonoscopy, such as RBC Count, Hb, Hct, WBC Count, Platelet Count, MPV, MCV, RDW, NLR, PLR, MLR, MPV/PLT ratio, Hb/PLT ratio, Lymphocyte/Monocyte ratio and the Hb/RDW ratio were investigated and then the usability of these hemogram parameters in colorectal cancer screening was studied.

Statistical differences were observed in WBC, Hemoglobin, hematocrit, MCV, RDW, lymphocyte, MPV/PLT, Hb/PLT, Lymphocyte/monocyte and Hb/RDW ratios with T Test between cancer patients and patients with normal colonoscopy findings. Additionally, in multiple group comparisons, a statistically significant difference was detected in age, WBC, RBC and MCV parameters.

This study is the most comprehensive study ever conducted with 18 hemogram parameters. As a result of binary and multivariate analysis, a statistically significant difference was detected in 10 parameters with T Test and in 4 parameters with multivariate analysis. It was concluded that hemogram parameters will be used alone or in addition to existing screening methods in colorectal cancer screening through prospective studies with the appropriate combination of these parameters.

Keywords: colorectal cancer, screening, hemogram parameters

Introduction

Colorectal cancers constitute the most common cancer group of the gastro intestinal tract and rank 2nd in the list of deaths from all cancers (1-3). Approximately 85% of colorectal cancers occur from polyps. Early detection and treatment of these polyps is important to reduce the risk of colorectal cancer (4). Screening methods are used for early detection of colorectal polyps and cancers. The gold standard in screening is colonoscopy (5). Since colonoscopy is an invasive procedure that requires colon preparation and general anesthesia and has complications, it is not suitable for every individual. (6). A fecal occult blood test(FOBT), which is a non-invasive test, is performed to narrow down the population to undergo colonoscopy(7). Although the FOBT test is useful in the early diagnosis of colorectal cancer, its use remains limited due to poor patient compliance (8). In Turkey, the situation is worse and the rate of FOBT is 13.2% (9). There is a need for a cheap, easily accessible and non-invasive test with good patient compliance that accurately narrows the indications for colonoscopy in the risk population for colorectal cancer screening. In this study, we wanted to investigate the usability of hemogram parameters.

Material and Methods

The study was conducted on patients aged between 18 and 80 who underwent colonoscopy in the endoscopy unit of Van Yüzüncü Yıl University Faculty of Medicine Hospital. Patients who underwent colonoscopy between January 2023 and December 2024 were included in the study. According to colonoscopy reports and histopathological results, the patients were divided into 7 groups: colorectal cancer, polyp, Inflammatory bowel disease, non-specific colitis or ileitis, normal findings, other benign findings, and the group with suspicion of malignancy on colonoscopy but histopathological data could not be obtained. Age, gender and the hemogram parameters that was taken before colonoscopy

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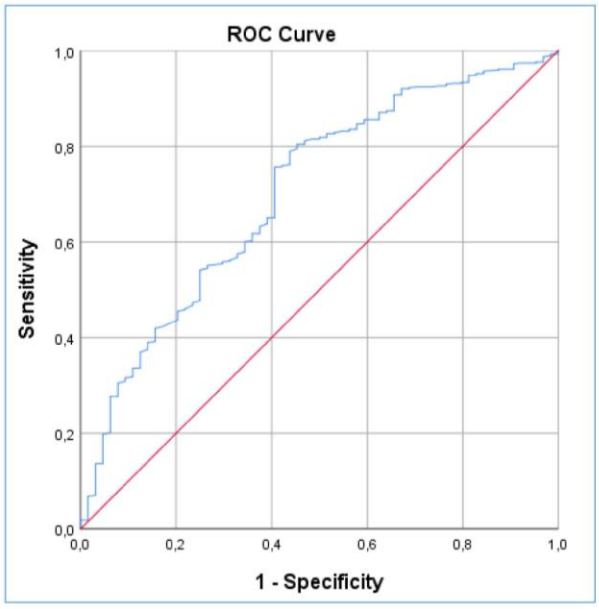

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Figure 1 Brief results of ROC analysis

Area	Std. Error	p	95% Confidence Interval		Cut off value	Sensitivity	Specificity
			Lower Bound	Upper Bound	93.0500	0.756	0.594
0.703	0.035	0.001	0.635	0.771	97.4500	0.651	0.609

Fig. 1. Brief Results of ROC Analysis

procedure such as Red Blood Cell (RBC) Count and Hemoglobin (Hb), Hct, white Blood Cell (WBC) Count, platelet Count, Platelet volume (MPV), mean Erythrocyte Volume (MCV), erythrocyte Distribution Width (RDW), neutrophil-lymphocyte ratio (NLR), platelet-lymphocyte ratio (PLR), monocyte-lymphocyte ratio (MLR), MPV/PLT ratio, Hb/PLT ratio, Lymphocyte/monocyte ratio and Hb/RDW ratio results were examined and the usability of hemogram parameters in colorectal cancer screening was investigated. Patients diagnosed with colorectal cancer, patients whose hemogram results could not be obtained, and patients whose colonoscopy could not be completed were excluded from the study.

Statistical Analysis: Descriptive statistics for continuous variables among the features emphasized; While it is expressed as Mean, Standard Deviation, Minimum and Maximum values, it is expressed as number and percentage for categorical variables. One-way analysis of variance was performed to compare group averages in terms of continuous variables. Following the analysis of variance, Duncan multiple comparison test was used to determine different groups, and T Test was used for pairwise group comparison. To determine the relationship between these variables, Pearson correlation coefficients were calculated separately in the groups. Chi-square test was used to determine the relationship between groups and categorical variables. In the calculations, the statistical significance level was taken as 5% and the SPSS (ver: 21) statistical package program was used for the calculations.

Results

A total of 605 patients were included in the study. 291 of the patients were male, 314 were female and the average age was 49.02. The distribution of hemogram parameters according to gender is shown in table 1. Statistically significant differences were detected in the hemogram parameters of WBC, Hemoglobin, hematocrit, MCV, RDW, lymphocyte, MPV/PLT, Hb/PLT, Lymphocyte/monocyte and Hb/RDW ratios between cancer patients and patients with normal colonoscopy findings (tables 2). In multiple group comparisons, a statistically significant difference was detected between the cancer group and the other groups in Age, WBC, RBC and MCV parameters (Table 3).

Discussion

Colorectal cancer is an important health problem worldwide and in Turkey. According to the 2016 report of the American Cancer Society, colorectal cancer stands out as the third most common type of cancer in both men and women (2). Current statistical data in Turkey is similar to literature data. Colorectal cancer ranks third in cancer and second in cancer-related deaths for both genders (3). Despite being so common and lethal, the fact that most colorectal cancers develop from polyps enables screening programs to reduce both cancer frequency and cancer-related death rates by diagnosing this malignancy before it develops or at an early stage.

The primary goal of colorectal cancer screening is to reduce the incidence of cancer, facilitate early detection of malignancies, and reduce cancer-related mortality rates. There are non-invasive and invasive methods in the field of colorectal screening. Fecal occult blood test (FOBT) and Fecal Immunochemical Test (FIT) are the most commonly used non-invasive methods. FIT is preferred due to its higher sensitivity and specificity compared to FOBT (10). Apart from these, modalities such as sigmoidoscopy, colonoscopy, double contrast barium enema and virtual colonoscopy are used. Colonoscopy is considered the gold standard for CRC screening, allowing detection and removal of precancerous

Table 1: Distribution of Parameters by Gender

Variables	Female (n:314)	Male (n:291)	P value
Age, years	48.04 ± 16.30	50.08 ± 15.29	0.113
WBC (10^3/L)	6.97 ± 1.94	7.35 ± 2.35	0.033
RBC (10^6/uL)	4.37 ± 0.76	4.77 ± 0.73	0.001
HMG (g/dL)	13.29 ± 5.74	14.61 ± 6.38	0.008
HCT (%)	40.07 ± 5.42	45.06 ± 25.13	0.001
MCV (fL)	85.29 ± 23.87	84.98 ± 10.34	0.838
PLT (10^3/uL)	320.56 ± 266.77	262.05 ± 79.75	0.001
RDW (%)	42.91 ± 13.34	41.20 ± 5.60	0.042
MPV (fL)	10.97 ± 7.82	9.98 ± 1.12	0.034
NTF (10^3/uL)	6.19 ± 33.82	4.61 ± 2.03	0.427
MONO (10^3/uL)	0.56 ± 0.52	0.64 ± 0.49	0.047
LENF (10^3/uL)	2.29 ± 0.79	2.22 ± 0.75	0.235
NTF/LENF	3.82 ± 26.30	2.78 ± 4.78	0.506
PLT/LENF	164.01 ± 204.41	141.32 ± 157.14	0.129
MONO/LENF	0.28 ± 0.33	0.35 ± 0.69	0.093

Note: WBC: White blood cell count, RBC: Red blood cell count, MCV: Mean corpuscular volume, RDW: Red cell distribution width, MPV: Mean platelet volume.
Statistical significance set at $p<0.05$.

lesions (5, 10). Screening is performed for individuals at intermediate to high risk, with high efficacy observed in those classified as high risk. Colonoscopy is recommended for individuals considered at high risk, but there are no standard recommendations for individuals identified as intermediate risk (5, 11).

Awareness and low participation rates in colorectal cancer screenings also pose a serious problem. The Netherlands has the highest participation rates at 68.2%, while the participation rates in the USA are around 63%. (12, 13). The awareness and participation in CRC screening is lower than expected in Turkey. Awareness and participation rates for FOBT and colonoscopy are 19.3% and 13.2% for FOBT and 31.7% and 10.0% for colonoscopy, respectively (14).

Although colonoscopy is the gold standard method for CRC screening, it is an invasive procedure. Colonoscopy-related complications hinder patient participation due to discomfort during the procedure, preparation requirements, and accessibility issues (5, 6, 10). Since stool-based tests have high false positive rates and low sensitivity, there is a clear need for new less invasive, more accurate and cost-effective CRC screening methods (15, 16). In this context, blood-based tests are being investigated as a potential tool for CRC screening. Blood-based tests are preferred in the detection of colorectal cancer for reasons such as low risk, minimal pain and ease of sample collection; however, concerns about their accuracy warrant further research (17).

Prediagnostic WBC counts, including leukocytes and neutrophils, have been shown to increase as CRC diagnosis approaches. These prediagnostic values are also associated with worse survival outcomes, highlighting the potential of WBC counts as early indicators of CRC prognosis (18). In our study, the increased leucocyte levels were found to be significant in CRC cases ($p = 0.001$). It was determined that the WBC count is a prognostic indicator in colorectal cancer patients (19) and that the preoperative WBC count is an independent risk factor for survival in patients undergoing colorectal surgery (20).

Because hypohemoglobinemia is common in the population with CRC (21), colorectal cancer (CRC) screening in patients with hypohemoglobinemia is very important due to the iron deficiency anemia (IDA) can be an important

Table 2: Distribution of Blood Parameters According to Colonoscopy Findings (Cancer vs Normal)

Parameter	Cancer (n=64)	Normal (n=234)	P-Value
WBC ($10^3/\mu L$)	8.07 ± 2.56	6.75 ± 1.93	0.001
Hemoglobin (g/dL)	12.43 ± 2.39	13.82 ± 2.06	0.001
Hematocrit (%)	39.03 ± 6.79	42.34 ± 5.61	0.001
RDW (%)	43.13 ± 5.79	41.12 ± 6.13	0.020
MCV (fL)	80.64 ± 7.11	84.44 ± 9.26	0.003
Lymphocytes ($10^3/\mu L$)	2.07 ± 0.87	2.31 ± 0.72	0.026
MPV/PLT Ratio	0.0325 ± 0.0100	0.0449 ± 0.0415	0.018
Hemoglobin/PLT Ratio	0.0411 ± 0.0140	0.0579 ± 0.0521	0.015
Lymphocyte/Monocyte Ratio	3.55 ± 1.86	4.73 ± 1.95	0.001
Hemoglobin/RDW Ratio	0.2958 ± 0.0763	0.3507 ± 0.1289	0.001
Platelet ($10^3/\mu L$)	331.63 ± 91.89	297.60 ± 301.90	0.374
MPV (fL)	9.82 ± 0.89	10.56 ± 6.19	0.343
Neutrophils ($10^3/\mu L$)	5.52 ± 2.38	6.60 ± 39.12	0.826
RBC ($10^6/\mu L$)	4.41 ± 0.77	4.58 ± 0.67	0.074
Monocytes ($10^3/\mu L$)	0.64 ± 0.23	0.61 ± 0.76	0.702
Neutrophil/Lymphocyte Ratio	3.69 ± 2.94	4.08 ± 30.46	0.848
Platelet/Lymphocyte Ratio	185.93 ± 92.75	150.73 ± 229.49	0.231
Monocyte/Lymphocyte Ratio	0.36 ± 0.19	0.29 ± 0.47	0.292

Note: Statistical significance $p<0.05$

indicator of underlying malignancies, especially right-sided CRC in individuals over 40 years of age (22). A study by Almilaji et al shows that iron deficiency anemia is an important determinant of right-sided colorectal cancer (CRC) and that screening for CRC in individuals with hypohemoglobinemia may improve early diagnosis and potentially increase prognosis (23). In our study, hemoglobin values were lower than in normal individuals, and this was statistically significant ($p = 0.001$).

Mean corpuscular volume (MCV) has emerged as a potential indicator in colorectal cancer (CRC) screening, particularly to detect advanced colorectal cancer (ACRC). MCV offers a noninvasive, cost-effective alternative that may increase early diagnosis, especially in older populations. This approach is particularly important given the challenges and limitations associated with current CRC screening methods, such as low participation rates and the need for more accurate and accessible techniques. Integration of MCV into CRC screening protocols could potentially improve detection rates and patient outcomes. A study by A Leischker shows that reduced mean corpuscular volume (MCV) serves as an independent predictor for the detection of advanced colorectal cancer (ACRC) in patients even in the absence of symptoms. This suggests that MCV may be a valuable clinical indicator to determine the necessity of colonoscopy in elderly patients and highlights its role in colorectal cancer screening, and these findings highlight the importance of considering MCV levels alongside traditional screening methods to improve early diagnosis of ACRC (24). In our series, MCV was found to be lower in individuals with CRC, and this was significant in both T test and multivariate analysis ($p = 0.03$).

Red cell distribution width (RDW) has emerged as a potential biomarker in colorectal cancer (CRC) screening and provides insights into tumor characteristics and patient prognosis. RDW, a measure of variation in red blood cell size, is routinely included in complete blood count tests and has been associated with systemic inflammation and cancer progression. Its role in CRC screening is multifaceted, covering

Table 3: Multiple Group Comparisons Using Duncan Multiple Comparison

Parameters	Cancer (n:64)	Polyp (n:84)	IBD (n:41)	Non-spesific colit (n:59)	Normal (n:233)	Other findings (n:107)	Patology missing (n:15)	P value
Age, years	56.5±12.96 ab	58.14±11.99 a	41.97±15.59d	39.32 ±14.20e	45.72±15.99cd	51.34± 15.77bc	58.26±15.14 a	0.001
WBC	8.07±2.56a	7.30±2.09ab	8.06±2.77a	7.03± 2.34b	6.75±1.93b	7.02±1 .87b	7.53±1.30ab	0.001
RBC	4.40±0.77a	4.51±0.66a	4.55±1.50a	4.68± 0.68a	4.58±0.66a	4.68±0 .68a	4.06±0.59b	0.037
HMG	12.42±2.38	14.82±11.25	13.63±5.82	15.60 ±12.09	13.81±2.05	13.84± 2.09	11.69±2.06	0.053
HCT	39.03±6.78	41.54±5.74	41.14±8.32	43.38 ±5.08	42.34±5.61	46.33± 40.44	36.46±5.73	0.143
MCV	80.64±7.10 b	85.53±15.81 b	93.82±58.89a	85.16 ±6.36 b	84.44±9.26b	86.07± 13.16b	82.40±8.74b	0.033
PLT	331.6±9.8	293.3±95.17	297.3±124. 3	165.9 ±73.8	295.3±301	265.1± 83.2	325.8±118	0.426
RDW	43.12±5.79 ab	44.96±23.16 ab	43.05±8.22 ab	40.88 ±6.53 b	41.12±6.13b	41.01± 4.21b	46.46±9.39a	0.028
MPW	9.82±0.88	10.65±3.87	9.88±0.87	10.33 ±1.01	10.56±6.19	10.97± 9.31	10.22±1.42	0.890
NTF	5.52±2.37	4.48±1.87	5.24±1.99	4.38± 1.90	6.59±39.12	4.27±1 .54	4.96±1.46	0.985
MONO	0.64±0.23	0.58±0.19	0.64±0.31	0.55± 0.18	0.60±0.76	0.56±0 .22	0.59±0.15	0.934
LENF	2.07±0.86	2.37±0.83	2.16±0.69	2.19± 0.72	2.31±0.72	2.27±0 .80	1.84±0.60	0.058
NTF/LENF	3.68±2.93	2.20±1.54	2.93±2.78	2.40± 2.07	4.07±30.46	2.72±7 .10	5.20±3.66	0.983
PLT/LNF	185.9±92.7	140.7±75.6	150.8±92.3	129.3 ±46.5	157.2±229	156.6± 243	193.9±83.7	0.645
MONO/LNF	0.35±0.19	0.27±0.14	0.30±0.12	0.27± 0.11	0.29±0.46	0.36±1 .04	0.38±0.25	0.840

a,b,c →: Different lower cases in the same row represent statistically significant differences among the groups. No lettering was made for the features for which no difference was found to be significant.
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diagnostic, prognostic and predictive aspects. One study found 80% sensitivity and 60% specificity for RDW in predicting colon cancer. This suggests that RDW may serve as a useful marker in the early detection of colorectal cancer, complementing current screening methods (25).

Another study suggests that red blood cell distribution width (RDW) may serve as an additional marker for differential diagnosis in colorectal cancer (CRC), particularly in identifying right-sided CRC. It showed a sensitivity of 76.3% and a specificity of 64.2%, highlighting the importance of RDW in clinical assessments regarding CRC localization (26). In our series, a significant difference was found between CRC cases and normal individuals (p = 0.02).

Lymphocyte count plays an important role in colorectal cancer (CRC) screening, serving as a prognostic marker and helping stratify patients for treatment decisions. It was found that high lymphocyte count was associated with a higher 5-year overall survival (OS) rate compared to low lymphocyte count (27). In our series, lymphocyte values showed a significant decrease compared to normal individuals (p = 0.026).

Red blood cell count (RBC) contributes significantly to prognostic assessment in colorectal cancer (CRC) screening by demonstrating overall survival outcomes. The study found that patients with higher RBC levels (≥ 3.9 x10^12/L) experienced significantly improved overall survival compared to those with lower levels (28). In our series, lower RBC numbers were detected in individuals with CRC than in normal individuals (p = 0.037).

The lymphocyte-to-monocyte ratio (LMR) is a valuable screening tool, with low levels indicating more advanced stages of CRC. The lymphocyte-to-monocyte ratio (LMR) serves as an indicator of inflammation and has shown significant differences between colorectal cancer (CRC) patients and healthy individuals (29). In our study, LMR rates were found to be lower in individuals with cancer (p=0.001). Studies have also shown that a high LMR is associated with improved overall survival (OS) and recurrence-free survival (RFS) in CRC patients (30, 31). One study found that MPV/PC was lower in colorectal cancer patients compared to those with adenomatous polyps and healthy controls (32). Mean Platelet Volume (MPV) is a measure of the average platelet size in the blood and is considered a marker of platelet activation. It reflects the functional status of platelets, which can be affected by various physiological and pathological conditions, including cancer (33, 34). The ratio of MPV to platelet count (PC), known as MPV/PC, has been highlighted as a potentially more informative marker for cancer diagnosis than MPV or PC alone. This ratio provides a better diagnostic and predictive value by integrating both the size and quantity of platelets (35, 36). Studies show that the MPV/PLT ratio is significantly lower in CRC patients compared to those with adenomatous polyps and healthy controls. This suggests that a lower MPV/PLT ratio may be indicative of the presence of CRC (37). In our study, MPV/PC was found to be lower in individuals with CRC. (p=0.018). Although the Hb/RDW ratio alone is not sufficient for the diagnosis of CRC, its combination with other markers increases diagnostic accuracy. Combined use of RDW with CEA and CA19-9 increases sensitivity and specificity in distinguishing CRC patients from healthy controls (38). In our study, the Hb/RDW ratio was found to be lower in individuals with CRC than in normal individuals (p=0.001). A low Hb/RDW ratio is similarly associated with advanced disease stages and poorer prognosis in CRC patients (39). Additionally, we could not find any studies in the literature on the Hb/Plt ratio, which we found to be statistically significantly lower in individuals with CRC compared to normal individuals in our series (p=0.005).

Although the combined use of neutrophil-lymphocyte ratio (NLR), platelet-lymphocyte ratio (PLR) and monocyte-lymphocyte ratio (MLR) were found to be useful parameters in predicting the surveillance analysis of endometrial cancer, they were not found to be effective in predicting the diagnosis of colorectal cancer in our study (40, 41).

ROC analysis was performed to determine a cut off value that can be used to identify patients who need colonoscopy and those who do not need colonoscopy by using the value formed by the sum of haemogram values. As a result of the ROC analysis, the area under the curve was found to be 0.703 square units and statistically significant (p<0.001). Accordingly, Sensitivity was found to be 75.6% and Specificity was found to be 59.4% for 93.05 cut off value, while Sensitivity was found to be 65.1% and Specificity was found to be 60.9% for 97.45 cut off value.

Accordingly, if patients with a value lower than 93.05 are sent to colonoscopy, it is predicted that 75.6% of these patients will actually require colonoscopy, similarly, if patients with a value above this value (93.05) are not sent to colonoscopy, it is predicted that 60.9% of them will not require colonoscopy.

In conclusion, the incidence of CRC and cancer-related mortality rates can be reduced with screening methods. Due to the invasive nature of colonoscopy and the high rate of false positivity in

stool-based tests, we demonstrated in this study that hemogram parameters are a potential alternative. The limitation of this study is that it is retrospective. The presented study is the most comprehensive study ever conducted with hemogram parameters and was conducted with 18 hemogram parameters, and as a result of binary and multivariate analyses, statistically significant differences were detected in 10 parameters with T test and in 3 parameters with multivariate analysis. As a result of this study, we believe that prospective studies with the appropriate combination of these parameters will be used in CRC screening by hemogram parameters alone or in addition to existing screening methods.

Conflicts of Interest: The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

Patient Permission/Consent Declaration: Verbal consent was obtained from the cases included in the study by calling the contact numbers registered in the system.

References

1. Kastrinos, F. and S. Syngal, Inherited colorectal cancer syndromes. The Cancer Journal, 2011. 17(6): p. 405-415.
2. Hossain, M.S., et al., Colorectal cancer: a review of carcinogenesis, global epidemiology, current challenges, risk factors, preventive and treatment strategies. Cancers, 2022. 14(7): p. 1732.
3. Eser, S., et al., Cancer incidence, mortality and survival in Türkiye as of 2020. Basic & Clinical Cancer Research, 2023.
4. Gopalappa, C., et al., Probability model for estimating colorectal polyp progression rates. Health care management science, 2011. 14: p. 1-21.
5. Montminy, E.M., et al., Screening for colorectal cancer. Medical Clinics, 2020. 104(6): p. 1023-1036.
6. Aras, A., et al., Colonoscopic perforations, what is our experience in a training hospital? Surgical Laparoscopy Endoscopy & Percutaneous Techniques, 2016. 26(1): p. 44-48.
7. Towler, B., et al., Screening for colorectal cancer using the faecal occult blood test, hemoccult. The Cochrane Database of Systematic Reviews, 2000(2): p. CD001216-CD001216.
8. Gingold-Belfer, R., et al., The compliance rate for the second diagnostic evaluation after a positive fecal occult blood test: a systematic review and meta-analysis. United European gastroenterology journal, 2019. 7(3): p. 424-448.
9. Aydogan Gedik, S., S. METİNTAŞ, and M. ÖNSÜZ, Recognition and participation of colorectal cancer screening in Turkiye: A systematic review and meta-analysis study. Northern Clinics of Istanbul, 2023. 10(6).
10. Chan, S.C.H. and J.Q. Liang, Advances in tests for colorectal cancer screening and diagnosis. Expert review of molecular diagnostics, 2022. 22(4): p. 449-460.
11. Burns, R.B., et al., How Would You Screen This Patient for Colorectal Cancer? Grand Rounds Discussion From Beth Israel Deaconess Medical Center. Annals of Internal Medicine, 2022. 175(10): p. 1452-1461.
12. Siersema, P.D., Colorectal Cancer Awareness Issue 2019. Endoscopy, 2019. 51(03): p. 207-208.
13. Navarro, M., et al., Colorectal cancer population screening programs worldwide in 2016: An update. World journal of gastroenterology, 2017. 23(20): p. 3632.
14. Aydoğan, S., S. Metintaş, and M. Önsüz, Recognition and Participation of Colorectal Cancer Screening in Turkey: Meta-analysis of Literature. European Journal of Public Health, 2019. 29(Supplement_4): p. ckz186. 711.
15. Ferrari, A., et al., Towards novel non-invasive colorectal cancer screening methods: a comprehensive review. Cancers, 2021. 13(8): p. 1820.
16. Ferlizza, E., et al., The roadmap of colorectal cancer screening. Cancers, 2021. 13(5): p. 1101.
17. Ong, C., et al., Advancing colorectal Cancer detection with blood-based tests: qualitative study and Discrete Choice experiment to Elicit Population preferences. JMIR Public Health and Surveillance, 2024. 10(1): p. e53200.
18. Turri, G., et al., Pre-diagnostic prognostic value of leukocytes count and neutrophil-to-lymphocyte ratio in patients who develop colorectal cancer. Frontiers in Oncology, 2023. 13: p. 1148197.
19. Weng, M., et al., High preoperative white blood cell count determines poor prognosis and is associated with an immunosuppressive microenvironment in colorectal cancer. Frontiers in Oncology, 2022. 12: p. 943423.
20. Wang, B., et al., Impact of preoperative white blood cell count on outcomes in different stage colorectal cancer patients undergoing surgical resection: a single-institution retrospective cohort study. BMC cancer, 2024. 24(1): p. 242.

21. Erichsen, C., V. Rosberg, and P.-M. Krarup, Streamlined Preoperative Iron Deficiency Screening and IV Treatment for Colorectal Cancer Patients beyond Clinical Trials. Journal of Clinical Medicine, 2024. 13(19): p. 6002.
22. Nwabuko, O.C., et al., Colorectal carcinoma-induced iron deficiency anemia: A literature review and a case scenario. Cancer Plus, 2024. 6(3): p. 3021.
23. Almilaji, O., et al., Evidence for improved prognosis of colorectal cancer diagnosed following the detection of iron deficiency anaemia. Scientific Reports, 2021. 11(1): p. 13055.
24. Leischker, A., Niedriges MCV: Auch bei beschwerdefreien Patienten mit normalem Hämoglobinwert ist eine Koloskopie indiziert! Wissenstransfer zu Kato M, et al.: Digestion 2018; 97: 177-182. Kompass Onkologie, 2018. 5(3): p. 167-168.
25. Parsirad, M., et al., Investigating the Relationship between Red Blood Cell Distribution Width and Early Detection of Colorectal Cancer and Colonic Polyps. Journal of Kerman University of Medical Sciences, 2020. 27(2): p. 134-140.
26. Fancellu, A., et al., Red blood cell distribution width (RDW) correlates to the anatomical location of colorectal cancer. implications for clinical use. Journal of gastrointestinal cancer, 2022: p. 1-6.
27. Iseki, Y., et al., The impact of the preoperative peripheral lymphocyte count and lymphocyte percentage in patients with colorectal cancer. Surgery today, 2017. 47: p. 743-754.
28. Cai, H., et al., A Novel Nutrition-Related Prognostic Biomarker for Predicting Survival in Patients with Colorectal Cancer. Nutrition and Cancer, 2025. 77(2): p. 221-229.
29. Qu, Q. and Q. Sun, Screening value of methylated Septin9 and lymphocyte-to-monocyte ratio in colorectal cancer. Medicine, 2024. 103(22): p. e38386.
30. Shiraishi, T., et al., Effect of lymphocyte-to-monocyte ratio on prognosis in obstructive colorectal cancer patients with colonic stent: a Japanese retrospective multicenter study. (No Title), 2024.
31. Kasahara, K., et al., Preoperative lymphocyte-to-monocyte ratio in the prognostication of advanced resectable colon cancer: A retrospective observational study. Indian Journal of Surgical Oncology, 2021. 12: p. 498-506.
32. Wu, Y.-Y., et al., Mean platelet volume/platelet count ratio in colorectal cancer: a retrospective clinical study. BMC cancer, 2019. 19: p. 1-7.
33. Şahin, F. and A.F. Aslan, Relationship between inflammatory and biological markers and lung cancer. Journal of clinical medicine, 2018. 7(7): p. 160.
34. Herszényi, L., et al., The role of inflammation and proteinases in tumor progression. Digestive Diseases, 2012. 30(3): p. 249-254.
35. Sun, S., et al., The clinical implications of mean platelet volume and mean platelet volume/platelet count ratio in locally advanced esophageal squamous cell carcinoma. Diseases of the Esophagus, 2018. 31(2): p. dox125.
36. Inagaki, N., et al., Prognostic impact of the mean platelet volume/platelet count ratio in terms of survival in advanced non-small cell lung cancer. Lung cancer, 2014. 83(1): p. 97-101.
37. Zhang, H., F. Lin, and Z. Wang, Mean platelet volume/platelet count ratio in combination with tumor markers in colorectal cancer: a retrospective clinical study. BMC cancer, 2023. 23(1): p. 124.
38. Song, Y., et al., Clinical usefulness and prognostic value of red cell distribution width in colorectal cancer. BioMed Research International, 2018. 2018(1): p. 9858943.
39. Zhang, X., et al., The combined detection of hematological indicators is used for the differential diagnosis of colorectal cancer and benign-colorectal lesions. Cancer Biomarkers, 2024. 39(3): p. 223-230.
40. Cong, R., et al., Combination of preoperative neutrophil-lymphocyte ratio, platelet-lymphocyte ratio and monocyte-lymphocyte ratio: a superior prognostic factor of endometrial cancer. BMC cancer, 2020. 20: p. 1-11.
41. Anuk, T. and A.C. Yıldırım, Clinical value of platelet-to-lymphocyte ratio in predicting liver metastasis and lymph node positivity of colorectal cancer patients. Turk J Colorectal Dis, 2017. 27(2): p. 50-55.