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Evaluating the Efficacy of Fecal Occult Blood Test and Tumor Marker Combined Screening for Colorectal Cancer

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Abstract: *Objective:* To analyze the screening effectiveness of combining the fecal occult blood test with tumor marker detection for colorectal cancer. *Methods:* A total of thirty patients with colorectal cancer and thirty patients with benign colon hyperplasia who received treatment from January 2020 to January 2023 were selected. These patients were assigned to the observation group and the control group, respectively. All patients in both groups underwent both fecal occult blood tests and tumor marker detection. The levels of tumor markers between the two groups were compared, the tumor marker levels in different stages were assessed within the observation group, and the positive detection rates for single detection and combined detection were compared. *Results:* The levels of various tumor markers in the observation group were significantly higher than those in the control group ($P < 0.05$). Furthermore, as the Duke stage increased within the observation group, the levels of various tumor markers also increased ($P < 0.05$). The positive detection rate of the combined test was notably higher than that of single detection ($P < 0.05$). *Conclusion:* Combining the fecal occult blood test with tumor marker detection in colorectal cancer screening can significantly improve the overall detection rate.

Keywords: Colorectal cancer; Fecal occult blood test; Tumor marker detection

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1. Introduction

Colorectal cancer is a relatively common malignant tumor of the digestive system. In recent years, significant changes in people's lifestyles and dietary habits have led to a notable increase in the incidence of this disease compared to previous years. In the early stages of the disease, there are typically no specific symptoms. As the disease progresses and the tumor grows in size, various adverse symptoms, such as diarrhea, abdominal pain, and increased bowel movements, become more prominent. In the advanced stages of the disease, anemia and various other complications may occur. Early diagnosis is crucial for improving prognosis.

Tumor markers are vital substances for analyzing and assessing the development of malignant tumors. Their dynamic changes can reflect the progression of the disease [1]. Early monitoring of tumor marker levels can help determine the disease's status. Other studies have demonstrated that combining tumor marker detection

with fecal occult blood tests can further enhance the diagnostic accuracy of colorectal cancer [2]. This study aims to analyze the role of combined fecal occult blood tests and tumor marker detection in colorectal cancer screening. To achieve this, 30 patients with confirmed colorectal cancer and 30 patients diagnosed with benign colon hyperplasia were selected as the research subjects.

2. Materials and methods

2.1. General information

Thirty patients with colorectal cancer were enrolled to comprise the observation group, all admitted between January 2020 and January 2023. Additionally, 30 patients with benign colon hyperplasia who received treatment during the same period were selected for the control group.

The observation group comprised 19 males and 11 females, with an age range of 48–79 years and an average age of 63.26 ± 5.17 years. The control group comprised 18 males and 12 females, with an age range of 46–78 years and an average age of 63.12 ± 5.23 years. Disease types included 9 cases of colon adenoma, 7 cases of colon polyps, 8 cases of rectal adenoma, and 6 cases of rectal polyps. Duke stage distribution included 10 cases in Stage I, 8 cases in Stage II, 7 cases in Stage III, and 5 cases in Stage IV. Statistical analysis was conducted on the data from both groups, yielding a conclusion of $P > 0.05$.

Inclusion criteria included all 30 patients in the observation group who were pathologically diagnosed with colorectal cancer, and they had primary adenocarcinomas, patients who could actively cooperate with various examinations, and patients with complete examination data. Exclusion criteria included patients with contraindications to surgery, patients with concurrent ascites or peritoneal inflammatory reactions, patients with serious underlying diseases, and patients with a history of major abdominal surgery.

2.2. Methods

(1) Fecal occult blood test procedure: Utilizing the fecal occult blood colloidal gold detection test paper technique, the process involves using a sample rod to add the collected stool specimen into a sample collection tube containing 1.5 mL of a 0.85% normal saline sample diluent. The test strip/card is taken out of its aluminum foil bag and laid flat on the table for marking. The next steps include unscrewing the tip of the sample collection tube and vertically adding approximately 80 μL (3 drops) of sample diluent to the test strip's designated area or the sampling hole of the test card. Results are then observed and displayed within a 10-minute timeframe, where a positive outcome is indicated by the presence of two red reaction lines, while a negative result is denoted by a single red reaction line.

(2) Serum tumor marker detection method: A fasting morning venous blood sample of 3 mL was collected, and serum was obtained after centrifugation. A fully automatic biochemical analyzer was used to measure carcinoembryonic antigen (CEA; positive standard: ≥ 5.0 **μg**/L), carbohydrate antigen 50 (CA50; positive standard: ≥ 25 U/L), carbohydrate antigen 199 (CA199; positive standard: ≥ 37 U/L), and carbohydrate antigen 724 (CA724; positive standard: ≥ 6.9 U/L) levels.

2.3. Observation indicators

(1) Comparison of tumor marker levels between the control group and the observation group.
(2) Comparison of tumor marker levels among patients with different Duke stages in the observation group.
(3) Comparison of the positive detection rates of fecal occult blood test, single diagnostic method,

and combined diagnostic method of tumor marker detection in diagnosing the 30 patients in the observation group.

2.4. Statistical methods

Data from the study were entered into SPSS 25.0 statistical software for analysis. Measurement data were represented as mean ± standard deviation (SD) when in line with normal distribution, and count data were represented as [*n* (%)]. Independent sample *t*-tests were conducted (*F*-tests for data with three groups or more), as well as χ^2 tests. If $P < 0.05$ was obtained, it indicated statistical significance in the compared date.

3. Results

3.1. Comparison of tumor marker levels between the two groups

As depicted in **Table 1**, the levels of various tumor markers in the observation group were significantly higher than those in the control group ($P < 0.05$).

Table 1. Comparison of tumor marker levels between the two groups (mean ± SD)

Group	*n*	CEA (μg/L)	CA50 (U/L)	CA199 (U/L)	CA724 (U/L)
Control group	30	13.20 ± 1.16	17.52 ± 2.15	31.54 ± 3.29	4.51 ± 0.48
Observation group	30	33.25 ± 4.17	45.36 ± 5.29	79.52 ± 7.13	20.26 ± 2.17
t	-	25.372	26.704	33.467	38.816
P	-	0.000	0.000	0.000	0.000

3.2. Comparison of tumor marker levels among patients with different Duke stages in the observation group

As illustrated in **Table 2**, the comparison of various tumor marker levels revealed a pattern: Stage IV > Stage III > Stage II > Stage I ($P < 0.05$).

Table 2. Comparison of tumor marker levels among patients with different Duke stages in the observation group (mean ± SD)

Group	*n*	CEA (μg/L)	CA50 (U/L)	CA199 (U/L)	CA724 (U/L)
Phase I	10	15.10 ± 2.13	23.52 ± 3.31	38.47 ± 4.10	10.14 ± 2.26
Phase II	8	20.14 ± 2.20	32.57 ± 3.16	52.05 ± 5.13	16.36 ± 2.69
Stage III	7	27.46 ± 4.14	41.50 ± 4.52	73.54 ± 5.29	24.52 ± 3.38
Stage IV	5	45.17 ± 5.39	55.35 ± 5.74	95.05 ± 9.15	37.46 ± 3.10
F	-	6.264	5.457	8.416	7.965
P	-	0.000	0.000	0.000	0.000

3.3. Comparison of positive detection rates between single detection and combined detection

As displayed in **Table 3**, there is no notable difference in the positive detection rate between the fecal occult blood test and tumor marker detection ($P > 0.5$). However, the positive detection rate of the combined test was significantly higher than that of the single test result ($P < 0.05$).

Table 3. Comparison of positive detection rates between single detection and combined detection [*n* (%)]

Detection method	*n*	Positive	Negative
Fecal occult blood test	30	22 (73.33)	8 (26.67)
Tumor marker detection	30	23 (76.67)	7 (23.33)
Joint testing	30	29 (96.67)	1 (3.33)
Comparison of single test results (χ^2/*P*)	-	0.089/0.766	
Comparison of joint detection results (χ^2/*P*)	-	6.537/0.038	

4. Discussion

Colorectal cancer stands as the most common malignant tumor in the digestive system worldwide. According to the latest global cancer burden data released by IARC in 2020, there are approximately 1.9 million new cases of colorectal worldwide (around 560,000 cases in China) and about 935,000 deaths caused by colorectal cancer (about 290,000 cases in China). It ranks as the third most prevalent cancer globally in terms of incidence and the second most prevalent cancer in China. Colorectal cancer's incidence and mortality in China are ranked second and fifth, respectively [3,4], making its prevention and control a pressing concern. Studies have demonstrated that early screening and timely intervention significantly improve the five-year survival rate and may even lead to complete cures [5]. Therefore, early screening, diagnosis, and treatment for colorectal cancer are of paramount importance.

Presently, there are numerous methods for clinically screening colorectal cancer. Aside from pathological examination, colonoscopy is the most effective and widely used diagnostic method. During colonoscopy, colorectal lesions can be visually identified, and entities such as adenomas and polyps can be removed during the procedure. However, colonoscopy necessitates rigorous bowel preparation, can cause discomfort, and carries the risk of complications such as bleeding. Additionally, it is relatively costly, limiting its clinical applicability and patient compliance [6]. There is a need to explore alternative, safer, more convenient, affordable, and accurate screening methods. The fecal occult blood test serves as a significant non-invasive screening technology for early colorectal cancer. It can be classified into chemical and immunological fecal occult blood tests. Among the former, the guaiac fecal occult blood test is the most commonly used, based on the hemoglobin content. Hemoglobin possesses peroxidase activity, generating new oxygen during catalysis, which triggers color development in the reagent. Test results are determined by this color development. While this method is simple and cost-effective, it is susceptible to dietary influences before the test [7]. For instance, the consumption of lean meat, iron supplements, or large leafy vegetables before the test can interfere with results, leading to relatively low sensitivity and an increased risk of false positives. The immunological fecal occult blood test relies on the antigen-antibody reaction principle to detect antibodies against globin components in fecal blood [8], with methods such as enzyme-linked immunoassay, latex agglutination turbidimetric method, and the colloidal gold test paper method being more commonly used. In this study, the colloidal gold test paper method was employed. Immunological fecal occult blood tests are not affected by dietary factors and have fewer interfering variables. The results indicate a positive detection rate of 73.33% for a single fecal occult blood test, highlighting the potential for further improvement in detection rates.

Tumor markers are substances produced due to the upregulation of tumor-related gene expression or the body's response to tumor tissue. Tumor markers are present only in small amounts or absent in normal tissues but are significantly elevated in tumor tissues. The quantitative and qualitative detection of tumor markers can

help screen for malignant tumors, determine prognosis, and play a critical role in treatment plan development, efficacy prediction, and recurrence monitoring [9]. The most commonly used tumor markers in colorectal cancer detection include CEA, CA50, CA199, and CA724. CEA is a specific tumor marker for colorectal adenocarcinoma, classified as a tumor embryonic antigen. In colorectal cancer, CEA interacts with cells and has associations with extramatrix adhesion, causing elevated levels that inhibit cell differentiation and disrupt tissue structure. CA50 is a sialoglycoprotein highly expressed in most colon cancer patients [10]. CA199 is associated with tumor cell gangliosides and is used in diagnosing various digestive tract tumors, such as pancreatic cancer. CA724 is a mucin antigen [11], with a higher sensitivity in colon cancer as compared to CEA and CA199 [12]. The results in this study indicate that the levels of various tumor markers in patients with colorectal cancer in the observation group are higher than those in patients with benign colon hyperplasia in the control group. Furthermore, higher Duke stages in the observation group correlate with higher levels of various tumor markers, demonstrating the markers' potential to distinguish between benign and malignant colorectal tumors and assess disease severity. When comparing the positive detection rates of the fecal occult blood test, single tumor marker detection, and combined detection, the results reveal that the positive detection rate of single detection does not significantly differ, while the positive detection rate of combined detection surpasses that of single detection. This underscores the enhancement of the positive detection rate through the combination of these two detection methods.

In conclusion, colorectal cancer represents a relatively high-incidence malignant tumor of the digestive tract. Various detection methods for colorectal cancer screening have their own advantages and limitations. It is recommended to employ both the fecal occult blood test and tumor marker detection simultaneously to boost the positive detection rate, which holds great significance for early disease diagnosis and treatment.

Disclosure statement

The author declares no conflict of interest.

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