OBSERVATIONAL STUDY

Utility of the Asia-Pacific colorectal screening scoring system and the presence of metabolic syndrome components in screening for sporadic colorectal cancer

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Abstract

AIM: To determine the utility of the Asia-Pacific colorectal screening (APCS) scoring system and metabolic syndrome components in individual screening for sporadic colorectal cancer.

METHODS: The subjects were patients admitted to the Peking University People's Hospital for colonoscopy between October 2012 and July 2013. Clinical information, including patient willingness to undergo colonoscopy, medical history, endoscopic findings, histology, and other information, was collected, and the patients were grouped according to APCS scores and the presence of metabolic syndrome components. Colorectal tumor detection rates were compared between the groups.

RESULTS: A total of 219 patients were included in the study, 108 were male and 111 were female, resulting in a male-to-female ratio of 1:1.03. The average age of the patients was 56.8 ± 13.7 years. According to APCS scores, 88 (40.2%) patients were included in the average-risk (AR) group, 113 (51.6%) patients were included in the moderate-risk (MR) group, and 18 (8.2%) patients were included in the high-risk (HR) group. Colorectal tumors were detected in 69 (31.5%) subjects, and the detection rates in the AR, MR, and HR groups were 15.9%, 36.3%, and 77.8%, respectively. The difference in the detection rates between the three groups was statistically significant ($P < 0.01$). The combined detection rate of colorectal tumors in the APCS MR and HR groups was 42.0%. However, patients in the MR and HR groups who presented with metabolic syndrome components, in particular obesity, exhibited a significantly higher colorectal tumor detection rate (59.5%) than did those without these components (19.2%, $P < 0.01$) and those who underwent colonoscopy because of doctor's recommendation (36.5%, $P < 0.01$).

CONCLUSION: The APCS scoring system can be used in individual screening for sporadic colorectal cancer. The combined use of APCS scores and the metabolic syndrome components, in particular obesity, will significantly improve the efficacy of individual colorectal cancer screening.

Core tip: This study assessed the utility of the Asia-Pacific colorectal screening (APCS) scoring system and the presence of metabolic syndrome components in outpatient screening for colorectal cancer (CRC) by stratifying individuals according to these parameters. The APCS scoring system can be used in individual screening for sporadic CRC. The combined use of APCS scores and the metabolic syndrome components, in particular obesity, will significantly improve the efficacy of colorectal cancer screening.

INTRODUCTION

Colorectal cancer (CRC) is one of the most common malignant tumors worldwide[1-3]. Both the incidence and associated mortality rates of CRC in China have increased because of improved standards of living and changes in eating habits[4]. In most cases, CRC is sporadic and develops from adenomas. As effective CRC prevention methods are lacking, the best method to prevent the morbidity associated with CRC is to improve the detection rate of early-stage disease. A growing body of evidence has shown that detection and elimination of lesions at the precursor or early stage can reduce both the incidence of and mortality from CRC[5]. The decreased incidence of CRC in the United States over the past 2 decades has been attributed by some efficient CRC screening[6].

Many studies have recommended screening programs for CRC[7-9]. Among them, the Asia-Pacific colorectal screening[2] (APCS) system, reported in 2011, uses age, gender, a family history of colorectal tumors, and smoking history as the factors to calculate scores. Individuals are categorized into 3 groups according to these scores: the average-risk (AR), moderate-risk (MR), and high-risk (HR) groups. Colonoscopy is recommended for individuals in the HR group. The APCS scoring system is simple and convenient for outpatient screening; however, it was proposed only recently, and therefore, its effectiveness requires further evaluation. Because the APCS system was established using asymptomatic individuals, whether it is useful for individual screening in symptomatic outpatients was discussed in this study.

Metabolic syndrome (MS) comprises the metabolic risk factors of cardiovascular disease and type 2 diabetes, which mainly include obesity, dyslipidemia, hypertension, hyperglycemia, and insulin resistance[10]. Because of the adoption of Western dietary habits and life-style, many Asian countries have witnessed a substantial increase in the prevalence of obesity and MS over the past few decades[11,12].

A large number of epidemiological studies have shown that MS components are closely related to the occurrence of colorectal tumors[13-17]. However, the APCS scoring system does not incorporate MS components. Therefore, in this study, we assessed the utility of the APCS system and the presence of MS components in outpatient screening for CRC by stratifying individuals according to these parameters.

MATERIALS AND METHODS

Subjects

We selected patients who were admitted to the Peking University People's Hospital for colonoscopy between October 2012 and July 2013. The exclusion criteria were as follows: age less than 20 years or more than 90 years; familial adenomatous polyposis or hereditary non-polyposis CRC; and inflammatory bowel disease.

The study was approved by the Ethical Committee of Peking University People's Hospital. All the patients enrolled in the study were well informed and signed the informed consent.

Methods

We collected the clinical information of patients, including gender; age; body mass index (BMI); history of hypertension, high blood glucose levels, dyslipidemia, alcohol consumption, smoking, and cancer; and the history of CRC in immediate family members. Additionally, we determined the reasons for which patients underwent colonoscopy: whether the patient volunteered to undergo these examinations or whether these examinations were recommended by their doctors.

The colonoscopy findings and tumor pathology results were reviewed. Colorectal tumors were classified as non-advanced tumors (tubular adenoma with a maximum diameter < 1 cm, without severe dysplasia) or advanced tumors (tubular adenoma with a maximum diameter $\geq$ 1 cm, villous or tubulovillous adenoma, adenoma with severe dysplasia, or cancer).

The subjects were divided into the AR, MR, and HR groups according to APCS scores, which were assigned as follows: age: < 50 years = 0 points, 50-69 years = 1 point, $\geq$ 70 years = 2 points; gender: female = 0 points, male = 1 point; immediate family member with CRC: no = 0 points, yes = 1 point; and smoking status: no smoking history = 0 points, current or former smoker = 1 point. On the basis of the cumulative scores, patients were classified into the following groups: AR = 0-1, MR = 2-3, and HR = 4-7.

In this study, the MS components and related diseases that were evaluated were obesity (BMI $\geq$ 25 kg/m^2), hyperlipidemia, hypertension, and diabetes. According to

Table 1 Comparison of the colorectal tumor detection rates in patients in the different Asia-Pacific colorectal screening risk groups n (%)

Groups	AR (n = 88)	MR (n = 113)	HR (n = 18)
Colorectal tumor	14 (15.9)	41 (36.3)[b]	14 (77.8)[bd]
Non-advanced tumor	12 (13.6)	30 (26.5)[a]	9 (50)[bc]
Advanced tumor	2 (2.3)	11 (9.7)[a]	5 (27.8)[bc]

[a]P < 0.05, [b]P < 0.01 vs AR group; [c]P < 0.05, [d]P < 0.01 vs MR group. AR: Average-risk; MR: Moderate-risk; HR: High-risk.

Table 2 Effect of the presence of metabolic syndrome components on the colorectal tumor detection rate n (%)

Groups	A (n = 52)	B (n = 39)	C (n = 40)	B + C (n = 79)
Colorectal tumor	10 (19.2)	22 (56.4)[b]	25 (62.5)[b]	47 (59.5)[b]
Non-advanced tumor	9 (17.3)	14 (35.9)[a]	16 (40)[a]	30 (38.0)[a]
Advanced tumor	1 (1.9)	8 (20.5)[b]	9 (22.5)[b]	17 (21.5)[b]

[a]P < 0.05, [b]P < 0.01 vs group A.

Table 3 Comparison of the colorectal tumor detection rates for different screening programs n (%)

Groups	Patient volunteered (D) (n = 41)	Doctor recommended (E) (n = 126)	APCS MR/HR (F) (n = 131)	APCS MR/HR with obesity (G) (n = 79)
Colorectal tumor	6 (14.6)	46 (36.5)[b]	55 (42.0)[b]	47 (59.5)[bde]
Non-advanced tumor	5 (12.2)	33 (26.2)	39 (29.8)[a]	30 (38.0)[b]
Advanced tumor	1 (2.4)	13 (10.3)	16 (12.2)	17 (21.5)[bc]

[a]P < 0.05, [b]P < 0.01 vs group D; [c]P < 0.05, [d]P < 0.01 vs group E; [e]P < 0.05 vs group F. APCS: Asia-Pacific colorectal screening; MR: Moderate-risk; HR: High-risk.

the presence of MS components and related disorders, individuals in the APCS MR and HR groups were further stratified and colorectal tumor detection rates were compared between individuals who did and those who did not have these MS components and related diseases to determine their utility in CRC screening.

Statistical analysis

All data were analyzed using IBM SPSS Statistics 20 software (SSPS, Inc., Chicago, IL, United States). Continuous variables with a normal distribution were presented as means ± SD. Categorical data were presented as percentages (%) and were analyzed using the χ^2 test or Fisher's exact test, with a significance level of α = 0.05. A P value of < 0.05 was considered statistically significant.

RESULTS

General characteristics

Among the 219 enrolled patients, 108 were male and 111 were female, resulting in a male-to-female ratio of 1:1.03. The average age of the patients was 56.8 ± 13.7 years. Among the 219 patients, 52 (23.8%) had a history of colorectal polyps and 4 had a history of CRC. Colorectal tumors were detected in 69 patients (31.5%); of these, 14 (15.9%) were in the AR group, 41 (36.3%) were in the MR group, and 14 (77.8%) were in the HR group. Further, 51 patients (23.3%) had non-advanced tumors and 18 (8.2%) had advanced tumors, including 9 cases of invasive carcinoma.

Effect of stratification according to APCS scores on the colorectal tumor detection rate

According to the APCS criteria, of the 219 patients, 88 (40.2%) were in the AR group, 113 (51.6%) were in the MR group, and 18 (8.2%) were in the HR group. The colorectal tumor detection rates for the AR, MR, and HR groups were 15.9%, 36.3%, and 77.8%, respectively, and the differences between the groups were statistically significant (Table 1). The combined detection rate of the MR and HR groups was 42.0%.

Effect of the presence of MS components on the colorectal tumor detection rate

A sub-group analysis was performed on the 131 patients in the APCS MR and HR groups. Based on the presence of MS components and related diseases, these patients

were divided into 3 groups: group A (control group), BMI < 25 kg/m^2 and no MS components; group B, BMI ≥ 25 kg/m^2 with 1 or no MS components; and group C, BMI ≥ 25 kg/m^2 with 2-3 MS components. The colorectal tumor detection rates were as follows: group A, 19.2% (10/52); group B, 56.4% (22/39); group C, 62.5% (25/40); and group B + C, 59.5% (47/79). Statistical analysis revealed that the values of groups B and C were significantly different from that of group A; however, the difference between groups B and C was not statistically significant (Table 2).

Comparison of the colorectal tumor detection rates for different screening programs

On the basis of their reasons for undergoing colonoscopy, patients were divided into groups D (those who volunteered to undergo colonoscopy) and E (those who underwent colonoscopy based on their doctor's recommendation), and the colorectal tumor detection rates were compared between the two groups. These data were also compared to those of the APCS MR/HR group (group F) and the APCS MR/HR group with obesity (BMI ≥ 25 kg/m^2 with or without other MS components; group G). The colorectal tumor detection rate was significantly higher in group E than in group D (P < 0.01), whereas this rate was significantly higher in group G than in group E (P < 0.01) and in group F (P < 0.05; Table 3).

DISCUSSION

Researchers at the National University of Singapore

conducted a study on tertiary hospitals in 11 Asian cities, including 2752 asymptomatic individuals who underwent screening colonoscopy. The researchers developed the APCS scoring system based on the results of multivariate logistic regression analysis of the risk factors for colorectal tumors[9]. In the validation group, the rates of advanced neoplasia in the AR, MR, and HR groups were 1.3%, 3.2%, and 5.2%, respectively. Patients in the MR and HR groups had a 2.6-fold (95%CI: 1.1-6.0) and 4.3-fold (95%CI: 1.8-10.3) higher rate of advanced neoplasia, respectively, than patients in the AR group. In our study, we observed colorectal tumor detection rates of 15.9%, 36.3%, and 77.8%, respectively, for the AR, MR, and HR groups, and the detection rates for advanced colorectal tumor were 2.3%, 9.7%, and 27.8% in these groups, respectively. The differences in the detection rates between the 3 groups were statistically significant, suggesting that APCS scoring system was useful in colorectal tumor screening for symptomatic outpatients, although the APCS scoring system was established using asymptomatic individuals. In addition, the APCS scoring system is simple and convenient for clinical use. In this study, the colorectal tumor detection rate was significantly higher than that in the APCS study; a possible reason for this difference is that many patients who visited the clinic had related symptoms and risk factors such as a history of colorectal polyps or CRC. Patients with a history of colorectal polyps might have recurrence rates exceeding 55.7%[15], and therefore, the colorectal tumor detection rate is higher in those patients than in the general population.

Numerous studies have indicated that MS components and related diseases are significantly associated with the development of colorectal tumors, and MS is a significantly independent element that influences the survival of the CRC[14-18]. Obesity is a key component of MS[19], and systematic reviews[20,21] revealed that obesity is a statistically significant risk factor for CRC. Therefore, we further stratified patients in the MR and HR groups according to these risk factors. When patients in the MR/HR group were stratified according to the presence of obesity, the colorectal tumor detection rate significantly increased (59.5% *vs* 19.2% for the MR/HR group without obesity, $P < 0.01$). Thus, MS components, especially obesity, are closely related to the onset of colorectal tumors.

Our previous studies[15,16] demonstrated that an increase in the number of MS components is related to an increased proportion of advanced colorectal tumors among all colorectal tumors. The number of MS components is also related to tumor recurrence. Patients with colorectal tumors that are not associated with any MS components have a recurrence rate of 18.42% within 1-3 years after initial treatment, whereas those with 1, 2, or ≥ 3 components have recurrence rates of 59.52%, 75%, and 77.78%, respectively. This finding suggests that the number of MS components is positively correlated with the risk of colorectal tumor development. This study revealed that the colorectal tumor detection rate increased

as the number of MS components increased; however, this increase did not reach statistical significance, which was probably due to the small sample size.

Individual screening, also known as opportunistic screening, comprises clinical screening and a face-to-face examination. This may be performed when patients request screening from doctors or doctors prescribe screening tests on the basis of the presence of risk factors. In fact, most early CRC diagnoses in China result from individual screening recommended by doctors in hospital[22]; however, neither doctors nor patients have clear guidelines to follow. In China, the CRC screening program involves screening methods such as the sequential fecal occult blood initial screening method[23]. Even with immunoassays of fecal occult blood, the detection rate of early-stage CRC is relatively low[23,24]. Thus, in CRC screening programs, a survey of high-risk factors for CRC should be emphasized, so that patients in the high-risk group can undergo screening colonoscopy without delay.

According to former studies, the extent of knowledge regarding CRC that primary care doctors and the general population have greatly influences compliance with CRC screening[25,26]. Given the limited medical resources, we should identify high-risk patients for prior colonoscopy screening. In the clinic, doctors' decisions are greatly influenced by personal experiences. Most doctors are not familiar with specific CRC screening principles, and many patients fear colonoscopy. This study illustrated that the combined use of the APCS score and the presence of MS components such as obesity had a significantly better effect on CRC screening than did physician advice or the patient's willingness to undergo colonoscopy. We suggest that the effects of the APCS scores as well as those of MS components on CRC onset be advocated in doctors and among the general population. Increased compliance with CRC screening should be ensured among patients in the APCS MR/HR group, especially among those with MS components, particularly obesity, to increase the efficiency of individual CRC screening programs and promote the accumulation of experiences and data that will provide evidence for improving CRC screening in China.

COMMENTS

Background
Colorectal cancer (CRC) is one of the most common malignant tumors worldwide. The best method to prevent the morbidity associated with CRC is to improve the detection rate of early-stage disease. The Asia-Pacific colorectal screening (APCS) system uses age, gender, a family history of colorectal tumors, and smoking history as the factors to calculate the risk of colorectal tumors. However, the APCS scoring system does not incorporate metabolic syndrome, which has been proved closely related to the occurrence and development of colorectal tumors.

Research frontiers
There are a large number of studies aiming to reveal the risk factors of CRC, including but not limited to age, gender, smoking, a family history of colorectal tumors and metabolic syndrome. Accordingly, many screening models for CRC

have been recommended.

Innovations and breakthroughs
This study assessed the efficacy of APCS scoring system and the combined use of metabolic syndrome in individual screening for sporadic CRC.

Applications
The combined use of APCS scores and the metabolic syndrome components, in particular obesity, may significantly improve the efficacy of individual CRC screening, and has clinical significance.

Terminology
Individual screening, also known as opportunistic screening, is a new model based on clinical practice. It may be performed when patients request screening from doctors or doctors prescribe screening tests on the basis of the presence of risk factors.

Peer review
The APCS scoring system can be used in individual screening for sporadic colorectal cancer. The combined use of APCS scores and the metabolic syndrome components, in particular obesity, will significantly improve the efficacy of colorectal cancer screening. This is a potentially important study, especially in the Asian population, and has clinical significance. The manuscript is well written and clear.

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