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BRIEF ARTICLE

Effectiveness of gastric cancer screening programs in South Korea: Organized *vs* opportunistic models

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Abstract

AIM: To investigate the outcome and effectiveness of two screening programs, National Cancer Screening Program (NCSP) and opportunistic screening (OS), for the detection of gastric cancer.

METHODS: A total of 45 654 subjects underwent upper endoscopy as part of the NCSP or OS at the Chung-Ang University Healthcare System in Korea between January 2007 and December 2010. The study population was comprised of subjects over the age of 40 years. More specifically, subjects who took part in the NCSP were Medicaid recipients and beneficiaries of the National Health Insurance Corporation. Still photographs from the endoscopies diagnosed as gastric cancer were reviewed by two experienced endoscopists.

RESULTS: The mean age of the screened subjects was 55 years for men and 54 years for women. A total of 126 cases (0.28%) of gastric cancer were detected from both screening programs; 100 cases (0.3%) from NCSP and in 26 cases (0.2%) from OS. The proportion of early gastric cancer (EGC) detected in NCSP was higher than that in OS (74.0% *vs* 53.8%, $P = 0.046$). Among the 34 416 screenees in NCSP, 6585 (19.1%) underwent upper endoscopy every other year as scheduled. Among the 11 238 screenees in OS, 3050 (27.1%) underwent upper endoscopy at least once every two years during the study period. The detection rate of gastric cancer was found to be significantly higher during irregular follow-up than during regular follow-up in both screening programs (0.3% *vs* 0.2%, $P = 0.036$). A higher incidence of EGC than advanced gastric cancer was observed during regular follow-up compared with irregular follow-up.

CONCLUSION: Compliance to the screening program is more important than the type of screening system used.

Key words: Gastric cancer; National Cancer Screening Program; Opportunistic screening; Early gastric cancer

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INTRODUCTION

Gastric cancer is the second most common cause of cancer death worldwide, and East Asian countries, such

as China and Japan, have high incidence rates of gastric cancer[1,2]. Although the incidence has declined in recent decades, gastric cancer remains the most frequently diagnosed form of cancer in South Korea[3-6]. The symptoms of gastric cancer appear quite late; in fact, a large number of advanced gastric cancer cases, as well as most early gastric cancer (EGC) cases, show no symptoms. Thus, gastric cancer screening is extremely important for the early detection of gastric cancer.

Screening can be defined as the systematic application of a test or inquiry to identify individuals at sufficient risk of a specific disorder who will benefit from further investigation or direct preventive action, among those who have not sought medical attention[7]. Some countries, such as Japan and South Korea, provide gastric cancer screening to populations with an average risk to reduce the disease burden.

Cancer screening may be offered in an organized or opportunistic model[8]. An organized model is primarily distinguished from opportunistic screening (OS) in that invitations to screening are issued from population registers[9]. Organized screening programs have nationally implemented guidelines defining who should be invited, how frequently they should be screened, and how any abnormalities detected on screening should be followed up and treated[8,10]. In South Korea, a nationwide gastric cancer screening program began in 1999 as part of the National Cancer Screening Program (NCSP). NCSP provides screening services free of charge for Medicaid enrollees and people with National Health Insurance with a premium below 50%. The NCSP recommends biennial upper endoscopy or upper gastrointestinal series for men and women aged $\geqslant$ 40 years.

In addition to the organized screening program, OS is also widely available in South Korea. OS programs involve various options in terms of the items screened, intervals between screening, and costs, depending on the preference by the individual, but these services are entirely paid by the users[11]. OS has been highly implemented owing to the low cost and easy accessibility of endoscopy. However, OS involves fewer formal decisions on whether to screen, whom to screen, and at what intervals the screening should be done. Moreover, the evidence and efficiency of this examination tend to be underestimated.

Although screening programs are conducted widely in South Korea, the utilization of such screening programs, including both organized and opportunistic programs, is still unclear[11]. Even though there have been some studies carried out on the characteristics of gastric cancer detected by mass screening, there is neither a study evaluating the efficiency of gastric cancer screening programs or comparison between organized and OS. Therefore, in this study, we investigated the current features of gastric cancer screening programs in South Korea, in terms of the outcome and effectiveness of NCSP and OS conducted at a single center.

MATERIALS AND METHODS

Subjects

The present study was conducted by reviewing medical records. A total of 45 991 subjects underwent upper endoscopy as part of the NCSP or OS at the Chung-Ang University Healthcare System in South Korea between January 2007 and December 2010. The study population was comprised of subjects over the age of 40 years. More specifically, subjects who took part in the NCSP were Medicaid recipients and beneficiaries of the National Health Insurance Corporation. Still photographs from the endoscopies diagnosed as gastric cancer were reviewed by two experienced endoscopists. The gross shape of the lesion was determined as either EGC or advanced gastric cancer (AGC). If there was a discrepancy between the two endoscopists' findings, a final decision was made after further discussion.

Statistical analysis

Statistical analyses in this study were conducted using the SPSS version 12.0 software package (SPSS, Chicago, IL, United States). Categorical data analysis was conducted using the χ^2 test or Fisher's exact test. Continuous data were analyzed using Student's *t*-test. Continuous variables measured in this study are expressed as mean ± SD. All *P* values were 2-tailed. *P* values of less than 0.05 were considered statistically significant. The study was approved by the Institutional Review Board of the Chung-Ang University Medical Center in South Korea.

RESULTS

Demographics of the subjects

A total of 45 991 subjects were screened for gastric cancer during the study period. Of these, 34 481 subjects were included in NCSP and 11 238 subjects in OS. In NCSP, 275 subjects were excluded due to previous gastric surgery (n = 233) and endoscopic resection (n = 42). In OS, 62 subjects were excluded due to previous gastric surgery (n = 45) and endoscopic resection (n = 17). A total of 45 654 subjects (34 416 in NCSP and 11 238 in OS) were subsequently enrolled in this study. The mean age of the screened subjects was 55.1 years for men and 54.4 years for women. The male to female ratio of the screened subjects was 0.7:1. The mean age of the subjects was 56.2 ± 9.2 years in NCSP and 50.0 ± 8.0 years in OS, respectively. In addition, the male to female ratio was 0.5 in NCSP and 1.4 in OS, respectively. The demographics of the subjects are shown in Table 1.

Participation rate of the subjects

In NCSP, a total of 6585 subjects (19.1%) underwent upper endoscopy every other year as scheduled. Their mean age was 58.7 ± 8.3 years, and the male to female ratio was 0.5:1. In contrast, in OS, a total of 3050 subjects (27.1%) underwent upper endoscopy at least once

Table 1 Demographics of participants *n* (%)

	National Cancer Screening Program	Opportunistic screening	*P* value
No. of subjects	34 416 (75.4)	11 238 (24.6)	
Age (yr), mean ± SD	56.2 ± 9.2	50.0 ± 8.0	< 0.001
40-49	8723 (25.4)	6159 (54.8)	
50-59	12 491 (36.3)	3623 (32.2)	
60-69	10 645 (30.9)	1165 (10.4)	
70+	2557 (7.4)	291 (2.6)	
Sex			< 0.001
Male	11 987 (34.8)	6668 (59.3)	
Female	22 429 (65.2)	4570 (40.7)	
No. of regular follow-up	6585 (19.1)	3050 (27.1)	< 0.001
Gastric cancer	100 (0.3)	26 (0.2)	0.299
Endoscopic feature			0.046
EGC	74 (74.0)	14 (53.8)	
AGC	26 (26.0)	12(46.2)	

EGC: Early gastric cancer; AGC: Advanced gastric cancer.

Table 2 Outcomes according to compliance to screening systems *n* (%)

	Regular follow-up	Irregular follow-up	*P* value
No. of subjects	9635 (21.1)	36 019 (78.9)	
Age (yr), mean ± SD	54.4 ± 9.3	55.7 ± 9.1	< 0.001
40-49	2783 (28.9)	12 099 (33.6)	
50-59	3413 (35.4)	12 701 (35.2)	
60-69	2789 (28.9)	9021 (25.1)	
70+	650 (6.8)	2198 (6.1)	
Sex			< 0.001
Male	4170 (43.3)	14 485 (40.2)	
Female	5465 (56.7)	21 534 (59.8)	
Gastric cancer	17 (0.2)	109 (0.3)	0.036
Endoscopic feature			0.942
EGC	12 (70.6)	76 (69.7)	
AGC	5 (29.4)	33 (30.3)	

EGC: Early gastric cancer; AGC: Advanced gastric cancer.

every two years during the study period. Their mean age was 49.4 ± 7.1 years, and the male to female ratio was 1.3:1. Among these subjects, 140 subjects (0.6%) had undertaken upper endoscopy every year during the study period.

Gastric cancer detection rate

As shown in Table 1, gastric cancer was diagnosed in 126 (0.28%) of 45 654 subjects (87 men and 39 women). Their mean age was 60.3 ± 9.5 years. Of these, 88 subjects (0.19%) were endoscopically diagnosed with EGC and 38 subjects (0.08%) with AGC. The proportion of EGCs among the total cases of gastric cancer was 69.8%. Figure 1 shows the annual EGC/AGC ratio in each system.

A total of 100 cases of gastric cancer found in NCSP included 74 cases of EGC (74%) and 26 cases of AGC (26%). The EGC/AGC ratio was 2.9. On the other hand, 14 cases of EGC (53.8%) and 12 cases of AGC (46.2%) were found in OS. The EGC/AGC ratio was 1.2. Hence, the detection rate of EGC in NCSP was significantly higher than that in OS ($P = 0.046$).

Outcomes according to compliance

In this study, we defined regular follow-up as satisfying the biennial checks in NCSP and a check-up at least once every two years during the period in OS. Table 2 shows the outcomes according to compliance to the systems. As a result, their detection rates in regular follow-up were 0.12% for EGC and 0.05% for AGC, respectively. With regard to compliance to the system, EGC was found more than AGC during regular follow-up compared with irregular follow-up in both NCSP and OS.

Among the 100 cases of gastric cancer in NCSP, 10 cases (83.3%) of EGC and 2 cases (16.7%) of AGC were found during regular follow-up. On the other hand, 64 cases (72.7%) of EGC and 24 cases (27.3%) of AGC were found during irregular follow-up. As for OS, 2 cases (40%) of EGC and 3 cases (60%) of AGC were found during regular follow-up, whereas 12 cases (57.1%) of EGC and 9 cases (42.9%) of AGC were found during irregular follow-up. Annual follow-up revealed no cases of gastric cancer among the 140 subjects.

DISCUSSION

In this study, we measured the effectiveness of gastric cancer screening between NCSP and OS. The results showed no significant difference in the gastric cancer detection rate between NCSP and OS. However, the proportion of EGC was higher in NCSP than in OS. In addition, regular check-ups were important regardless of the screening system.

Screening has become an important component in health promotion programs along with the progress of diagnostic technology aimed at early detection of diseases[7]. Screening has the potential to produce benefits in preventing morbidity and mortality as long as the screening program fulfills certain conditions.

The epidemiology and natural history of the disease, including development from the latent to declared disease, should be adequately understood; and there should be a detectable risk factor, disease marker, latent period, or early symptomatic stage. All cost-effective primary prevention interventions should have been implemented as far as practicable. Therefore, many countries have developed a variety of screening programs as part of their preventive health services according to the recommendations of specialized committees[7]. For example, national cancer control programs should be organized to ensure that a large proportion of the target group is screened and that those individuals in whom abnormalities are observed receive appropriate diagnosis and therapy. Agreement should be reached on the guidelines for proper application of national cancer control programs. The purpose of gastric cancer screening is to reduce the cancer-related mortality, and the effect of gastric cancer screening should be evaluated on the basis of this purpose. From the perspective of the South Korean public

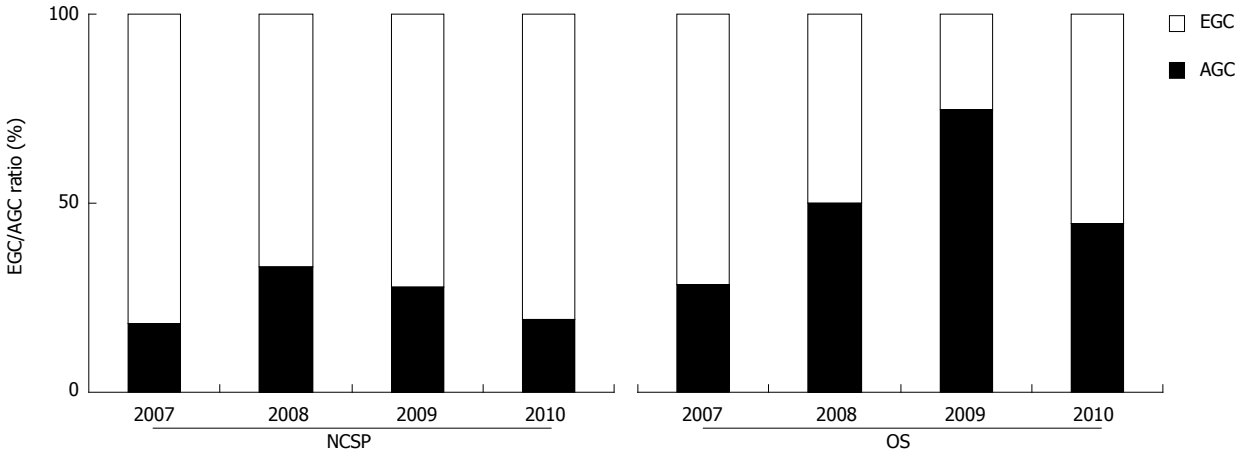

Figure 1 Annual early gastric cancer/advanced gastric cancer ratio in National Cancer Screening Program and opportunistic screening. The proportion of early gastric cancers (EGCs) among a total of 126 gastric cancers was 69.8%. The EGC/advanced gastric cancer (AGC) ratio in National Cancer Screening Program (NCSP) was 2.9, while the EGC/AGC ratio in opportunistic screening (OS) was 1.2. The detection rate of EGC in NCSP was significantly higher than that in OS (P = 0.046).

health care system, reducing the gastric cancer-related mortality rate appears to have the utmost importance[12].

Recently, endoscopy has replaced photofluorography as the initial mass screening method in South Korea. This method has become increasingly useful for gastric cancer screening owing to its high detection rate[13]. Considering the circumstances in South Korea that the cost of endoscopy is as low as that of photofluorography and the incidence of gastric cancer is still high, endoscopy is regarded as the most cost-effective screening method in South Korea. However, gastric cancer screening using endoscopy as a mass screening method has not yet been reported.

NCSP in South Korea has been available for several years, and has played a role in the early detection of gastric cancer. Apart from NCSP, OS has also contributed to screening gastric cancer in South Korea. Although the contents and process of the screening program are similar to those of the NCSP, there are some distinctive features in OS[7]. For this reason, some criticize that this unestablished guideline may drive the population into unnecessary socioeconomic consumption. Our hospital has run both NSCP and OS in the same healthcare system, which is rare in South Korea. A total of 8 well-trained gastroenterologists with at least 5 year of endoscopy experience performed upper endoscopy using a flexible endoscope (Q260 or Q240, Olympus Optical Co., Tokyo, Japan) in our healthcare system (NCSP and OS). They rotated between NCSP and OS as scheduled. Hence, there was little qualitative difference between NCSP and OS. Thus, this study could be regarded as a community-based study conducted for the local population.

So far, numerous studies on gastric cancer screening have focused on either OS or NCSP. Therefore, to our knowledge, this is the first study to compare the efficiency of two gastric cancer screening programs, NCSP and OS, in South Korea.

In this study, a total of 126 cases (0.28%) of gastric cancer were detected from both screening programs; 100 cases (0.3%) from NCSP and in 26 cases (0.2%) from OS during the study period. Screening for gastric cancer revealed that the proportion of EGC detected in NCSP was higher than that in OS (74.0% *vs* 53.8%, P = 0.046).

Kim *et al*[12] reported a significant relationship between the history of gastric examination and severity of gastric cancer. This suggests that gastric cancer screening is effective in detecting early stage gastric cancer. Unfortunately, an appropriate interval for screening gastric cancer has not been determined[14,15]. Despite the lack of evidence, screening for gastric cancer is conducted every other year in South Korea. Therefore, we compared the gastric cancer detection rates between NCSP and OS according to the frequency of check-ups.

We classified the subjects in each system according to the number of tests performed during the study period. This implies compliance to their target screening program. Regular follow-up was defined as satisfying the biennial check-ups in NCSP and a check-up at least once every two years during the period in OS. As a result, only 21.1% of subjects underwent endoscopy.

In this study, compliance to gastric cancer screening programs was determined to be as low as 19.1% in NCSP and 27.1% in OS, respectively. Hence, OS seems to be more effective regarding the examination interval. However, the detection rate of gastric cancer was significantly higher during irregular follow-up than during regular follow-up, regardless of the type of system (0.3% *vs* 0.2%, P = 0.036). While gastric cancer detected during the screening appears to have a good prognosis, several biases should be carefully assessed. Generally, individuals taking part in screening programs are healthier than those who do not. Selection bias has been discussed as a major limitation of case-control studies in which infor-

mation on confounding factors were not obtained[16,17]. Ideally, the effectiveness of a screening program is evaluated by an interventional study in which subjects are randomly allocated to screened and unscreened groups[18]. Due to the wide implementation of gastric cancer screening, however, no such interventional study has been carried out.

The present study had some limitations. First, this study had little information on risk factors. Second, gastric cancer was classified as EGC and AGC based on endoscopic findings, instead of surgical findings. Finally, this study did not cover the clinical course after diagnosis, including stage work-up, treatment, and prognosis, including survival. However, the present study reflects the features of presently available gastric cancer screening programs and may have an influence on future plans for cancer control.

In conclusion, this study demonstrated that NCSP was an effective screening system comparable to OS in the early detection of gastric cancer. The results suggest that compliance to the screening program is more important than the type of screening system itself. However, further studies on the efficiency and analysis of cost-effectiveness will be needed for successful progression of both systems. Furthermore, more comprehensive analyses with extensive nationwide data are warranted.

COMMENTS

Background

Gastric cancer remains one of the leading causes of cancer-related death worldwide. Currently, screening is performed in countries where gastric cancer is highly prevalent such as South Korea and Japan. In South Korea, cancer screening is widely available in two systems; organized cancer screening program, *e.g.*, National Cancer Screening Program (NCSP) and opportunistic screening (OS). However, there are no comparative studies on the effectiveness and outcomes of these two systems.

Research frontiers

Apart from government-led mass screening programs, OS programs by individual needs using an endoscopic examination have become common. However, OS has not been estimated in terms of clinical usefulness as well as cost-effectiveness. This study evaluated the effectiveness of screening systems with regard to early detection of gastric cancer and compliance to the system.

Innovations and breakthroughs

So far, most epidemiologic studies on gastric cancer screening have dealt with screening tools, screening interval and the cost-effectiveness of mass screening. However, little attention has been paid to the differences between two screening systems, *e.g.*, organized and opportunistic models. The authors made a comparison between these two systems and suggest that regular check-up is essential in the early detection of gastric cancer regardless of the screening system used.

Applications

The authors demonstrated that regular check-up is more important than the screening system in the early detection of gastric cancer. This work is interesting and will help health professionals establish a practical program for gastric cancer screening. Furthermore, it will contribute to the exploration of future strategies for gastric cancer prevention and control.

Terminology

NCSP is a cancer screening program which has been conducted by the South Korean government since 1999. OS is a screening program which depends on requests from individuals and has no guidelines.

Peer review

The authors have compared the effectiveness of NCSP and OS for gastric cancer screening. This paper has some valuable information and is worthy of publication.

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