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Effects of Screening on Gastric Cancer Management: Comparative Analysis of the Results in 2006 and in 2011

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Purpose: This study aimed to analyze the effect of screening by using endoscopy on the diagnosis and treatment of gastric cancer.
Materials and Methods: The clinicopathologic characteristics of gastric cancer were compared in individuals who underwent an endoscopy because of symptoms (non-screening group) or for screening purposes (screening group). The distributions of gastric cancer stages and treatment modalities in 2006 and 2011 were compared.
Results: The proportion of patients in the screening group increased from 45.1% in 2006 to 65.4% in 2011 (P<0.001). The proportion of stage I cancers in the entire patient sample also increased (from 60.5% in 2006 to 70.6% in 2011; P=0.029). In 2011, the percentages of patients with cancer stages I, II, III, and IV were 79.9%, 8.2%, 10.9%, and 1.1%, respectively, in the screening group, and 47.9%, 10.8%, 29.8%, and 11.5%, respectively, in the non-screening group. The proportion of laparoscopic and robotic surgeries increased from 9.6% in 2006 to 48.3% in 2011 (P<0.001), and endoscopic submucosal dissection increased from 9.8% in 2006 to 19.1% 2011 (P<0.001).
Conclusions: The proportion of patients diagnosed with gastric cancer by using the screening program increased between 2006 and 2011. This increase was associated with a high proportion of early-stage cancer diagnoses and increased use of minimally invasive treatments.

Key Words: Early detection of cancer; Stomach neoplasms; Therapeutics

Introduction

Gastric cancer is currently the fourth most common malignancy worldwide, with approximately 1 million new cases estimated in 2008 (989,000 cases, 7.8% of total cancers).[1,2] In Korea, 29,727 individuals were diagnosed with cancer in 2008, and gastric cancer was the second most commonly occurring cancer, affecting 20.1% of men and 10.5% of women.[3]

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In countries without an appropriate screening system, gastric cancer is usually detected at a late stage.[4] The 5-year survival rates are much lower for patients with advanced gastric cancer than for those with early-stage gastric cancer, for whom survival rates can exceed 90%.[5] Use of endoscopy to screen for gastric cancer may facilitate early detection and improve survival, particularly in countries such as Korea and Japan that have a high incidence of gastric cancer.[5-7] However, the effect of screening with endoscopy on early diagnosis and treatment modality has rarely been reported.

The National Cancer Control Committee was established in in Korea 1996. It developed a nationwide screening system as well as guidelines for the National Cancer Screening Program (NCSP) in 1999. The NCSP commenced a screening program for stomach, breast, and cervical cancers at that time. Screening for liver cancer in high-risk individuals was introduced in 2003, and the screening

program now includes stomach, breast, cervical, colorectal, and liver cancer.[8] The NCSP recommends that individuals >40 years of age undergo gastric cancer screening via either the upper gastrointestinal series or endoscopy every 2 years.[7]

The proportion of patients with gastric at the Seoul National University Hospital (SNUH) who were diagnosed through the screening program was only 4.7% in 1996 and 17.2% in 2001.[9] The national screening rate has increased since that time,[10] and with an associated increase in the detection of early stage gastric cancers, there have been improvements in minimally invasive treatments such as endoscopic submucosal dissection (ESD) and laparoscopic gastrectomy.

This study aimed to evaluate the effect of screening by using endoscopy on the distribution of gastric cancer stages and treatment modalities at 5-year intervals since our last investigation in 2001.

Materials and Methods

We retrospectively collected information of 1,952 gastric cancer patients who underwent surgery or ESD at the SNUH in 2006 (n=901) or 2011 (n=1,051), which are the 5-year intervals following those investigated in our previous study (1996 and 2001).[9]

The patients were categorized into a screening group or a non-screening group. The patients in the screening group were diagnosed with gastric cancer through screening by using endoscopy regardless of the presence of symptoms. The patients in the non-screening group were diagnosed with gastric cancer through various patient-reported symptoms. The pathologic stage was classified according to the 7th American Joint Committee on Cancer tumor node metastasis (TNM) stage. Patients were considered inoperable when a non-resectable cancer with unknown stage was identified during the operation. Multiple symptoms reported by the same patient were included in the total count. The proportion of symptoms was compared between the screening and non-screening groups according to age, sex, and year (2006 and 2011).

Chi-square tests were used for comparisons between the screening and non-screening groups and between the data from 2006 and 2011. Statistical significance was set at $P<0.05$. All analyses were performed by using IBM SPSS version 19.0 (IBM Corp., Armonk, NY, USA).

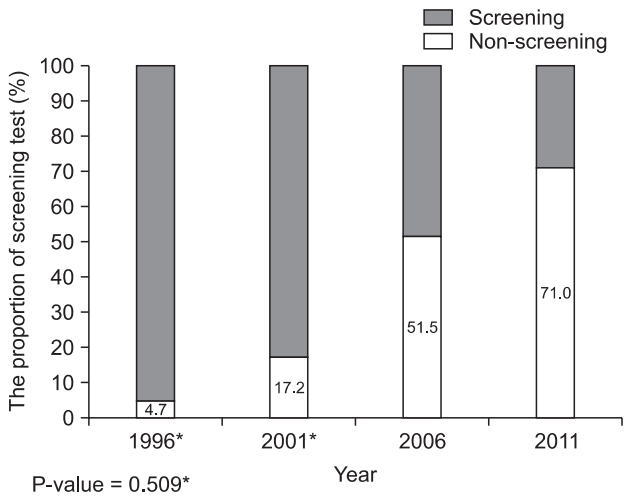

Fig. 1. Proportion of patients with gastric cancer detected through screening by using endoscopy. *Refered from the article of Kong et al.[9].

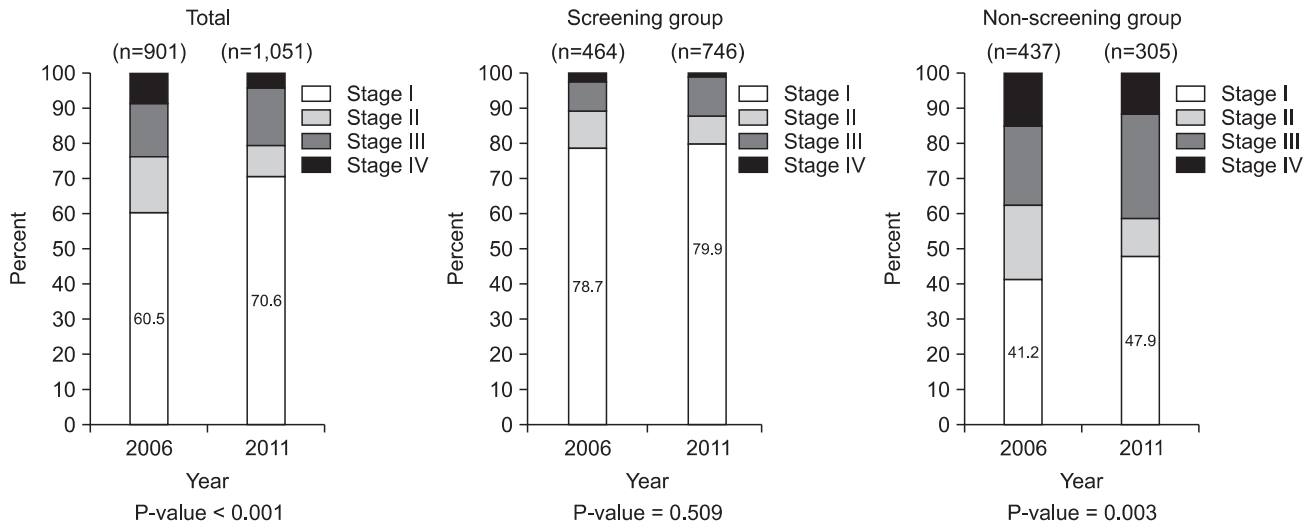

Fig. 2. Proportion of gastric cancers at each stage in 2006 and 2011.

Table 1. Sex ratios of patients diagnosed with gastric cancer through screening by using endoscopy in 2006 and 2011

		2006 (n=901)	2011 (n=1,051)	P-value
Total patients	Sex (male : female)	2.06 : 1	2.03 : 1	0.856
	Age (yr)	58.4 ±11.92	60.3±12.14	0.001
Screening group	Sex (male : female)	2.77 : 1	2.07 : 1	0.001
	Age (yr)*	58.3±10.36	60.0±11.07	0.186
	≤29	25.0 (2/8)	37.5 (3/8)	1
	30-39	35.3 (18/51)	47.8 (22/46)	0.456
	≥40	52.7 (444/842)	72.3 (721/997)	<0.001

Values are presented as ratio of men to women, mean±standard deviation, or mean (numbers of men/women). *The screening group is distributed according to age.

Results

The proportion of patients in the screening group significantly increased from 51.5% in 2006 to 71.0% in 2011 (P<0.001) (Fig. 1). These proportions are considerably higher than those reported in our previous study (4.7% in 1996 and 17.2% in 2001).[9]

1. Comparison of clinicopathologic features between screening and non-screening groups

The percentage of patients with a gastric cancer diagnosis on the basis of screening by endoscopy significantly increased between 2006 and 2011 for both sexes (Table 1). Notably, the ratio of men to women in the screening group decreased from 3.8 : 1 (83 : 22) in 2001[9] to 2.77 : 1 (341 : 123) in 2006 and further to 2.07 : 1 (503 : 243) in 2011. The ratio of men to women in the screening group in 2011 is similar to the ratio of men to women in the entire sample of patients with gastric cancer in 2011 (2.03 : 1, 704 : 347).

The proportion of stage I in the entire patient sample significantly increased from 60.5% in 2006 to 70.6% in 2011 (P<0.001) (Fig. 2).

When stratified by age, the proportion of patients ≥40 years of age who were diagnosed through a screening test significantly increased between 2006 (52.7%) and 2011 (72.3%; P<0.001) (Fig. 3). The proportion of stage I cancers diagnosed in this age group was also significantly higher in 2011 than in 2006 (P<0.001). Although patients 30 to 39 years of age are not included in the nationwide screening service, they also showed a significant increase in the proportion of diagnosed stage I cancers between 2006 and 2011 (P=0.029).

In the screening group, the proportion of stage I gastric cancers was similar between 2006 (78.7%) and 2011 (79.9%). However, in the non-screening group, the proportion of stage I gastric cancers significantly increased between 2006 (41.2%) and 2011 (47.9%, P=0.003) (Fig. 2).

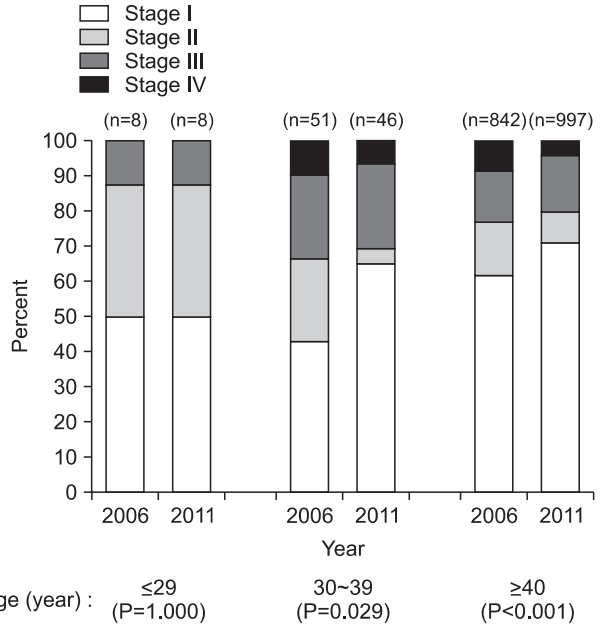

Fig. 3. Stage of gastric cancer in different age groups in 2006 and 2011.

2. Patient-reported symptoms

In the symptomatic patients, non-specific epigastric pain was the most commonly reported symptom (Fig. 4). Patients with gastrointestinal-related problems experienced diarrhea or constipation. Other patients had non-specific symptoms that included poor oral intake, fatigue, fever, chills, general weakness, swallowing difficulties, and hematuria.

Diagnosis occurred an average of 5.6±9.0 months after symptoms were reported, and this period was significantly longer in

2006 (6.1±8.8 months) than in 2011 (4.8±9.0 months; P=0.040). The most common symptoms in patients diagnosed with stage II to IV gastric cancer were obstruction, weight loss, and gastrointestinal bleeding.

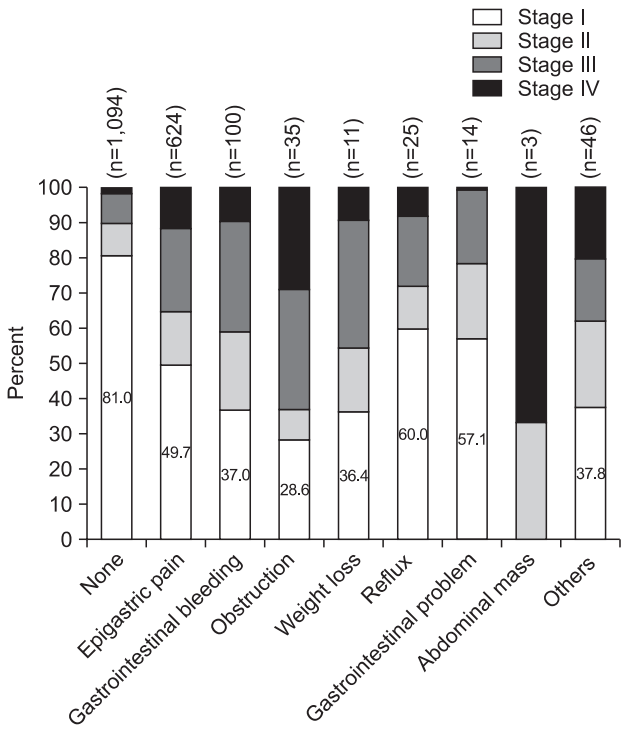

Fig. 4. Stage of gastric cancer and patient-reported symptoms.

3. Comparison of treatment modality between 2006 and 2011

The proportion of patients who underwent ESD significantly increased between 2006 (9.8%) and 2011 (19.1%; P<0.001) (Table 2). Following ESD, the proportion of ESD procedures that were followed by an operation (laparoscopic surgery in all instances) was 0.2% in 2006 and 1.6% in 2011. The distribution of open, laparoscopic, and robotic surgeries significantly changed between 2006 and 2011 (P<0.001), with a decrease in the number of open surgeries and an increase in the number of the two other surgery types (Fig. 5). The rate of pylorus preserving gastrectomy (PPG) surgeries significantly increased (0.9% in 2006, 9.6% in 2011; P <0.001) (Table 2), and there was an increased use of laparoscopic surgery for stage IV gastric cancers that paralleled an increase in the use of diagnostic laparoscopy (Fig. 5).

Discussion

In this study, we documented the effect of gastric cancer screening by using endoscopy on the detection of gastric cancer and development of treatment modalities. The symptoms of gastric cancer are often non-specific (e.g., abdominal discomfort), which does not necessarily prompt an endoscopy. Therefore, the screening group in the present study consisted of patients for whom gastric cancer was detected through screening by using endoscopy

Table 2. Surgical treatments for gastric cancer in 2006 and 2011

Treatment	2006 (n=901)	2011 (n=1,051)	P-value
Endoscopic submucosal dissection	88 (9.8)	201 (19.1)	<0.001
Operation	813 (90.2)	850 (80.9)	
Open	735 (90.4)	440 (51.8)	<0.001
Laparoscopy	78 (9.6)	372 (43.8)	
Robot-assisted	0 (0.0)	38 (4.5)	
Subtotal gastrectomy	581 (71.5)	509 (59.9)	<0.001
Total gastrectomy	158 (19.4)	131 (15.4)	
Near total gastrectomy	3 (0.4)	2 (0.2)	
Proximal gastrectomy	31 (3.8)	42 (4.9)	
Pylorus preserving gastrectomy	7 (0.9)	133 (15.6)	
Gastrojejunostomy	11 (1.4)	6 (0.7)	
Exploration only	19 (2.3)	26 (3.1)	
Whipple operation	1 (0.1)	1 (0.1)	
Ivor-Lewis	2 (0.2)	0 (0.0)	

Values are presented as number (%).

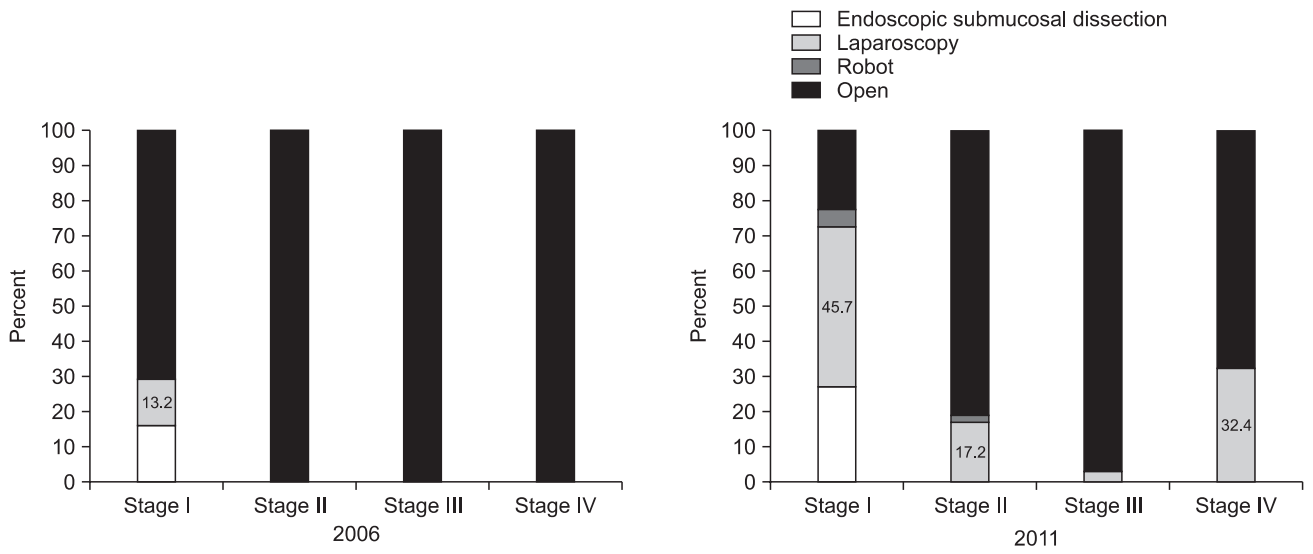

Fig. 5. Surgical management of gastric cancer according to stage in 2006 and 2011.

regardless of symptoms.

The proportion of patients at the SNUH diagnosed with gastric cancer through the screening program increased from 51.5% in 2006 to 71.0% in 2011. On the basis of the nationwide screening rate for gastric cancer in Korea (37.4% in 2004 and 63.5% in 2011),[10] the rate of private screening of individuals or in workplaces can be roughly estimated at 10%.

The ratio of men to women for whom gastric cancer was detected through screening by using endoscopy decreased from 3.8 : 1 in 2001 to 2.07 : 1 in 2011, which suggests that women may have had less opportunity to access screening previously. The gradual increase in the proportion of women accessing gastric cancer screening may account for the similarity of the sex ratio in the screening group and the entire gastric cancer patient sample in 2011. The increased proportion of detection in the screening rate in individuals aged ≥40 years (from 52.7% in 2006 to 72.3% in 2011) is likely due to the fact that the NCSP is only available to people of that age. Despite a lack of statistical significance, the increase in screening in patients aged 30 to 39 years might reflect more employer-provided medical examinations and more awareness of the benefits of health examinations.

There was no significant difference in the distribution of cancer stages in the screening group between 2006 and 2011; however, the proportion of stage I cancers increased in this group. Along with the increase in the proportion of early stage diagnoses, the use of less-invasive treatments also increased. Moreover, the proportion of patients in the non-screening group with stage I cancers increased slightly but significantly (6.6%, P=0.003). The more widespread use of endoscopy for screening presumably made it more accessible to symptomatic patients, thereby resulting in early detection in those patients as well. Also contributing to earlier detection in the non-screening group is the shorter duration between reporting of symptoms and diagnosis in 2011 than in 2006.

The rate of performance of ESD increased to 19.1% in 2011 from 9.8% in 2006. Although this increase is largely attributable to the development and propagation of ESD instruments and techniques, the greater proportion of early-stage gastric cancers, which is indicated ESD,[11] may also have contributed. The numbers and techniques of laparoscopic- and robotic-assisted surgeries have also risen. The increase in the proportion of early gastric cancers enabled a successful enrollment of approximately 1,400 patients in 5 years in the 'KLASS-01' trial, which is a randomized prospective trial comparing open and laparoscopic distal gastrectomy.[12]

Detection of early-stage gastric cancer through screening by using endoscopy boosts interest in patient outcomes, including survival, post-operative function, and quality of life, and long-term considerations such as nutrition and secondary cancers. The increased use of PPG, a representative functional gastrectomy,[13-15] also reflects an emerging interest in outcomes. Further research in this area will provide information about medical services for gastric cancer other than surgery.

In conclusion, the proportion of patients screened for gastric cancer in Korea increased between 2006 and 2011, especially in women. This increase was accompanied by an increase in early cancer detection as well as the development and use of less invasive treatment modalities.

Acknowledgments

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