

ORIGINAL ARTICLE

## 대장내시경 숙련자와 비숙련자 간의 대장회수시간에 따른 선종 발견율의 차이

김영두, 배원기, 최윤희, 좌윤정, 정상경, 이부현, 백우현, 김정욱, 김남훈, 김경아, 이준성

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### Difference in Adenoma Detection Rates according to Colonoscopic Withdrawal Times and the Level of Expertise

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**Background/Aims:** Adequate screening colonoscopy in the general population decreases the mortality associated with colorectal cancer through detection and removal of adenomatous polyps. Prolonged colonoscopic withdrawal times (>6 min) are reportedly beneficial for adenoma detection rates (ADRs). However, the quality of the endoscopist compared with colonoscopic withdrawal times is not known. The aims of this study were to investigate the difference in ADRs between trainees and experienced examiners.

**Methods:** A total of 967 consecutive patients who underwent screening colonoscopy in a single University hospital from June 2010 to November 2011 were enrolled in this prospective observational study. Colonoscopy was performed by four experienced staff and seven gastroenterology fellows.

**Results:** Seven gastroenterology fellows performed 633 colonoscopies and four experienced staff performed 334 colonoscopies. The overall detection rates of colorectal adenoma were 31.5% with ADRs of fellows and staff of 29.4% and 35.6%, respectively ( $p=0.047$ ). Fellows also showed lower advanced ADRs (5.7% vs. 9.9%,  $p=0.016$ ), and fellows had longer mean withdrawal times than staff ( $12.4\pm4.9$  min vs.  $8.2\pm4.1$  min,  $p<0.001$ ). Multivariate analysis showed significantly increased ADRs and advanced ADRs for staff compared with fellows (adjusted OR 2.41, 95% CI 1.70-3.43; adjusted OR 2.55, 95% CI 1.47-4.45, respectively).

**Conclusions:** ADRs were significantly lower when colonoscopy was performed by trainees, although withdrawal times were longer than those of staff. Our results demonstrated that the quality of colonoscopy, as measured by ADRs, may be improved by experienced examiners. (Korean J Gastroenterol 2014;64:278-283)

**Key Words:** Colonoscopy; Adenoma

### INTRODUCTION

Colorectal cancer is the third most common malignancy (14.1%) in the Republic of Korea, and the incidence rate is increasing at 6.9% per year.<sup>1</sup> This disease can be prevented by

colonoscopic removal of adenomatous polyps because of the progression of adenoma to adenocarcinoma.<sup>2</sup> Therefore, screening for colorectal cancer has important public health implications.

Although it was initially estimated that colonoscopy with

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polypectomy could decrease colon cancer incidence by as much as 80%, more recent reports of significant miss rates for adenomas of up to 27% have called into question the effectiveness of colonoscopy.<sup>3</sup>

Based on studies of the prevalence of adenomas in the general population, current guidelines recommend adenoma detection rates (ADRs) of at least 25% in men and 15% in women.<sup>4</sup> Subsequently, there has been intense interest in determining the factors that predict adenoma detection. Factors reported to affect polyp and adenoma detection include the time spent viewing during withdrawal, cecal intubation rates, the adequacy of bowel preparation, and the time spent cleaning the colonic mucosa of excess fluid.<sup>5-7</sup> In addition, the performing endoscopist, independent of patient-related factors, has recently been shown to strongly influence adenoma detection.<sup>8,9</sup> Endoscopist behaviors, such as time spent on inspection, looking behind folds, cleansing, and distention of the colon, are also associated with higher adenoma detection.<sup>10,11</sup>

Recent studies examining the issue of quality colonoscopy have focused on the importance of a withdrawal time of  $\geq 6$  minutes because of its association with higher ADRs.<sup>7,12</sup> The focus on the 6-minute threshold is largely based on the assumption that withdrawal time is an indication of the quality of the withdrawal technique. After all, one would suppose that an who performs a careful inspection of the colonic mucosa for adenomatous polyps would also take a prolonged period of time in doing so. However, only a few studies comparing withdrawal time and withdrawal technique between endoscopists have been reported.<sup>10,13,14</sup>

Therefore, we sought to investigate differences of ADRs according to the quality of the endoscopist compared with colonoscopic withdrawal times. In addition, we investigated the detection rates of colorectal adenoma and factors affecting ADRs.

## SUBJECTS AND METHODS

### 1. Patients and physicians

Data on 967 consecutive patients who underwent screening colonoscopy in Inje University Ilsan Paik Hospital (Goyang, Korea) from June 2010 to November 2011 were prospectively collected. Four experienced staff and seven gastroenterology fellows performed the screening colonoscopy for all patients. Staff physicians were experienced in perform-

ing more than 10,000 colonoscopies. Seven fellows with first- or second-year training participated, and all were qualified to make medical and procedural decisions during a colonoscopic examination.

Exclusion criteria included incomplete examination (inability to reach the cecum, poor bowel preparation, occurrence of complication), prior colonoscopy, history of inflammatory bowel disease, and prior colonic resection. Patients participated according to endoscopic scheduling by the colonoscopist. The Ilsan Paik Hospital ethics committee approved this study. Informed consent was obtained from each enrolled patient before the procedure.

### 2. Clinical analysis

We recorded age, gender, BMI, history of abdominal surgery, bowel preparation, withdrawal time of the colonoscope, and pathology and ADRs among colonoscopists. Complete colonoscopic examination was regarded as cecal intubation and adequate bowel preparation. In this study, adequate bowel preparation was defined as more than "fair" according to the Aronchick scale. The endoscopy machine recorded times automatically when taking pictures for the following procedural events: colonoscope insertion into the rectum, identification of the base of the cecum, start and end of biopsy or polypectomy, and withdrawal of the colonoscope across the anus. The times were recorded immediately after the procedure by either the endoscopist or the nurse present at the time the procedure was performed. The withdrawal time excluded time taken for maneuvers such as polypectomy that were performed during the withdrawal phase of the examination.

Although polyp size was visually estimated by the endoscopists during colonoscopy, most endoscopists in our institution and our trainees use an open forceps (8 mm) as a reference standard if visual assessment is judged as insufficient. As an additional objective measure of size estimation, we also reviewed the histopathologic sizes. Microscopically, all detected adenomas were classified as tubular, tubulovillous, or villous. Advanced adenomas were defined as follows: size of more than 10 mm, presence of a villous component, and presence of high-grade dysplasia.<sup>12,13</sup> All procedures were performed using an adjustable stiffness endoscope (Olympus® CF-H260AL; Olympus, Tokyo, Japan).

### 3. Statistical analysis

Statistical analysis was performed using PASW Statistics-version 18.0 for Windows (IBM Corporation, Armonk, NY, USA). Normally distributed continuous variables are presented as mean ( $\pm$ SD). Categorical variables are presented as total proportions and percentages (n, %). The primary outcome was to determine the factors affecting adenoma detection. Univariable analysis was performed using the chi-squared test for comparison of categorical variables and the unpaired t-test for continuous variables. Variables that were statistically significant in the univariable analysis were subsequently included in a multivariable analysis using the logistic regression model. A p-value of less than 0.05 was considered statistically significant. We also compared differences between staff and fellows using t-tests and Fisher's exact test or chi-squared tests.

The following patient variables were tested: sex, age, BMI,

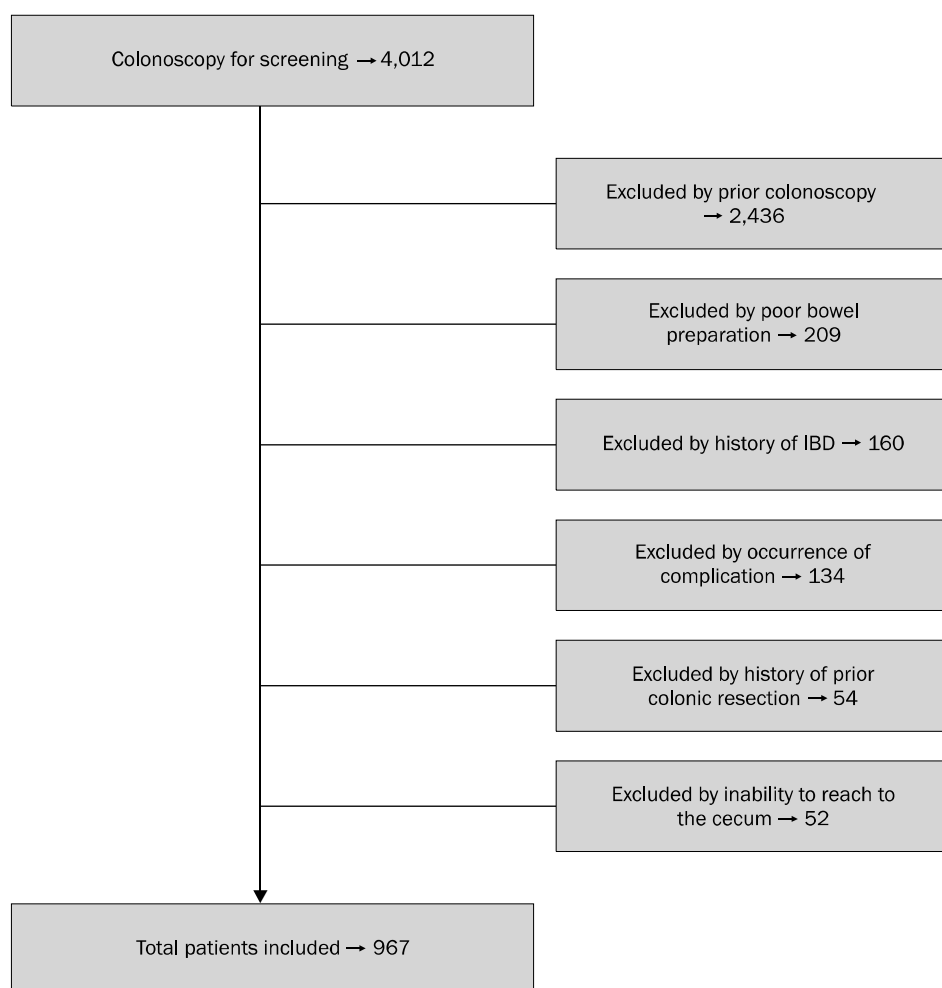
family history of colon cancer, and smoking status. The following colonoscopy variables were tested: bowel preparation, endoscopists, and withdrawal time.

## RESULTS

### 1. Clinical characteristics of patients

Among 4,012 patients initially surveyed, 967 patients (582 men [60.2%], 385 women [39.8%]) met inclusion criteria for screening, as depicted in Fig. 1. The main exclusion criteria were prior colonoscopy or history of colonic polyps (n=2,436).

The mean age of patients was 49.78 years (SD 11.29), and the age range was between 15 and 84 years. The mean BMI ( $\text{kg}/\text{m}^2$ ) was 23.78 (SD 3.10). The frequency of previous abdominal surgery was 17.1%, and 4.6% of the patients had a family history of colon cancer. Bowel preparation presented as excellent (44.2%), good (41.8%), and fair (14.1%). Microscopically, 305 (31.5%) of the 967 patients were diag-



**Fig. 1.** Study enrollment. Listed exclusions include prior colonoscopy, poor bowel preparation, history of inflammatory bowel disease (IBD), occurrence of complication, history of prior colonic resection, and inability to reach the cecum.

nosed with adenoma at biopsy; 69 (7.1%) were advanced adenoma and four (0.4%) were cancer. Experienced staff performed 334 colonoscopies (34.5%) while fellows performed 633 (65.5%). Mean withdrawal time during colonoscopic examination was 10.96 min (SD 5.04).

## 2. Factors affecting adenoma detection

Table 1 shows the univariate analysis of factors influencing adenoma detection. Family history of colon cancer and bowel preparation (more than "fair") were not associated with adenoma detection. Age, gender, BMI, smoking, and endoscopists showed association with adenoma detection ( $p < 0.05$ ). The mean withdrawal time of patients detected with adenoma was 12.7 min (SD 6.2), while that of the undetected group was 10.1 min (SD 4.1) ( $p < 0.001$ ).

## 3. Results of a logistic regression model predicting adenoma detection

Gender and BMI did not show a relative risk of adenoma detection in the logistic regression model. Age greater than 50 years, smoker, staff, and longer withdrawal time were associated with adenoma detection ( $p < 0.05$ ) (Table 2). In particular, age older than 50 years and examination by staff had

a more than two fold relative risk ( $p < 0.001$ ).

## 4. Factors affecting advanced adenoma detection

In univariable analysis, age greater than 50 years (47 [11.5%]/22 [3.9%],  $p < 0.001$ ), male (54 [9.2%]/15 [3.9%],  $p = 0.001$ ), and staff (33 [9.9%]/36 [5.7%],  $p = 0.016$ ) showed association with advanced adenoma detection. In addition, the mean withdrawal time of patients with advanced detection of adenoma was 13.3 min (SD 4.7), while that of the undetected groups was 10.8 min (SD 4.7) ( $p < 0.001$ ).

Logistic regression analysis showed that age greater than 50 years, male gender, staff, and longer withdrawal time were significant independent variables associated with advanced adenoma detection, as depicted in Table 2.

## 5. Comparison between staff and fellows

Table 3 shows the differences between staff and fellows. The mean withdrawal time of the colonoscope differed significantly between staff (8.24 min) and fellows (12.4 min) (Fig. 2). In particular, ADR and advanced ADR of the staff were higher than those of the fellows (ADR 35.6% vs. 29.4%,  $p < 0.05$ ; advanced ADR 9.9% vs. 5.7%,  $p < 0.05$ ).

Withdrawal time and ADR according to the endoscopists are

**Table 1.** Variables Influencing Adenoma Detection

Variable	Procedures with adenoma detection, n (%)	OR (95% CI)	p-value
Age (yr, $\leq 50 / > 50$ )	127 (22.8)/178 (43.5)	2.63 (1.99-3.48)	$< 0.001$
Male/female	207 (35.6)/98 (25.5)	1.62 (1.22-2.16)	0.01
BMI ( $\text{kg}/\text{m}^2$ , $< 25 / \geq 25$ )	182 (28.4)/123 (37.7)	1.53 (1.15-2.03)	0.003
Family history of colon cancer			
Present/absent	14 (31.8)/291 (31.6)	1.009 (0.53-1.93)	0.979
Bowel preparation			
Excellent	122 (28.6)	1.16 (0.76-1.76)	0.497
Good	140 (34.7)	1.33 (0.99-1.78)	0.060
Fair	43 (31.6)		0.170
Smoker/nonsmoker	103 (36.8)/202 (29.4)	1.39 (1.04-1.86)	0.025
Staff/fellow	119 (35.6)/186 (29.4)	1.32 (1.00-1.75)	0.047

**Table 2.** Results of a Logistic Regression Model Predicting Adenoma Detection and Advanced Adenoma Detection

Variable	Adenoma		Advanced adenoma	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Male	1.34 (0.95-1.89)	0.099	2.62 (1.44-4.77)	0.002
Age $\geq 50$ yr	2.31 (1.71-3.13)	$< 0.001$	2.80 (1.63-4.81)	$< 0.001$
BMI $\geq 25 \text{ kg}/\text{m}^2$	1.32 (0.97-1.80)	0.075		
Smoker	1.44 (1.00-2.06)	0.047		
Staff	2.41 (1.70-3.43)	$< 0.001$	2.55 (1.47-4.45)	0.001
Withdrawal time	1.14 (1.10-1.19)	$< 0.001$	1.08 (1.03-1.12)	$< 0.001$

**Table 3.** Comparison of Study Factors by Staff vs. Fellows

	Staff	Fellow	p-value
No. of colonoscopies	334 (34.5)	633 (65.5)	
Gender (male)	190 (56.9)	392 (61.9)	0.128
Age (yr)	50.80±12.88	49.24±10.33	0.056
BMI (kg/m <sup>2</sup> )	23.41±3.18	23.97±3.04	0.007
< 25	234 (70.1)	407 (64.3)	0.071
≥ 25	100 (29.9)	226 (35.7)	0.013
History of abdominal surgery	67 (20.1)	98 (15.5)	0.072
Family history of colon cancer	15 (4.5)	29 (4.6)	0.937
Smoker	80 (24.0)	200 (31.6)	0.076
Bowel preparation			0.174
Excellent	161 (48.2)	266 (42.0)	
Good	131 (39.2)	273 (43.1)	
Fair	42 (12.6)	94 (14.8)	
Withdrawal time (min)	8.24±4.13	12.40±4.89	< 0.001
Adenoma detection rate	119 (35.6)	186 (29.4)	0.047
Advanced adenoma detection rate	33 (9.9)	36 (5.7)	0.016

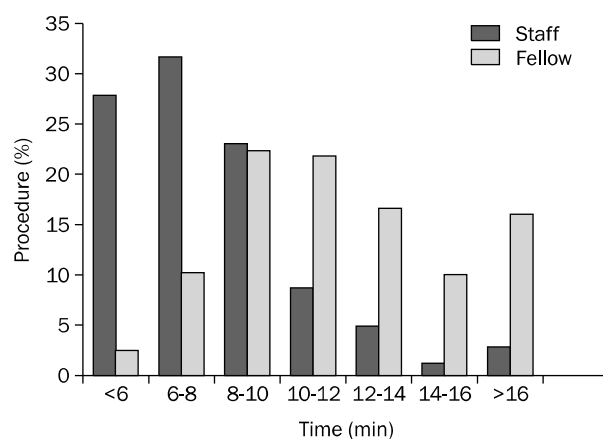
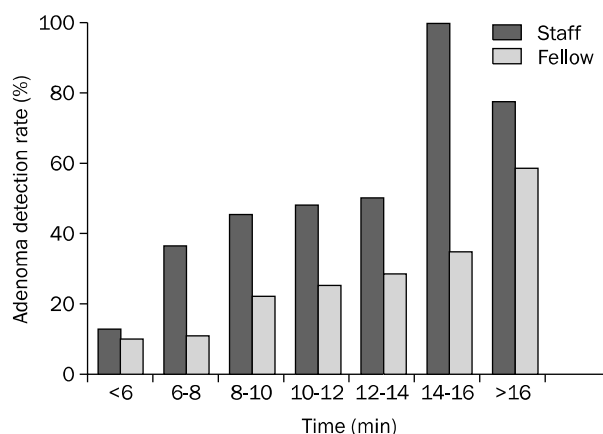
Values are presented as n (%) or mean±SD.

shown in Figs. 2 and 3. Even though the withdrawal time of staff was shorter than that of fellows, ADRs were higher for staff.

## DISCUSSION

Use of colonoscopy has become accepted as the most effective method of screening the colon in average-risk patients because colonoscopy and polypectomy have effectively reduced the incidence of colorectal cancer.<sup>2,15</sup> Subsequently, the ADR has become the most widely used surrogate for measurement of colonoscopy quality.<sup>4,5,16</sup> Higher ADRs have been associated with decreased risk of interval colorectal cancer after screening colonoscopy.<sup>12</sup> Colonoscopy is a technically demanding procedure requiring considerable training and experience for optimal performance. Along with patient-related factors such as age and sex, factors related to the individual endoscopist also have an impact on ADRs.<sup>7,8,17,18</sup>

In large-scale studies, greater rates of adenoma detection have been reported among endoscopists who had longer mean times for withdrawal of the colonoscope.<sup>7,10</sup> However, in our study, we found shorter withdrawal times and higher ADRs for experienced staff than fellows, suggesting that the withdrawal technique of individual colonoscopists is also an important indicator in the quality improvement process for colonoscopy. Recent studies have indicated that there are large disparities between endoscopists in their rates of detection of adenomas

**Fig. 2.** Withdrawal time according to endoscopists.**Fig. 3.** Adenoma detection rate according to endoscopist, stratified by withdrawal time.

and that ADRs may be related to the procedural technique used during withdrawal of the colonoscope.<sup>8,13,19,20</sup> We suggest that the colonoscopic technique and precision of observation influence the shorter withdrawal time and higher ADRs by staff.

In addition, advanced ADR was significantly higher for staff than for fellows. Patients with an advanced adenoma have an increased risk of advanced neoplasia at follow-up or during surveillance colonoscopy compared to those with no neoplasia or small (< 10 mm) adenomas.<sup>12</sup> This is reflected in the standard recommendation for shortened surveillance intervals for patients with prior advanced adenomas compared to those with adenomas lacking advanced features.<sup>21</sup> There is a clinical concern that inexperienced colonoscopists may miss large, advanced polyps further along in the dysplastic progression pathway to colorectal cancer than experienced colonoscopists. Therefore, our study suggests a need for a skill training program on colonoscopic examination.

In addition, our study also demonstrated high ADRs associated with older age, smoking, prolonged withdrawal time, and experienced staff. These data are not surprising as previous studies have reported correlation of the incidence of adenomas with increased age and smoking.<sup>22,23</sup>

Our trial results may be limited due to the large number of patients who were excluded because of the narrow inclusion window. It could cause bias, but our cohort is what would be considered an average risk for colorectal cancer and ideal colonoscopy conditions.

In conclusion, ADRs and advanced ADRs were significantly lower when colonoscopy was performed by trainees, although withdrawal times were longer than those of experienced examiners. Accordingly, our results demonstrated that the quality of colonoscopy, as measured by ADRs, may be improved by use of experienced examiners.

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