ORIGINAL ARTICLE

Factors Related to Incomplete Flexible Sigmoidoscopy Among Adult Chinese in Taiwan

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Background: Sigmoidoscopy is effective in colorectal cancer screening, but incomplete examinations may overlook colonic pathologies and delay diagnosis. This study aimed to explore risk factors for incomplete insertions of flexible sigmoidoscopy among Taiwanese.

Methods: Healthy adults participating in health check-up in a tertiary medical center were invited for study. Subjects were recruited when they had fully consented and agreed to participate. Factors related to incomplete insertions of flexible sigmoidoscopy were evaluated and multivariate logistic regression was used to determine independent risk factors. A predictive model was generated by the risk factors identified.

Results: In total, 1,252 subjects (mean age, 53.9 ± 13.1 years; age range, 21–87 years; male/female, 780/472) were enrolled, and 278 (22.2%) incomplete insertions were recorded. Multivariate analysis showed that female gender (odds ratio [OR], 2.06; 95% confidence interval [CI], 1.56–2.73; $p < 0.001$), age ≥ 60 years (OR, 1.68; 95% CI, 1.26–2.23; $p < 0.001$), inadequate bowel preparation (OR, 1.66; 95% CI, 1.21–2.16; $p = 0.001$), history of constipation (OR, 2.43; 95% CI, 1.04–5.69; $p = 0.042$), and body mass index (BMI) < 25 kg/m^2 (OR, 1.41; 95% CI, 1.05–1.89; $p = 0.024$) were all independent risk factors. The probability of incomplete insertion was significantly associated with the sum of the aforementioned risk factors ($p < 0.001$). Compared with subjects with no risk factors, the risks of incomplete insertions increased significantly among subjects bearing 1 risk factor (OR, 2.57; 95% CI, 1.47–4.49; $p = 0.001$), 2 risk factors (OR, 4.41; 95% CI, 2.52–7.39; $p < 0.001$), 3 risk factors (OR, 6.40; 95% CI, 3.56–11.52, $p < 0.001$) and ≥ 4 risk factors (OR, 10.00; 95% CI, 3.89–25.70, $p < 0.001$).

Conclusion: Female sex, age ≥ 60 years, BMI < 25 kg/m^2, history of constipation, and inadequate bowel preparation were independent risk factors for incomplete insertion of flexible sigmoidoscopy. Subjects with multiple risk factors may consider alternative modalities for colonic examination. [*J Chin Med Assoc* 2007;70(9):361–366]

Key Words: colorectal neoplasm, risk factor, sigmoidoscopy

Introduction

Colorectal cancer (CRC), the second most common malignancy in developed countries, may extinguish 500,000 lives in a year.[1] Through detection and treatment of early-stage CRC, the mortality of the disease can be reduced and life expectancy can be prolonged.[2–4] Some CRC lesions may arise from adenomatous polyps, and the incidence of CRC may be reduced if these polyps are removed sufficiently.[5] Currently, flexible sigmoidoscopy (FS) has been shown to be a safe and cost-effective screening tool for CRC.[6–11] About 80% of advanced colonic neoplasms can be identified by colonoscopy, following identification of an adenoma of any size by FS if it reaches the splenic flexure.[12] However, incomplete FS examination may result in a

3-fold reduction of detecting distal CRC, and 31.9% of advanced colonic neoplasms may be missed if FS does not reach the descending colon.[13]

Apart from its documented safety and effectiveness, FS is undoubtedly an invasive procedure. Therefore, incomplete FS insertion should be avoided whenever possible to avoid inadequate diagnosis of colonic pathologies. Previous studies disclosed that female sex, older age, history of pelvic or abdominal surgery, and poor bowel preparation are independent risk factors of incomplete FS insertion,[13–18] but similar studies are lacking in Taiwan. The purpose of this study was to explore the risk factors for incomplete FS insertions in Taiwan and aid clinicians to reduce the incomplete FS insertion rate in the future.

Methods

Between December 2004 and March 2006, subjects who participated in the self-paid health check-up at Kaohsiung Veterans General Hospital, Taiwan, were invited for study and were recruited when they gave full consent. Participants were prepared and ate only lightly in the 2 days before the procedure as well as on the day of examination. After lunch, a nurse performed an enema (Laitest 125 cc/bottle, Taiwan Stanch Co. Ltd.) for each participant 1 hour before the sigmoidoscopic examination. No sedative or analgesic agent was given except topical lubricant containing 2% xylocaine. Digital rectal examination was performed before the procedure. A repeat enema was performed when retained stool was noted and the participants agreed.

Complete history-taking and physical examinations were performed for every subject. Constipation was defined as < 3 bowel movements per week.[19] Tobacco smoking was defined as smoking everyday. Habitual consumption of alcohol, coffee and tea were defined as when subjects drank those twice or more per week in the recent half year. Body mass index (BMI) was calculated, and obesity was classified as non-obesity (BMI $< 25\,kg/m^2$) and obesity (BMI $\geq 25\,kg/m^2$).[20] Four qualified gastroenterologists performed all examinations with a 60-cm Olympus video sigmoidoscope. Maximum depth of scope insertion was recorded, and an insertion longer than 50 cm above the anal verge or the scope reaching the splenic flexure was defined as a complete FS insertion.[6,13] On the other hand, reasons for incomplete insertion (e.g. intolerance, acute angulation, or poor bowel preparation) were carefully evaluated when it occurred. Sufficient quality of bowel preparation, which was evaluated by the examiners, was defined as the ability to visualize 90% of the surface area of the bowel up to the depth of scope insertion.[14]

Data of continuous variables in the text and tables are expressed as mean ± standard deviation (SD). Serial comparisons were performed by Student's t test, χ^2 test, and Fisher's exact test when appropriate. Multivariate logistic regression model was used to evaluate independent factors for incomplete FS insertion. Logistic regression was also used to detect any significant difference in the risk for incomplete FS insertion among the subjects with 1, 2, 3 and ≥ 4 risk factors compared with no risk factors, respectively. For all tests, statistical significance was defined as $p < 0.05$ (2-tailed test). SPSS version 12.0 software (SPSS Inc., Chicago, IL, USA) was used to perform all statistical analyses.

Results

In total, 1,252 subjects (mean age, 53.9 ± 13.1 years; age range, 21–87 years; male/female, 780/472) participated in this study, and 278 (22.2%) of them did not complete the FS insertions (Table 1). The most common causes for incomplete FS insertion were intolerance (55.8%) and inadequate bowel preparation (36.7%). Univariate analysis showed that females, older age, lower BMI, constipation and previous history of pelvic or abdominal surgery were significantly associated with incomplete FS insertions, whereas tobacco smoking, alcohol consumption and tea drinking were inversely related to incomplete FS insertions (Tables 1 and 2).

By using stepwise multivariate logistic regression, we found that female gender (OR, 2.06; 95% CI, 1.56–2.73; $p < 0.001$), age ≥ 60 years (OR, 1.68; 95% CI, 1.26–2.23; $p < 0.001$), inadequate bowel preparation (OR, 1.66; 95% CI, 1.21–2.16; $p = 0.001$), history of constipation (OR, 2.43; 95% CI, 1.04–5.69; $p = 0.042$), and non-obesity (BMI $< 25\,kg/m^2$) (OR, 1.41; 95% CI, 1.05–1.89; $p = 0.024$) were all independent risk factors for incomplete FS insertions (Table 3). Moreover, the sum of the aforementioned independent risk factors was significantly associated with higher probability for incomplete FS insertions ($p < 0.001$). Compared with subjects with 0 risk factors, the risks of incomplete insertions increased significantly among subjects bearing 1 risk factor (OR, 2.57; 95% CI, 1.47–4.49; $p = 0.001$), 2 risk factors (OR, 4.41; 95% CI, 2.52–7.39; $p < 0.001$), 3 risk factors (OR, 6.40; 95% CI, 3.56–11.52; $p < 0.001$), and ≥ 4 risk factors (OR, 10.00; 95% CI, 3.89–25.70; $p < 0.001$) (Table 4).

Table 1. Univariate analysis of patients' demographic characteristics and their incomplete flexible sigmoidoscopies

	Total subjects (N = 1,252) n (%)	FS insertion Complete (n = 974) n (%)	FS insertion Incomplete (n = 278) n (%)	p
Gender				< 0.001
Male	780 (62.3)	644 (82.6)	136 (17.4)	
Female	472 (37.7)	330 (69.9)	142 (30.1)	
Age (yr)				0.001
≥ 60	389 (31.1)	279 (71.7)	110 (28.3)	
< 60	863 (68.9)	695 (80.5)	168 (19.5)	
BMI (kg/m^2)				0.006
≥ 25	471 (37.6)	386 (82.0)	85 (18.0)	
< 25	781 (62.4)	588 (75.3)	193 (24.7)	
History of constipation				0.013
No	1,213 (98.1)	950 (78.3)	263 (21.7)	
Yes	23 (1.9)	13 (56.5)	10 (43.5)	
Previous pelvic or abdominal surgery				0.002
No	1,183 (94.5)	931 (78.7)	252 (21.3)	
Yes	69 (5.5)	43 (62.3)	26 (37.7)	
Peptic ulcer disease				0.265
No	1,073 (85.7)	82.9 (77.3)	244 (22.7)	
Yes	179 (14.3)	145 (81.0)	34 (19.0)	
Diabetes mellitus				0.714
No	1,168 (93.3)	910 (77.9)	258 (22.1)	
Yes	84 (6.7)	64 (76.2)	20 (23.8)	
Hypertension				0.387
No	1,022 (81.6)	800 (78.3)	222 (21.7)	
Yes	230 (18.4)	174 (75.7)	56 (24.3)	

FS = flexible sigmoidoscopy; BMI = body mass index.

Discussion

FS has been shown to be a safe and cost-effective screening tool for CRC, and it can reduce the incidence and mortality of CRC. Seventy-five percent of colonic malignancies are located in the rectum and distal colon and can be detected by FS examinations. FS examinations have lower cost and cause less risk and inconvenience among subjects who receive physical check-up to detect colonic pathology than colonoscopy.[3,21] In contrast, colonoscopic examination requires preparation of the bowel using laxatives with or without enemas or large volumes of an oral cathartic solution, and patients need to undergo bowel preparation by taking clear liquid diet the day prior to the procedure.[22,23] Moreover, patients usually receive intravenous sedation during colonoscopic examinations in Western countries, and not all colonoscopic examinations can visualize the entire colon smoothly.[24]

Risk factors related to incomplete FS insertions have been reported before, but a similar study in a Chinese population was lacking. This study found that normal or underweight was an independent risk factor for incomplete screening FS insertions. Similar finding has been reported in colonoscopic examinations,[19,25] but not in FS examinations. It has been proposed that visceral adiposity tends to blunt the acute angulation of the colon in the left lower quadrant, which allows easier passage of the endoscope.[26,27] These observations also help to explain our findings. Other risk factors identified in this study, such as female sex, older age and inadequate bowel preparation had been identified in previous reports.[13–18] Although history of constipation was found to be an independent

Table 2. Univariate analysis of patients' external factors and their incomplete flexible sigmoidoscopies

	Total subjects (N = 1,252) n (%)	FS insertion		p
		Complete (n = 974) n (%)	Incomplete (n = 278) n (%)	
Tobacco smoking				0.018
No	975 (77.9)	744 (76.3)	231 (23.7)	
Yes	277 (22.1)	230 (83.0)	47 (17.0)	
Alcohol consumption				0.041
No	941 (75.2)	719 (76.4)	222 (23.6)	
Yes	311 (24.8)	255 (82.0)	56 (18.0)	
Coffee consumption				0.352
No	937 (74.8)	723 (77.2)	214 (22.8)	
Yes	315 (25.2)	251 (79.7)	64 (20.3)	
Tea consumption				0.013
No	656 (52.4)	492 (75.0)	164 (25.0)	
Yes	596 (47.6)	482 (80.9)	114 (19.1)	
Habitual exercise				0.361
No	754 (60.2)	580 (76.9)	174 (23.1)	
Yes	498 (39.8)	394 (79.1)	104 (20.9)	
Recent laxative use				0.240
No	1,172 (93.6)	916 (78.2)	256 (21.8)	
Yes	80 (6.4)	58 (72.5)	22 (27.5)	
Oral laxatives 1 day before exam				0.504
No	1,243 (99.3)	965 (77.6)	278 (22.4)	
Yes	9 (0.7)	9 (100)	0 (0)	
Light diet for 2 days				0.314
No	1,114 (89.0)	862 (77.4)	252 (22.6)	
Yes	138 (11.0)	112 (81.2)	26 (18.8)	
Bowel preparation				0.004
Adequate	881 (70.4)	725 (80.0)	176 (20.0)	
Inadequate	371 (29.6)	269 (72.5)	102 (27.5)	

FS = flexible sigmoidoscopy.

Table 3. Multivariate logistic regression model of factors predicting incomplete screening flexible sigmoidoscopy

Variable	Coefficient	SE	Adjusted OR	95% CI	p
Female gender	0.72	0.14	2.06	1.56–2.73	< 0.001
Age ≥ 60 yr	0.52	0.15	1.68	1.26–2.23	< 0.001
Non-obesity (BMI < 25 kg/m^2)	0.34	0.15	1.41	1.05–1.89	0.024
History of constipation	0.89	0.44	2.43	1.04–5.69	0.042
Inadequate bowel preparation	0.48	0.15	1.66	1.21–2.16	0.001

SE = standard error; OR = odds ratio; CI = confidence interval; BMI = body mass index.

risk factor in this study, it may be related to inadequate bowel preparation. However, constipation history retained its independence when inadequate bowel preparations were included in the regression model. The association between constipation, incomplete FS insertion, and independence of inadequate bowel preparations deserves further investigation for clarification.

Although identifying risk factors may help to understand the possibilities of incomplete FS insertions, developing a predictive model by the identified risk

Table 4. Logistic regression of the incomplete rate of insertion of sigmoidoscopy for subjects according to the number of risk factors

	Total subjects n (%)	Incomplete FS insertion n (%)	OR	95% CI	p
Number of subjects' risk factors					< 0.001
0	164 (13.3)	13 (7.9)		Reference	
1	383 (31.0)	65 (17.0)	2.57	1.47–4.49	0.001
2	467 (37.8)	114 (24.4)	4.31	2.52–7.39	< 0.001
3	192 (15.5)	68 (35.4)	6.40	3.56–11.52	< 0.001
≥ 4	30 (2.4)	13 (43.3)	10.00	3.89–25.70	< 0.001

FS = flexible sigmoidoscopy; OR = odds ratio; CI = confidence interval.

factors may be more important to clinicians. Subjects with ≥ 4 risk factors were at 10-fold risk for incomplete FS insertion compared to those without any risk factors. In this study, nearly a third of subjects with 3 risk factors did not complete their examinations, and half of subjects with ≥ 4 risk factors failed the FS examinations. Compared with subjects without risk factors, the risks of incomplete FS insertion were around 2-fold, 4-fold, 6-fold and 10-fold among those who had 1, 2, 3 and ≥ 4 risk factors, respectively. This predictive model may provide a quantified risk for a person who is preparing to undergo screening FS examination. An alternative modality, such as barium enema,[28,29] may be recommended for those who are at higher risk for incomplete FS insertion.

There were several limitations in this study. The major one was the unavoidable selection bias that all study subjects were participants for self-paid health check-up. However, it is hardly possible to conduct a population-based randomized controlled trial for such an invasive procedure. Therefore, our findings still provide critical information for clinical practice. Another limitation was the definition of complete FS insertion. Theoretically, the completeness of FS examination should be confirmed by fluoroscopic examination.[30] Instead, this study defined the insertion of scope for longer than the 50 cm marked on the shaft of the sigmoidoscope or the scope reaching the splenic flexure.

In conclusion, female sex, age ≥ 60 years, normal or underweight (BMI < 25 kg/m^2), constipation, and inadequate bowel preparation were all independent risk factors for incomplete FS insertion. The sum of aforementioned risk factors was significantly related to higher probability of incomplete FS insertion.

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