

Does flexible small-diameter colonoscope reduce insertion pain during colonoscopy ?

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Subject headings colonoscopy; abdominal pain; flexible colonoscope; insertion pressure; unfavorable factors; sigmoidoscopy

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Abstract

AIM It is well known that colonoscopy can be difficult due to abdominal pain induced during colonoscope insertion, if sedative agents are not given. Recently, an extra-flexible, small-diameter colonoscope (CF-SV, Olympus Inc., Japan) was developed in order to improve safety and comfort. The aim of this study was to access the usefulness of the CF-SV.

METHODS One hundred patients undergoing sigmoidoscopy were recruited and colonoscopy was performed by one experienced colonoscopist. First, a routine-type colonoscope (CF-230I) was inserted into the colon without sedation. When the patient complained of abdominal pain (even if mild), the scope was not advanced further and was withdrawn after the anatomic location of its tip was determined fluoroscopically. Then, the CF-SV was inserted until it reached the cecum or the site where abdominal pain occurred. Previous abdominal surgery and a abdominal disease were considered as unfavorable factors (UF) and the relationship between abdominal pain and UF, age and gender were investigated. Furthermore, the colonic insertion pressures in 36 patients with abdominal pain were measured with a force gauge.

RESULTS Thirty-four cases (34%) felt no pain with the CF-230I and successful pancolonoscopies to the cecum were performed. Sixty-six cases (66%) complained of abdominal pain. The procedure was painless for 47% of men and 24% of women, respectively. The CF-230I scope failed to reach the sigmoid-descending colon

junctions in 59 (89.4%) of the 66 patients complaining of abdominal pain. However, CF-SV reached proximal area in 94.9% of those who failed with CF-230I. The median pressure for pain-inducing was 700g/cm².

CONCLUSION Unsedated patients with UF were prone to complain of pain when the standard-type CF-230I scope was used. The newly developed extra -flexible CF-SV is useful for the aged and for those with UF or being prone to suffer from abdominal pain. Sedative agents may be unnecessary if this new type of colonoscope is used.

INTRODUCTION

Colonoscopy for patients who have undergone previous abdominal surgery, those with diverticular disease, women as well as the aged is technically difficult, even in expert hands^[1-8], and usually induces abdominal pain if sedative agents are not administered. One way of preventing pain during colonoscopy is to use a scope that is more flexible and thinner than the conventional scopes. It has been reported that success rate of colonoscopy could be significantly improved when a pediatric colonoscope was used instead of routine-type instrument for adults when stricture, fixation or painful looping was encountered^[9]. Kozarek *et al* achieved a similar increase in the success rate by using a small-caliber upper endoscope for colonoscopy in similar circumstance^[10]. In 1997, the softest and most flexible colonoscope (CF-SV, Olympus Inc., and 9.6mm in diameter with a 103cm working length) so far was developed^[11,12]. Moreover, a comparative study showed that fewer unsedated patients felt pain during colonoscopy with the CF-SV than with a conventional colonoscope^[11]. The aim of this self-controlled, prospective study was to evaluate whether less pain is experienced during colonoscopy with the CF-SV than with a routine-type colonoscope.

SUBJECTS AND METHODS

The study was approved by the ethics committee of Hiroasaki University Hospital. One hundred consecutive patients of this hospital undergoing sigmoidoscopy over a 6-week period were recruited. For the purpose of scientific comparison all of the performance of colonoscopy was done exclusively by

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Dr. Uno who has performed over 5000 colonoscopies.

Relationship between insertion pain and unfavorable factors (UF)

Each patient was placed on the X-ray table in the left lateral position. No sedating agent was given, but the anus was treated with xylocaine jelly, and a routine-type colonoscope CF-230I (Figure 1) (Olympus Inc. 13.6mm in diameter with a 130cm working-length) was inserted. As soon as the patient complained of abdominal pain, even it was mild, the colonoscope was advanced no further, the patient was moved to supine position and the anatomic location of the tip of the scope was determined by fluoroscopy. Then, the scope was pulled out and the air in the lumen was let out. The colonoscopist knew nothing about the patients' age, past history of surgery or abdominal diseases considered as UF of the patients until the procedure had been completed.

Re-insertion of CF-SV

The patients who suffered from abdominal pain with CF-230I were checked with CF-SV five minutes after CF-230I was withdrawn. When the patient complained abdominal pain of similar severity as that with CF-230I, the proximal location of the scope tip was confirmed fluoroscopically with the patient in supine position and the procedure was discontinued. If the patient did not complain of pain, insertion of the scope was continued until up to the cecum or the 103cm working length of the shaft had been inserted. Then, the proximal location of the tip was determined fluoroscopically and the procedure was terminated.

Measurement of the pain-inducing pressure during insertion

The first consecutive 36 patients who complained of pain during colonoscopy with CF-230I were investigated. The pain inducing pressure (g/cm^2) initiated by the hand of the colonoscopist was measured with a force gauge, and the relationship between the insertion force and location of the pain was evaluated.

Statistics

All statistical analyses were performed using either Chi-squared test or differences at P values of less than 0.05 were regarded as significant.

RESULTS

Thirty-four patients (34%) were free of abdominal pain during colonoscopy with CF-230I and the scope was inserted up to the cecum. More of these pain-free subjects were male (21 cases, 61.8%) than female (13 cases, 38.2%) (Table 1). There was no significant difference ($P < 0.05$) between the average ages of the males who did not complain of

pain (60.1 years) and those who did (59.0 years), but the average ages of the corresponding female groups (55.4yr. and 60.7yr., respectively) were significantly different ($P < 0.05$), which suggests that aging females may be prone to pain during colonoscopy insertion. There was no significant difference between the average ages of the males and females who did not complain of pain.

Relationship between insertion pain and UF

Eighteen male patients had past histories of surgery or abdominal diseases: seven (38.9%) had undergone appendectomy; 3 (16.7%) had cholecystectomy; 2 (11.1%) of each had gastrectomy, Crohn's disease and ileus; one (5.6%) of each had diverticulitis, cancer of bladder, trauma, and a previous abdominal operation for an unknown reason. One of these patients had two UFs. Seventeen of these 18 patients with UF complained of abdominal pain during colonoscopy.

Thirty-four females had UF: 10 (29.4%) had cancer of the uterus; 8 (23.5%) had undergone appendectomy; 7 (20.6%) had hysterectomy for myoma uteri; 5 (14.7%) had ovarian neoplasms; 3 (8.8%) of each had undergone cholecystectomy and had peritonitis; 2 (5.9%) had carcinoma of the stomach or bladder, and one (2.9%) had ileus. Seven of these 34 patients had 2 of UFs. Thirty-one patients (91.1%) complained of no abdominal pain during colonoscopy with CF-SV. Only one (4.8%) of the 21 males who did not complain of pain had UF (Table 1). Seventeen (70.8%) of the 24 male patients with abdominal pain had UF (Table 1) and 7 (29.2%) did not. Three (23.1%) of the 13 females whose procedures were painless were UF-positive, whereas 31 (73.8%) of the 42 females with abdominal pain were UF-positive (Table 1) and 11 (26.2%) were UF-negative. There was significant difference ($P < 0.05$) between the numbers of UF-positive patients receiving painless and painful colonoscopy.

Reinsertion of CF-SV

The anatomic location of the abdominal pain induced in 61 of the 64 patients with CF-230I was the sigmoid segment. However, in 59 of these 61 (96.7%) the CF-SV was successfully inserted proximal to sigmoid segment without causing abdominal pain (Figure 2). The remaining two patients who complained of abdominal pain during re-insertion of CF-SV were female and very short in stature. Among the 59 patients in whom the CF-230I was failed to pass through the sigmoid-descending colon junction, when re-inserted with CF-SV, it was passed in 56 (94.9%); transverse colon was passed in 30 (49.2%) and the ascending colon was reached in 14 (23.7%). Only one man (8.3%) and 6 women (17.6%) complained of abdominal pain with CF-SV, which was not inserted beyond the descending colon.

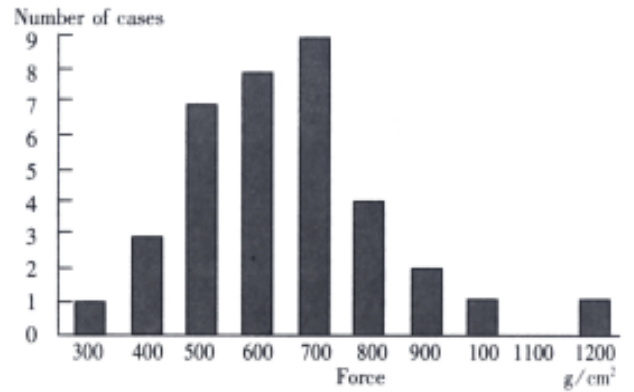


Figure 1 The standard colonoscope (CF-230 I) is shown on the top, the CF-SV is on the bottom.
Figure 3 The pressure associated with insertion-induced abdominal pain during colonoscopy.

	Anatomic depth of penetration							Age	Unfavorable factor
	Rectum	Recto-sigmoid junction	Sigmoid colon	Sigmoid-descending junction	Descending colon	Transverse colon	Ascending colon		
Female	▲	●						36	Uterus cancer (Hysterectomy and Radiation)
	▲	●						75	Gastrectomy
	▲							69	Uterus cancer (Hysterectomy)
	▲							68	Uterus cancer (Hysterectomy and Radiation)
	▲							68	Myoma uteri (Hysterectomy) and colectomy
	▲							63	Uterus cancer (Hysterectomy)
	▲							68	Visical cancer
	▲							40	Uterus cancer (Hysterectomy)
	▲							77	Uterus cancer
	▲							85	Uterus cancer and peritonitis
	▲							65	Cholecystectomy
	▲							66	Ovarian cancer
	▲							56	None
	▲							66	None
	▲							75	Peritonitis
	▲							36	Uterus cancer (Hysterectomy and Radiation)
	▲							44	Myoma uteri (Hysterectomy)
	▲							59	None
	▲							23	Appendectomy
	▲							75	Cholecystectomy
	▲							72	Myoma uteri (Hysterectomy)
	▲							35	Ovarian tumor
	▲							85	None
	▲							50	Myoma uteri (Hysterectomy)
	▲							54	None
	▲							44	None
	▲							48	Advanced gastric cancer
	▲							51	Myoma uteri (Hysterectomy) and appendectomy
▲							59	Appendectomy	
▲							62	Myoma uteri (Hysterectomy) and appendectomy	
▲							64	Myoma uteri (Hysterectomy)	
▲							66	Uterus cancer (Hysterectomy)	
▲							68	None	
▲							44	None	
▲							72	Ovarian cancer	
▲							72	Appendectomy	
▲							50	None	
▲							68	Ovarian tumor	
▲							75	Vesical cancer	
▲							65	None	
▲							44	None	
▲							65	None	
Male	▲	●						74	Cholecystectomy and ileus
	▲							61	Appendectomy
	▲							70	Laparotomy (ileus)
	▲							45	Appendectomy
	▲							58	Appendectomy
	▲							61	Diverticulitis
	▲							65	Gastrectomy
	▲							74	Cholecystectomy
	▲							52	None
	▲							58	None
	▲							60	Appendectomy
	▲							72	Gastrectomy
	▲							77	None
	▲							18	Crohn's disease
	▲							60	Appendectomy
	▲							65	Cholecystectomy
▲							75	None	
▲							48	None	
▲							57	Traumatic injury	
▲							75	Visical cancer	
▲							24	Crohn's disease	
▲							61	None	
▲							53	Appendectomy	
▲							52	None	

Figure 2 Anatomic depths of penetration of both colonoscopes, gender, patients' ages and unfavorable factors (UF).
 ▲: The location of insertion-induced abdominal pain with CF-230 I; ●: The location of insertion-induced abdominal pain with CF-SV; ○: Proximal area reached when re-inserted with CF-SV.

Table 1 Relationship between insertion-induced pain, gender, age and UF

	Insertion induced pain	Number of cases	Age (year) $\bar{x}\pm s$	UF-positive	
				No.	%
Male	Negative	21	60.1±11.2	1	4.8
	Positive	24	59.0±14.8	17	70.8
Female	Negative	13	55.4±11.2	3	23.1
	Positive	42	60.7±13.9	31	73.8

Measurement of the pain-inducing pressure during insertion of colonoscope

The pain-inducing pressure during insertion ranged from 300 to 1200g/cm² (Figure 3) and the median was 700g/cm². In 24 of 36 patients (66.7%), the range was 500-700g/cm². Only one patient, a 56-year old woman with a history of hysterectomy and abdominal radiation therapy complained of a abdominal pain even when the insertion pressure was as low as 300g/cm², and the anatomic location of the pain was around the upper rectum with the CF-230I and the rectosigmoid junction with CF-SV. Abdominal pain was induced at a pressure of 400g/cm² only in three females: one is a 35-year-old young lady suffering from a giant ovarian tumor; the other two patients, even the CF-SV scope could not be advanced to the proximal segment (the reason remains unknown). Two patients, both were 61 years old male, did not complain of abdominal pain even when the pressure exceeded up to 1000g/cm². Interestingly, one of them was UF-negative, but the other had undergone appendectomy previously.

DISCUSSION

The Japanese Society of Gastrointestinal Endoscopy has investigated, by carrying out questionnaire surveys, and reported the incidence of complications during endoscopy every 5 years since 1983. According to their data, from 1983 to 1992, the estimated incidence of colonic perforation during diagnostic and therapeutic colonoscopy was 0.04%^[13], which is far lower than that in other countries^[14-16]. However, the incidence did not change during this period which means that if the number of colonoscopic examination increases, the absolute number of cases of perforation will inevitably goes up. In Japan, the number of colonoscopies performed each year has been estimated to be over three millions. Therefore, over 600 perforation will occur per year, 1-2 cases per day^[17]. If perforation can be prevented, colonoscopy will be performed far more frequently.

When the tip or bend of a colonoscope presses hard against the colonic mucosa, a seromuscular tear will probably occur, even when there is no muscularis injury^[18], and clinically, more damage occurs before the symptoms of perforation appear. In order to avoid such injuries, it is very important

that colonoscopists undergo special training to improve their skill. The problem of perforation might be resolved if the procedure is easy to perform and independent of experience and/or expertise.

In 1957, the "sigmoid camera" was developed in our institution (Hirosak University, Japan)^[19,20]. Examined with camera, it was not necessary to use sedation. Since then, colonoscopy without sedation had been performed till several years ago. In order to minimize abdominal pain during colonoscope insertion, the loop maneuver technique was introduced^[21]. However, in some patients with UF, although the maneuver was performed, the scope could not be inserted more proximally because of severe insertion-induced abdominal pain. Therefore, no wadays, in our institution, there are two indications for colonoscopy under sedation: when a patient complains of severe insertion-induced abdominal pain during the procedure; the patient prefers to be sedated.

In Japan, based on extensive experience, "Abdominal pain is a signal for some dangerous conditions" has become one of the most important precepts. In our study, the pressure to induce insertion-related abdominal pain was not higher than 1200g/cm². An *in vitro* experiment on perforation of the human colon^[18] showed that perforation occurred when the pressure reached up to 2-3kg/cm². Therefore, the precept of our institution is true. Recently, colonoscopy without sedation and with selective sedation has been investigated in institutes in which colonoscopy under sedation used to be a routine procedure^[22-24]. Furthermore, the cost and complications may be reduced when colonoscopy is performed without sedation. According to Rex^[25], the success rate of unsedated colonoscopy has uniformly been reported to be high in a small number of American reports, although the patients appear to have been selected. For example, in one study, attempted unsedated colonoscopy only in volunteers consisting of about 30% of consecutive patients undergoing colonoscopy. In another study, colonoscopy was performed in consecutive male veterans.

In Japan, colonoscopy without sedation has also been reported but the subjects were young males undergoing a health check-up and did not include elderly subjects or those with UF. In fact, we found that abdominal pain during colonoscope insertion usually occurred in patients who were elderly or UF-positive. The sigmoid colon was the area where pain occurred in most of the subjects undergoing colonoscopy without sedation^[26]. In patients who are very young, very old, have diverticular disease, a fixed colon due to previous abdominal surgery, underwent previous pelvic radiation, have ovarian neoplasms as well as other kinds of abdominal

pathological disorders, colonoscope advancement to the transverse colon was difficult because of making loops re-form in the sigmoid colon. This problem might be solved by introducing a stiff wire into the instrument channel to stiffen the colonoscope after it has been straightened^[27,28]. Recently, a new type of colonoscope with a shaft of variable stiffness has been developed^[29].

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