Technical Competency in Flexible Sigmoidoscopy

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Background: **Family practice residencies offer training in flexible sigmoidoscopy; however, there are no objective recommendations for determining competency in learners. We describe a longitudinal study designed to determine the mean procedure time and depth of insertion for family practice residents.**

Methods: **During a 21-month period, data were collected for 421 patients undergoing flexible sigmoidoscopy. Second- or third-year family medicine residents supervised by family medicine faculty did all procedures. The data were analyzed with simple descriptive statistics, *t* test, and linear and logistic regression.**

Results: **The mean procedure time was 18 ± 9.3 minutes (17.2 – 19.6, 95% confidence interval [CI]). The mean insertion depth was 51.4 ± 12.4 cm (50.4 – 52.6 cm, 95% CI). Performing a biopsy was associated with an increase in procedure time (17.0 vs 27.3 minutes, $P < .0001$). Women with a history of pelvic surgery had less depth of insertion than did those who had no history of pelvic surgery (47 vs 53 cm, $P = .002$, *t* test).**

Conclusion: **Procedural competency consists of knowledge, technical skills, and attitudes. Knowledge and attitudes can be assessed with other items, such as examinations and observation. Primary care faculty can now use these standards of insertion depth and procedure time when determining technical skill proficiency for their residents in flexible sigmoidoscopy. (J Am Board Fam Pract 2001;14: 424–9.)**

Colon cancer is one of the most frequently diagnosed malignant neoplasms in the world.[1] The annual incidence in the United States is more than 150,000 with a 5-year survival rate of approximately 40%, accounting for 60,000 deaths annually.[2] Flexible sigmoidoscopy has been recommended by national health organizations as a screening tool for colon cancer.[3–5] This procedure is also an integral part of the evaluation of a variety of disorders including unexplained abdominal pain, rectal bleeding, alteration in bowel habits, and stools positive for occult blood.[6,7] Primary care providers perform approximately 500 of these procedures annually at both Madigan Army Medical Center and Bremerton Naval Hospital.

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Family practice training programs frequently offer training in this procedure.[8,9] There are no recommendations, however, based on objective data for determining competency in the learners.[10,11] Furthermore, there is considerable variation in the literature regarding the mean time of procedure, ranging from 5 minutes to nearly 20 minutes.[6,12–14] The maximum average depth of insertion ranges also from 30 cm to more than 50 cm.[9,11,15,16] In the absence of clear-cut recommendations for assessing competency, training programs have relied on a certain number of supervised procedures to provide enough experience to become competent. These numbers range from 15 to 25.[9,11,14] A more objective measure of competency, such as the average procedural time and the average depth of insertion, could provide a better assessment of the learners.

Although the goal of each examination is to evaluate a full 60 cm to 70 cm of the descending and rectosigmoid colon, several factors can prevent a complete examination from occurring. Factors that contribute to the depth of insertion and time of examination, other than level of experience, have not been delineated well.[11] In one study, patients with previous abdominal surgery had a lower rate of complete examination.[17] Other factors that can affect the performance of the procedure include

sex, history of gynecologic surgery, history of prostatic surgery, history of inflammatory bowel disease, and age. In one study, flexible sigmoidoscopic examinations on women tended to have a decreased depth of insertion (average 40 cm) and cause more discomfort. It has also been shown that women often have a more acute angle at the junction of the rectum and sigmoid colon that can make passage more difficult.[18] The effects, if any, of these factors on insertion depth and time of procedure should also be assessed.

The complication rate can affect providers' competency and alter the procedure time and depth of insertion. Mucosal biopsy during flexible sigmoidoscopy can add considerable time to the procedure. Providers who encounter suspicious lesions more frequently can have longer average procedure times. The effects of these variables on procedure time and depth must also be considered.

We describe a longitudinal study designed to determine the mean procedure time and depth of insertion for family practice residents. The effects of provider level of training, patient medical and surgical history, complications, and mucosal biopsy on these variables are evaluated.

Methods

From March 1996 until September 1998 the family practice clinic at Naval Hospital, Bremerton, performed 486 consecutive flexible sigmoidoscopic examinations. Second- and third-year residents in family medicine performed the procedures under the supervision of a credentialed family practice faculty physician. A family physician faculty member was present in the room for all procedures. The following data were collected: age, sex, ethnic status, provider level of training, time of procedure, depth of insertion, indication for procedure, complications, reason for termination, performance of a biopsy, and patient medical and surgical histories. Depth of insertion was determined as the maximal unassisted depth obtained by the resident. Faculty were allowed to give verbal instructions only. Residents began withdrawal when they reached the maximum depth allowed by the sigmoidoscope, if they were unable to continue inserting the sigmoidoscope after verbal instruction by the faculty, if the patient reported intolerable discomfort, or if the patient requested the procedure be terminated.

Forty-eight patients had incomplete data collected and were excluded from the study. Seventeen patients had their procedures performed by family practice staff and were also excluded. The data for the remaining 421 patients were entered into a database. Sixteen residents were responsible for more than 80% of procedures. All procedures were performed with an Olympus 65-cm or 75-cm flexible video sigmoidoscope. The patient preparation consisted of an enema the night before the procedure and a second enema the morning of the sigmoidoscopy. The time of procedure was measured using a digital timer from scope insertion until removal. The depth of insertion was measured using a disposable tape measure. The distance from the anal verge to the end of the sigmoidoscope was measured and subtracted from 65 cm to calculate insertion depth. The data were analyzed with simple descriptive statistics, *t* test, and linear and logistic regression using SPSS for Windows 7.5 (SPSS Inc, Chicago).

Table 1. Demographic Data of 421 Patients Undergoing Flexible Sigmoidoscopy.

Characteristics	Value
Mean age, years	58.3 ± 13.4
Age range, years	14–88
Male, %	56
White, %	87
No notable medical-surgical history, %	69
Routine screening, %	75

Results

The mean procedure time was 18 ± 9.3 minutes (17.2 – 19.6 minutes, 95% confidence interval [CI]). The mean insertion depth was 51.4 ± 12.4 cm (50.4 – 52.6 cm, 95% CI). The demographic data are displayed in Table 1. Ten percent of patients underwent mucosal biopsy. No complications were noted. Achieving the maximum possible insertion depth was the most common reason for terminating the procedure (69%), with patient discomfort (20%) and inadequate bowel preparation (11%) accounting for the remainder.

In assessing variables that might account for changes in time of procedure, performing a biopsy was significantly associated with an increase in procedure time (17.0 vs 27.3 minutes, $P < .0001$, *t* test). Other variables that did not seem to affect procedure time include provider level of training, sex, age, ethnic status, indication for procedure, or

Table 2. Linear Regression Model with Procedure Time as Dependent Variable.

Independent Variable	Beta	Standard Error	*P* Value	95% CI
Constant	11.90	3.7	.001	4.7–19.2
Age	0.08	0.06	.174	−0.034–0.187
Sex	−0.16	1.3	.905	−2.7–2.5
Third-year resident	1.40	1.5	.345	−1.5–4.3
History of pelvic surgery	1.96	1.8	.289	−1.6–5.6
Biopsy performed	9.60	2.1	<.0001	5.6–13.6

Adjusted R^2 change = 0.049, $P < .0001$.
CI—confidence interval.

reason for termination. To control for possible confounding effects of the variables, linear regression analysis was performed with procedure time as the dependent variable and the previous variables listed as dependent variables. The results of one of the models are shown in Table 2. When controlling for all other variables, performance of a biopsy was the only statistically significant variable affecting procedure time for any of the models constructed.

Women with a history of pelvic surgery had less depth of insertion than those who did not have a history of pelvic surgery (47 vs 53 cm, $P = .002$, t test). Logistic regression analyses were performed to assess the effects of other variables on achieving a full sigmoidoscopic examination (≥ 55 cm). The result for one model is shown in Table 3. For all models, a history of pelvic surgery was associated with lower odds of achieving a complete examination. Performing a biopsy was associated with higher odds of achieving a complete examination.

Table 3. Logistic Regression Model with Insertion Depth as Dependent Variable.

Independent Variable	Odds Ratio	CI	*P* Value
Second-year resident	0.91	–	.82
Third-year resident	0.91	–	.80
Age	1.00	–	.68
Biopsy	2.80	2.3–3.2	.01
Sex	0.93	–	.78
History of abdominal surgery	1.23	–	.52
History of pelvic surgery	0.37	0.29–0.45	.002
History of irritable bowel syndrome	1.20	–	.88
History of inflammatory bowel disease	0.003	–	.67

CI—confidence interval.

Discussion

Screening for colorectal cancer has been both advocated and questioned. The American Cancer Society, National Cancer Institute, and the American College of Physicians recommend population screening with flexible sigmoidoscopy.[19,20] The United States Preventive Services Task Force recommends colorectal cancer screening for all persons older than 50 years ("B" recommendation). There is insufficient evidence, however, to recommend fecal occult blood testing or sigmoidoscopy as the best method for screening.[21] Many primary care clinicians are performing screening and diagnostic flexible sigmoidoscopy while acknowledging the uncertainty. Determining standards relating to the flexible sigmoidoscopic examination can help primary care faculty evaluate the performance of their learners during their training period. An evaluation process that is more objective can assist faculty to recognize which learners are in need of increased education and instruction and allow for adequate remediation. Objective standards can also single out those learners who, after adequate education and instruction, should not be allowed to perform independently.

This study, with a large number of patient encounters, corroborates previous studies that document a mean procedure time of 16 to 19 minutes. The mean insertion depth in previous publications ranges from 35 cm to 52 cm. These results are consistent with the upper range of earlier studies.[8,13,16,22,23]

Time of procedure in studies is remarkably consistent. The previous studies did not indicate the percentage of procedures in which a biopsy was performed. Our study shows 10% of procedures had biopsies performed, and a substantial increase in the time of procedure when a biopsy was per-

formed. Regression analysis shows performance of a biopsy to be a statistically significant contributor to time of procedure after controlling for resident level of training and patient demographics. Accounting for the increased time of procedure when a biopsy is performed might alter considerably the average time of procedure. The average time is also influenced by the number of procedures with a biopsy performed. For our sample, the mean time of procedure decreases from 18 to 17 minutes when procedures with a biopsy are excluded. Other practice locations that perform more biopsies might have greater changes in procedure time when flexible sigmoidoscopies with biopsy are excluded.

The maximum unassisted insertion depth reported ranges widely from 35 cm to 52 cm. This range could be explained by differences in patient population. Our data indicate a statistically significant decreased insertion depth for women who have had a history of pelvic surgery, even when controlling for other important variables. The only other study to document a difference in insertion depth by patient factors showed a difference in women that have had any type of abdominal surgery.[16] We subdivided surgery into abdominal and pelvic. Pelvic surgery consisted of any type of surgery on the female genital tract, rectosigmoid colon, or urinary tract. Our data show no change in insertion depth for women who have had abdominal surgery only. Studies in which the population had a large percentage of women with a history of pelvic surgery could have a decreased overall insertion depth.

Individual skill of the operator could be more important for insertion depth than for procedure time. Whereas time of procedure is fairly uniform in the literature, the mean insertion depth has a wider range. Our linear and logistic regression analyses do not indicate a statistically significant contribution of being a third-year resident toward length of procedure or odds of achieving a complete examination. Our residents begin performing flexible sigmoidoscopy in their second year of residency, and by the time they are in their third year, all have had some experience. If only the number of procedures performed influenced insertion depth, then third-year residents would have increased depths of insertion compared with the second-year residents.

The main use for data of this type is to determine a standard for technical competency in flexible sigmoidoscopy. Technical proficiency is being able to perform the procedure for the correct indications to the intended outcomes without harm to the patient. Complete technical proficiency requires more than just good technical skills. Appropriate knowledge and attitudes are required as well. For example, knowledge of anatomy, pathology, indications, contraindications, and appropriate follow-up plans is necessary. Compassionate treatment of the patient and appropriate interactions with the nursing and teaching staff are examples of suitable attitudes. Proficiency in all three areas must be demonstrated for true procedural competency to be gained.

Examinations, either verbal or oral, can be used to evaluate proficiency in knowledge. Direct observation is a way to gather further information about knowledge and to assess attitudes. Direct observation has problems, however. Faculty preceptors have been shown to have poor observations skills when supervising these procedures.[24] There is also little standardization regarding what the faculty should be observing.[25] Data from this study, along with previous reports, indicate that we have a standard for time of flexible sigmoidoscopy for primary care clinicians of 16 to 19 minutes. Faculty can collect similar data for their residents and use this information to help evaluate the technical skill portion of their learning. Depth of insertion has a wider range of reported values. Three of the previous four reports, however, indicate a mean depth of insertion of more than 50 cm. Our data support this higher average depth of insertion. Faculty can use this data to support a standard of more than 50 cm for mean insertion depth for their residents. Computer networks, portable computers, and database and spreadsheet programs on all personal computers make collection and analysis of data of this type much easier now than in the past.

When applying these standards, it is important to consider the effects of biopsy performance on procedure time and the number of women in the population who have had pelvic surgery on insertion depth. When analyzing individual residency site data, a decision must be made how to evaluate the effects of these two variables. If biopsy performance and female patients with pelvic surgery are evenly distributed among all the residents, then no adjustment is needed; however, calculation of average insertion depths and procedure times with and without data from procedures with these variables

is necessary to determine what effects they might have. Residents who perform procedures with more than the average number of biopsies on women with pelvic surgery could have results that are biased.

Using the insertion depth and procedure time of family medicine residents as a reference standard is subject to argument. Perhaps similar data from seasoned family physicians who have performed hundreds of sigmoidoscopies should be gathered and analyzed for use as the standard. Alternatively, similar measures for gastroenterologists in active practice could determine the standard. We selected data from family medicine residents to use as the reference standard to make comparison easier. When judging technical competency of a learner at the end of their apprenticeship, should we not compare them with learners as similar stages of experience? It would not seem fair to compare the technical proficiency of family medicine residents in the last year of apprenticeship with seasoned masters of the profession.

Conclusion

For flexible sigmoidoscopy, we have a standard for technical performance. Five studies now show the average procedure time to be 16 to 19 minutes. Performance of a biopsy increases procedure time markedly and should be considered when calculating mean procedure time for flexible sigmoidoscopy. Four of five studies indicate an average depth of insertion of 50 to 53 cm. Female patients with a history of pelvic surgery have a decreased depth of insertion. A population with a high number of these patients could skew results of mean insertion depths. Procedural competency consists of knowledge, technical skills, and attitudes. Knowledge and attitudes, which were not the focus of in this study, can be assessed with such tools as examinations and direct observation. Primary care faculty can use these standards of insertion depth and procedure time when determining technical skill proficiency for their residents in flexible sigmoidoscopy, while using other tools to determine knowledge and attitude proficiency.

References

1. Newcomb PA, Norfleet RG, Storer BE, Surawicz TS, Marcus PM. Screening sigmoidoscopy and colorectal cancer mortality. J Natl Cancer Inst 1992;84:1572–5.
2. Leiberman D. Screening/early detection model for colorectal cancer. Why screen? Cancer 1994;74 (7 Suppl):2023–7.
3. Borum ML. Cancer screening in women by internal medicine resident physicians. South Med J 1997;90:1101–5.
4. Cockburn J, Thomas RJ, McLaughlin SJ, Reading D. Acceptance of screening for colorectal cancer by flexible sigmoidoscopy. J Med Screen 1995;2:79–83.
5. Rahman MI, Chagoury ME. Selections from current literature: screening for colorectal cancer. Fam Pract 1994;11:333–9.
6. DeMarkles MP, Murphy JR. Acute lower gastrointestinal bleeding. Med Clin North Am 1993;77:1085–100.
7. Metcalf JV, Smith J, Jones R, Record CO. Incidence and causes of rectal bleeding in general practice as detected by colonoscopy. Br J Gen Pract 1996;46:161–4.
8. Rodney WM, Ruggerio C. Outcomes following continuing medical education on flexible sigmoidoscopy. Fam Pract 1987;4:306–10.
9. Leshan LA, Fitzsimmons M, Marbella A, Gottlieb M. Increasing clinical prevention efforts in a family practice residency program through CQI methods. Jt Comm J Qual Improv 1997;23:391–400.
10. Day SC, Grosso LJ, Norcini JJ, Blank LL, Swanson DB, Horne MH. Residents' perception of evaluation procedures used by their training program. J Gen Intern Med 1990;5:421–6.
11. Hawes R, Lehman GA, Hast J, et al. Training resident physicians in fiberoptic sigmoidoscopy. How many supervised examinations are required to achieve competence? Am J Med 1986;80:465–70.
12. Traul DG, Davis CG, Pollock JC, Scudamore HH. Flexible fiberoptic sigmoidoscopy—the Monroe Clinic experience. A prospective study of 5,000 examinations. Dis Colon Rectum 1983;26:161–6.
13. Schertz RD, Baskin WN, Frakes JT. Flexible sigmoidoscopy training for primary care physicians: results of a 5-year experience. Gastrointest Endosc 1989;35:316–20.
14. Johnson RA, Quan M, Rodney WM. Flexible sigmoidoscopy. J Fam Pract 1982;14:757, 762–3.
15. Renneker M, Saner H. Low-cost flexible sigmoidoscopy screening: a community demonstration and education project. J Cancer Educ 1995;10:25–30.
16. Brill JR, Baumgardner DJ. Establishing proficiency in flexible sigmoidoscopy in a family practice residency program. Fam Med 1997;29:580–3.
17. Long HF. Sensitive sigmoidoscopy: a straight sigmoid technique. J Am Board of Fam Pract 1989;2:103–5.
18. Maule WF. Screening for colorectal cancer by nurse endoscopists. N Engl J Med 1994;330:183–7.
19. National Cancer Institute (US). Screening for colo-

rectal cancer (PDQ®). Bethesda, Md: National Cancer Institute, 2000.

20. Eddy DM. Screening for colorectal cancer. Ann Intern Med 1990;113:373–84.
21. Guide to clinical preventive services: report of the US Preventive Services Task Force. 2nd ed. Alexandria, Va: International Medical Publishers, 1996.
22. Lewan RB, Baskin WN, Sharon MW, Greenlaw RL, Frakes JT, Vidican DE. A supervised training program in flexible sigmoidoscopy: evaluating skills from residency training to clinical practice. Fam Med 1989;21:25–9.
23. DiSario JA, Sanowski RA. Sigmoidoscopy training for nurses and resident physicians. Gastrointest Endosc 1993;39:29–32.
24. Herbers JE, Noel GL, Cooper GS, Harvey J, Pangaro LN, Weaver MJ. How accurate are faculty evaluations of clinical competence? J Gen Intern Med 1989;4:202–8.
25. Wigton RS. Measuring procedural skills. Ann Intern Med 1996;125:1003–4.